

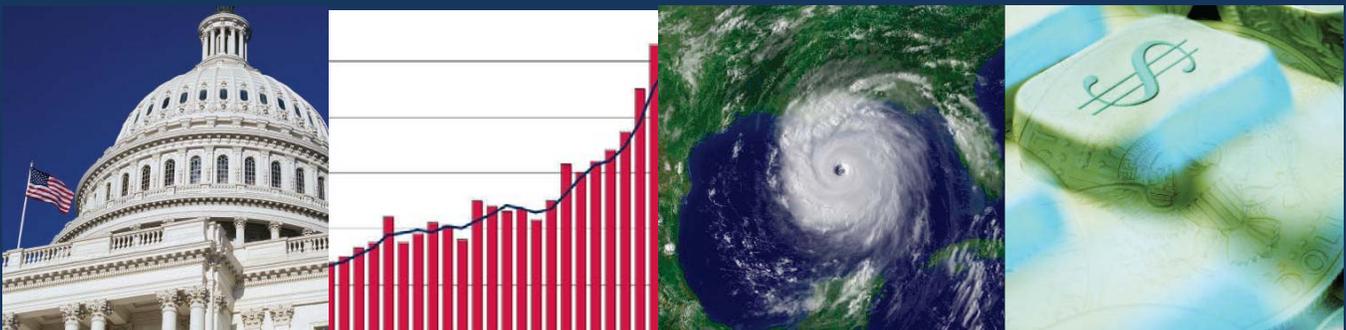


MANAGING LARGE-SCALE RISKS IN A NEW ERA OF CATASTROPHES

**Insuring, Mitigating and Financing Recovery
from Natural Disasters in the United States**

March 2008

*An Extreme Events Project of the
Wharton Risk Management and Decision Processes Center
in conjunction with
Georgia State University
and the Insurance Information Institute*



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THE WHARTON RISK MANAGEMENT AND DECISION PROCESSES CENTER

Established in 1984, the Wharton Risk Management and Decision Processes Center develops and promotes effective corporate and public policies for low-probability events with potentially catastrophic consequences through the integration of risk assessment, and risk perception with risk management strategies. Natural disasters, technological hazards, and national and international security issues (e.g., terrorism risk insurance markets, protection of critical infrastructure, global security) are among the extreme events that are the focus of the Center's research.

The Risk Center's neutrality allows it to undertake large-scale projects in conjunction with other researchers and organizations in the public and private sectors. Building on the disciplines of economics, decision sciences, finance, insurance, marketing and psychology, the Center supports and undertakes field and experimental studies of risk and uncertainty to better understand how individuals and organizations make choices under conditions of risk and uncertainty. Risk Center research also investigates the effectiveness of strategies such as risk communication, information sharing, incentive systems, insurance, regulation and public-private collaborations at a national and international scale. From these findings, the Wharton Risk Center's research team – over 50 faculty, fellows and doctoral students – is able to design new approaches to enable individuals and organizations to make better decisions regarding risk under various regulatory and market conditions.

The Center is also concerned with training leading decision makers. It actively engages multiple viewpoints, including top-level representatives from industry, government, international organizations, interest groups and academics through its research and policy publications, and through sponsored seminars, roundtables and forums.

More information is available at <http://opim.wharton.upenn.edu/risk>.

The Role of Applied Research in Advancing Knowledge on Large-Scale Risks

The *Managing and Financing Extreme Events* project was initiated in 1996 as a joint activity between the Wharton Risk Management and Decision Processes Center and the Wharton Financial Institutions Center. From its inception, this program was concerned with the role of mitigation, insurance and capital market instruments in managing catastrophic risks arising from natural hazards. Given the evolution of the terrorism threat worldwide and the September 11, 2001 attacks against our country, the project expanded to deal with these events.

In 2004, the Wharton Risk Center took the lead in launching a large project on the future of terrorism risk financing in the United States – the *TRIA and Beyond* initiative. The research was undertaken with a core group of project Sponsors in conjunction with over 50 public and private organizations here and abroad. Findings were presented at a conference in October 2005 at the Cannon House Office Building in Washington, DC, where government, business leaders and terrorism experts discussed long-term sustainable strategies for the nation to recover from future terrorist attacks. With the renewal of TRIA in December 2007, we continue to work actively on this front.

Wharton Risk Center's current multi-year initiative, *Managing Large-Scale Risks in a New Era of Catastrophes*, focuses on hurricane risk and flood hazard, and on providing protection to homeowners. It was launched in 2005, a few months after Hurricane Katrina made landfall. A report on the first phase of the study was issued in February 2007. Building on those preliminary findings, this report provides a series of in-depth analyses of the efficiency and equity of current disaster insurance markets and mitigation programs in the United States, the impact of state-based regulations on insurance protection and the loss distributions among different stakeholders.

DIRECTION AND COMPOSITION OF THE STUDY

This study is undertaken under the direction of Howard Kunreuther and Erwann Michel-Kerjan at the Wharton School of the University of Pennsylvania.

Contact them directly regarding information about this report, the study itself, or on becoming a sponsor of the Wharton Extreme Events project.

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**PREFACE
and
EXECUTIVE SUMMARY**

The recent upsurge in hurricanes, coupled with increasing residential and commercial development in coastal areas of the United States, has exposed people and property to an entirely new scale of destruction, with cascading effects on homeowners, businesses located within these devastated areas and those depending on them, insurance and financial markets, and the public sector. In 2005, three major hurricanes – Katrina, Rita and Wilma – made landfall in the Gulf of Mexico within a six-week period, killing over 1,500 people and leading to insurance reimbursements and federal disaster relief of over \$180 billion – an historic record. These three storms occurred after four other hurricanes had caused severe damage in Florida in 2004.

The occurrence of damaging hurricanes is highly variable and uncertain from year to year. Despite alarming weather forecasts in 2006 and 2007, the only hurricane to make landfall in the United States since 2005 was a Category 1 hurricane. However, it is unavoidable that in the coming years, more hurricanes will strike the Atlantic and Gulf coasts, and other parts of the nation will experience severe floods and earthquakes causing extreme damage to residential and commercial property and infrastructure.

Episodes of terrorism share certain similarities with natural disasters. The first successful attack on U.S. soil, against the World Trade Center, occurred in 1993. Over the next eight years, not a single attack was perpetrated by an international terrorist organization in the U.S. As time passed, the nation was lulled into a false sense of security. Then Al Qaeda launched its second, and much more devastating, attack on the morning of September 11, 2001.

While terrorism and natural disasters are different, they have several important features in common – uncertainty and wide variances in losses from one year to the next. Experts and decision makers face challenges in assessing the risks associated with these extreme events, developing strategies for reducing future losses, and facilitating the recovery process following a major disaster.

In the past seven years, we have entered a new era of catastrophes. Our nation is facing large-scale risks at an accelerating rhythm, and we are more vulnerable to catastrophic losses due to the increasing concentration of population and activities in high-risk coastal regions of the country. The question is not *whether* catastrophes will occur, but *when*, and *how frequently* they will strike, and the extent of damages they will cause.

Now is the time to develop and implement economically sound policies and strategies for managing the risk and consequences of future disasters. Absence of leadership in this area will inevitably lead to unnecessary loss of lives and economic destruction in the devastated regions.

Guiding Principles

A coherent strategy is necessary to assure a sustainable recovery from large-scale disasters and the appropriate future development of hazard-prone areas. This report provides the elements for developing such a program by focusing on the roles of mitigation, insurance and other risk transfer instruments. These issues are complex. They challenge our capacity as a nation to work together despite very different agendas and priorities regarding the role and responsibilities of the private and public sectors in dealing with catastrophic risks.

The following two guiding principles underlie the research team's analyses and proposed strategies for using the insurance infrastructure to deal more effectively with natural disasters:

Principle 1: Premiums Reflecting Risk

Insurance premiums should be based on risk in order to provide signals to individuals as to the hazards they face, and to encourage them to engage in cost-effective mitigation measures to reduce their vulnerability to catastrophes.

Principle 2: Dealing with Equity and Affordability Issues

Any special treatment given to homeowners currently residing in hazard-prone areas (e.g., low-income uninsured or inadequately insured homeowners) should come from general public funding and not through insurance premium subsidies.

This report addresses several basic questions:

- How can the above principles guide the design of insurance and mitigation programs for reducing future disaster losses and providing financial support for victims of these events?
- What roles can the key interested parties affected by natural disasters play in implementing these programs?
- Who should pay (and how much should they pay) to mitigate damages from future natural disasters and the losses that occur following these events?
- How can the analyses detailed in this report help inform private sector decisions and the policy debate in state legislatures and the U.S. Congress?

Focus of the Study

To address these questions, we focus on four states (*Florida, New York, South Carolina and Texas*) and metropolitan areas in each of these states (*Miami-Dade area, FL; New York City area, NY; Charleston area, SC; Houston area, TX*). These regions have the largest property exposure to hurricane risk in the country and also present significant differences in insurance market regulation and public/private risk sharing systems.

Florida presents a specific challenge due to its hurricane exposure, increasing population and rapid economic development, all of which makes this state a world peak-zone for extreme event coverage and capital allocation. Recently, it has been a source of controversy because its state government has intervened in the functioning of the private insurance market more explicitly than any other state in the country. For these reasons, we devote special attention to Florida, both for the hurricane risk and flood hazard.

Key Findings

The report consists of fourteen chapters organized in four parts. We present both conceptual and empirical findings using data from several sources acknowledged at the end of the Executive Summary. The relevant analyses supporting these findings are documented in the chapters themselves.

PART I: CAUSE FOR CONCERN

The first four chapters of the report detail the factors that have led to a major increase in damage from natural disasters over the past fifteen years (Chapter 1); the current institutional arrangements, including the regulatory environment and characteristics of the market for insuring and mitigating risks from hurricanes (Chapters 2 and 3); and an analysis of the National Flood Insurance Program (Chapter 4). The key findings are summarized below.

1. There has been a major increase in the cost of great natural catastrophes worldwide over the past fifteen years. A comparison of these economic losses (insured and non-insured) over time reveals a huge increase: \$53.6 billion (1950-59), \$93.3 billion (1960-69), \$161.7 billion (1970-79), \$262.9 billion (1980-89) and \$778.3 billion (1990-99). The current decade has already seen \$420.6 billion in losses, principally due to the 2004 and 2005 hurricane seasons, which produced historic records.

2. Property values at risk in hazard-prone areas in the U.S. have drastically increased in recent years. The key socio-economic factors causing the increased losses are the *development in hazard-prone areas* and *increased value at risk*. For example, the population of Florida was 2.8 million in 1950, 13 million in 1990 and is projected to grow to 19.3 million in 2010. Today, 80 percent of insured assets in Florida are located near the coast, the high-risk area of the state. The insured exposure in Florida coastal areas was \$1.9 trillion in 2004 and is growing, increasing the likelihood of severe economic and insured losses from future hurricanes unless cost-effective mitigation measures are implemented. Other coastal states also have large property values exposed to flood and hurricane risks. Today, over 50 percent of the U.S. population lives in coastal counties.

3. The impact of climate change is not clear, but is of growing concern. Some scientists have suggested that the series of major hurricanes that occurred in 2004 and 2005 might be partially attributable to the impact of a change in climate. There is a growing concern that global warming might lead to the occurrence of much more intense hurricanes hitting the coast over a shorter period of time.

4. Natural disasters involve a large number of key interested parties who often have different agendas and priorities. These stakeholders include homeowners in hazard-prone areas, insurers and reinsurers, banks and other financial institutions, the capital markets, risk modeling firms, rating agencies, the construction industry and developers, the real estate community, other businesses, and local, state and federal governmental agencies. For each of these stakeholders it is necessary to consider how their values and goals shape their agendas for assessing and managing these risks.

5. Insurance market regulation varies significantly across states. Differences in market regulation across states constitute a challenge for the development of a coherent national strategy. Florida has significantly tightened its grip on insurers' rates and other market practices in response to heavy political pressure from coastal property owners and other interest groups. Regulatory responses in other coastal states have been less restrictive, but that could change depending on market developments and political pressure.

6. A wind/water controversy emerged in the aftermath of Hurricane Katrina, creating further uncertainty related to the issues of insurer liability. Coverage for flood damage due to rising water is explicitly excluded in homeowners insurance policies, but coverage for these losses is available through the federal government's National Flood Insurance Program (NFIP). Nevertheless, following Hurricane Katrina, lawsuits were filed in Louisiana and Mississippi for damage alleged by insureds to have been caused by wind, and alleged by insurers to have been caused by water. Although insurers eventually won these cases, some companies have been reluctant to write new homeowners policies in these states, given the uncertainty of contract enforcement.

7. There has been significant growth in residual market mechanisms that provide coverage to property owners who are not able to obtain insurance from private insurers. Florida's property insurance residual market mechanism, the Citizens Property Insurance Corporation (Citizens), has experienced significant growth in recent years, with legislative changes in 2007 allowing Citizens to compete with private insurers. Citizens has now become the largest provider of wind coverage in Florida. By law, it can pass virtually all its deficit to private insurers in the state through *ex post* assessments, which has caused some private insurers to leave the Florida market. The growth of Citizens is effectively socializing a large portion of the catastrophe risk in the state. Residual market mechanisms in the other coastal states we studied have also grown, but to a much lesser degree than in Florida.

8. Insurers' cumulative total profits in Florida from 1992-2006 have been *negative* during the entire period. While the market price of homeowners insurance has significantly increased in coastal areas (especially in Florida), insurers are still concerned about earnings volatility and the possibility that their long-term profits will be negative in high-risk areas. Florida has experienced the greatest absolute increase in the average homeowners premium among the four states studied, from \$723 at the start of 2002, to \$1,465 in the first quarter of 2007. In coastal areas, premiums have tripled or even quadrupled for some homeowners. Nevertheless, at the end of 2006, insurers had a \$11.6 billion cumulative deficit on their Florida's homeowners business based on the period 1992-2006. Higher insurance premiums, coupled with no hurricane losses in 2007 in Florida, have improved insurers' long-term performance but companies are still extremely concerned about the future of their operation in this state.

9. Flood coverage, which is provided exclusively by the federal government through the National Flood Insurance Program (NFIP), has significantly increased over the past fifteen years. The number of flood insurance policies covered nationwide by this program increased from 2.5 million in 1992 to over 5.6 million at the end of 2007. The total property value covered by the program during this period increased from \$237 billion to over \$1.1 trillion.

10. Choice of flood insurance deductibles, coverage limits and cost per dollar of coverage have changed over time. Florida alone represents nearly 40 percent of the entire NFIP portfolio, so we focus our analysis on that state. Floridians reacted to flood damage caused by the 2004 hurricanes by choosing lower deductibles and higher coverage limits. Our analysis of several million flood insurance policies reveals that in 2005, almost 80 percent of policyholders chose the lowest possible deductible (\$500). Even though homeowners increased their insurance coverage between 2000 and 2005, almost three-quarters were still below the \$250,000 maximum coverage limit. One reason for this large percentage is that many homes had property values below this limit. On the cost side, the average premium per policy in Florida is among the lowest in the nation. Despite several major flooding episodes in 2004 in Florida, the premium paid per \$1,000 of coverage significantly decreased in all but two counties between 2000 and 2005.

11. Thirty percent of each dollar paid for flood insurance coverage goes to private insurers participating in the NFIP Write-Your-Own (WYO) program. These insurers play the role of financial intermediaries between policyholders and the NFIP but do not bear any of the risk. Over the period 1968-2005, these private insurers received over \$7.4 billion (excluding the loss adjustment expenses for which we do not have data) in fees. Turning to the financial operation of the program, prior to the 2005 hurricane season, which inflicted nearly \$18 billion in flood claims, the NFIP had a cumulative deficit of about \$3 billion after 37 years of operation.

PART II: UNDERSTANDING THE DEMAND AND SUPPLY OF DISASTER INSURANCE

Part II of the report looks at how homeowners make decisions on whether to purchase insurance (Chapter 5); and how insurers/reinsurers decide on the amount of coverage to offer and what price to charge for this protection (Chapters 6 and 7). New developments with respect to alternative risk transfer instruments involving the capital and financial markets are also analyzed (Chapter 8). The last two chapters of Part II provide conceptual and detailed empirical analyses of the factors influencing the demand for and supply of homeowners insurance coverage (Chapters 9 and 10). The key findings are summarized below.

12. Empirical evidence reveals that most individuals do not use cost-benefit analysis in their insurance purchase decisions. Some people correctly understand risk and have adequate insurance coverage, but others do not. A key factor that explains these homeowners' decisions not to purchase insurance or to buy inadequate levels of coverage is *underestimation of the risk*. In fact, some homeowners in hazard-prone areas believe that the disaster will **not** happen to them. Some families also face budget constraints which limit their interest and/or ability to voluntarily purchase adequate insurance to cover replacement costs should they suffer a major loss. This behavior is especially likely in areas where property values have increased rapidly.

13. Homeowners' decisions related to the purchase of insurance are driven by a variety of goals other than only financial protection. These may include reduction of anxiety (i.e., obtaining peace of mind), satisfying mortgage requirements, and satisfying social norms (e.g., purchasing insurance because one's friends and neighbors have coverage).

14. The number of Presidential disaster declarations has dramatically increased over the past 50 years with notable spikes during election years. There were 162 Presidential disaster declarations during the period 1955-1965 and 545 declarations between 1996-2005. Despite this upward trend, there is no empirical evidence that individuals are uninsured or underinsured because they expect to receive federal disaster relief following a disaster.

15. Insurers are likely to charge higher premiums if there is ambiguity associated with estimating the likelihood and consequences of a risk. A recent survey of actuaries and underwriters by the Wharton Risk Center revealed that insurers would charge 25 percent higher premiums for ambiguous risks than for risks with probabilities that were well specified.

16. Due to the unpredictability and sizable losses associated with catastrophes, insurers need to allocate more capital to cover the losses in the tail of the probability distribution. The need to secure an adequate rate of return on capital is not sufficiently understood. In particular, the prices charged for catastrophe insurance must be high enough, not only to cover the expected claims and other expenses, but also to cover the costs of allocating capital to underwrite this risk. For truly extreme risks, the resulting premium can be as much as 5 to 10 times higher than the expected loss, so as to provide investors with a fair return on equity and also maintain the insurer's credit rating. Following the 2004-2005 hurricanes, rating agencies instituted more stringent criteria for providing protection against catastrophic risk. This led insurers to allocate even more capital to cover the tail of the loss distribution.

17. While catastrophes are often characterized as low-probability/high-consequence events, the data suggest that they are expected to occur with a much higher frequency than in the past. Catastrophe models and exceedance probability (EP) curves have been more used in recent years by insurers to estimate their risks from natural disasters and manage their portfolios. Working with the risk modeling firm Risk Management Solutions (RMS) we determined aggregate residential losses associated with a series of hurricane scenarios for our four focus states. Using Florida as an illustrative example, we specified an EP curve that revealed a 15 percent annual probability of an insured loss in the state of at least \$10 billion, and a 5 percent annual probability that insured losses will exceed \$25 billion.

18. Insurance premiums are affected by expected losses and the variance in losses, due to the cost of capital. We compared the potential insured losses from hurricanes within Miami-Dade County with 46 counties in the northern part of Florida. Taken together, these 46 counties have the same expected annual insured losses as Miami-Dade County; however, the standard deviation of losses for Miami-Dade is \$4.2 billion, and for the 46 northern counties it is \$2.8 billion. The cost of capital to cover losses should then lead to higher premiums in Miami-Dade County than in these portions of northern Florida if insurers had the freedom to charge premiums reflecting risk.

19. Reinsurers consider both the expected loss *and* the variance of losses in their portfolio when pricing different layers of coverage. An analysis of different layers of reinsurance for a constructed portfolio of all the homeowners policies in Florida reveals that the average annual loss decreases with higher layers (because they are less likely to occur), but the variance of the losses increases. This leads to a higher price per dollar of coverage for the higher layers, which are normally associated with truly catastrophic losses.

20. Due to the severe hurricanes in 2004 and 2005, the United States reinsurance market hardened in 2006. Premiums rose on average 76 percent between July 1, 2005 and June 30, 2006 but have fallen somewhat since that time. The large increase in premiums attracted eight new major entrants into the market and \$26-\$27 billion of new capital during the period between Hurricane Katrina and June 30, 2006. Between July 1, 2006 and June 30, 2007, prices fell slightly and continued to fall at the January 2008 renewal. They are currently still considerably higher than they were at the beginning of 2005.

21. The significant increase in reinsurance prices after the 2005 hurricane season in the U.S., along with more stringent criteria by rating agencies for providing protection against catastrophic risk, has led to historic records in catastrophe bond issuance and the development of a multi-billion dollar market for other innovative financial instruments, such as industry loss warranties and sidecars. We provide up-to-date information on the evolution of this market. In 2006, twenty cat bonds were issued for \$4.7 billion, compared with eleven issued in 2005, the previous record. In 2007 the total value of cat bonds issued for natural disasters alone was \$7.1 billion. In 2006, a total of nineteen sidecar transactions were completed, providing over \$4 billion of capacity to the insurance market; that volume decreased to \$1.7 billion in 2007.

22. There is a need to expand catastrophe risk securitization, as it still represents a small proportion of the capital in the global insurance market today. We propose three complementary ways that could effectively trigger a much more significant volume of capital entering the insurance-linked securities (ILS) market: (1) increasing the interest of a broader base of investors through risk tranching; (2) addressing the basis risk challenge through index-based derivatives; and (3) developing new products such as those based on equity volatility dispersion.

23. An analysis of the demand for homeowners insurance policies in the four states studied reveals that a given increase in the price of insurance results in a similar percentage decrease in the amount of insurance purchased. Our analysis of several million policies, including the portfolios of several large insurers and the state of Florida insurer, Citizens Property Insurance Company (Citizens) over the period 2000-2005, reveals that a 10 percent increase in the average premium in Florida yields an 8.9 percent reduction in the number of people buying insurance. Similar behavior occurs in other states.

24. The elasticity of supply at the county level is very high. A 10 percent increase (decrease) in price that homeowners are willing to pay for insurance coverage will yield a 27 percent increase (decrease) in the quantity of policies supplied by insurers. This high supply price elasticity has the following important implication for rate regulation: if rates are significantly suppressed by the regulator, there would likely be a severe availability issue.

25. Using portfolio data provided by six large insurers, we find that homeowners insurance premiums are highest in Florida relative to New York, South Carolina and Texas. The mean policy premium for our sample companies is \$6,160 for Florida, approximately \$5,000 for South Carolina, \$2,375 in Texas, and only \$760 in New York. If we examine the premiums per \$1,000 of coverage, we see that Florida is the highest at \$8.13 per \$1,000 of coverage, followed by Texas at \$7.89, then South Carolina at \$5.14, and New York at \$3.94.

26. Many people choose low deductibles on their homeowners policies. Consistent with the literature and our analysis of the flood insurance market, a large percentage of the homeowners insurance policies in our sample have relatively low deductibles. In Florida and South Carolina, over 50 percent of the homeowners have a deductible of \$500 or less. In New York, 75 percent of homeowners have a deductible of \$500 or less.

Concluding Note on Part II: Taken together, these findings reveal that most homeowners do not undertake cost-benefit comparisons in making their insurance purchases. They often choose low deductibles, are influenced by budget constraints and are likely to underestimate the risk. The analysis also quantifies the degree to which the demand for insurance is sensitive to price. In the four states studied, a given percentage increase in the price of homeowners insurance results in a similar percentage decrease in the amount of insurance purchased.

In addition to looking at expected losses, insurers and reinsurers are forced to allocate considerable capital to protect themselves against catastrophic losses to satisfy investors' and rating agencies' concerns. There has been a significant increase in the use of alternative risk transfer instruments (e.g. catastrophe bonds) since 2005 to complement reinsurance, but these financial instruments still represent a small fraction of capital in the global insurance market. The analysis of the supply of coverage indicates that if regulators suppress rates too much, there is likely to be a severe decrease in the availability of coverage.

PART III: PROTECTING HOMEOWNERS AGAINST NATURAL DISASTERS

We begin this part by examining what proportion of homeowners in hurricane-prone areas is uninsured, and whether affordability is a significant determinant of insurance status for homeowners residing in these areas (Chapter 11). We then provide insight into how residents in hazard-prone areas decide whether to mitigate their property, and the economic incentives that have been provided for encouraging them to do so (Chapter 12). We also examine how the insurance programs currently in place impact those affected by the hurricane risk (*status quo analysis*). We then determine how much coverage is likely to be made available and what premiums would be charged in a hypothetical unregulated market where rates are determined only by the law of supply and demand (*competitive market analysis*) (Chapter 13). The key findings in Part III are summarized below.

27. American Housing Survey data reveal that for different definitions of the affordability threshold, a significant number of owner-occupied homes in eight sample cities are owned and insured by households with income below those thresholds. There is often confusion in the policy debate about *affordability* of insurance because there is no clear definition of the term. If one defines an affordability threshold as 200 percent of the poverty line, then between 16 percent (Dallas) and 31 percent (Tampa) of residences are owned by households who cannot afford insurance. If affordability is defined as 125 percent of the poverty line, the percentage varies from nearly 7 percent in Dallas to 17 percent in Tampa. Among these low-income households, between 66 and 92 percent (depending on the city) *are* insured, even when there is no mortgage that requires them to purchase coverage. These results have important policy implications: any plan that directs insurance subsidies to all low-income homeowners will allocate a large proportion of these funds to those who are already insured.

28. While affordability measurements based on ability to consume and on household choices capture static notions of affordability, one also needs to consider the fairness in changes in homeowners insurance premiums over time. In particular, if changes in premiums are distributed very unevenly across households, one could view those subject to very large increases as not being treated fairly and justly. While our analysis reveals that raising premiums to reflect risk would lead to only a very small increase in the number of homeowners classified as *unable* to afford insurance, if some homeowners see their premiums jump by thousands of dollars in a given year, while others see modest changes, a case could be made that one subgroup is being singled out for unfair premium increases. There is a need for innovative programs to address this inequity.

29. The adoption of building codes significantly reduces damage from hurricanes. Based on a sample of over 5,600 homeowners impacted by Hurricane Charley in 2004, residences built under wind-resistant standards that were enforced in 1996 had a claim frequency of 60 percent less than those that were built pre-1996. Furthermore, claims for pre-1996 damaged homes resulted in an average of \$24 per square foot compared to \$14 per square foot for those constructed between 1996 and 2004.

30. Despite the cost-effectiveness of mitigation measures, many homeowners do not voluntarily invest in them. In contrast to insurance, where premiums cover a six month or annual period, mitigation measures (e.g., strengthening the roof of one's house) require a large upfront expenditure which yields benefits over the length of the life of the property. The principal reasons that homeowners do not invest in such measures are that they do not consider the long-term benefits of their investment, underestimate the risk due to excessive optimism, and do not learn sufficiently from past experience. On the other hand, social norms can lead individuals to take steps to reduce future disaster losses. If all homeowners in your hurricane-prone neighborhood installed strong storm shutters, then you would very likely want to follow suit.

31. It is possible to significantly increase use of mitigation measures by enforcing building codes, developing economic incentive programs such as tax rebates, and by adopting zoning ordinances. Collaboration between the public and private sectors is critical in this regard. For instance, tax credits can be given to property owners who purchase building supplies used to make their homes more storm resistant. Mitigation grants are available to low-income families for retrofitting their homes, and matching grants (on a dollar-for-dollar basis) can be made available to all homeowners in the state, as authorized in the South Carolina’s Omnibus Coastal Property Insurance Reform Act of 2007.

32. The proportion of losses covered by private insurers for a 100-year hurricane under current insurance programs in place (*status quo*) differs widely among the four states studied. Using a hurricane with a return period of 100 years as our base case, we find that should this event occur in South Carolina, private insurers would cover 80 percent of the loss, compared to about 70 percent in New York and 50 percent in Texas. In Florida, private insurers would cover 25 percent of the loss, and the state-operated insurer, Citizens, 10 percent. Private reinsurance covers less than 10 percent of the losses in New York and South Carolina and over 17 percent of the loss in Texas. In Florida, private reinsurance would cover 20 percent of the losses and the Florida Hurricane Catastrophe Fund over 30 percent. The actual dollar amounts of loss to residential properties from a 100-year hurricane are much lower in South Carolina and New York than in Texas and Florida. We provide similar loss-sharing analyses for 250-year and 500-year hurricanes for each state.

33. If a hurricane with a return period of 100 years were to occur in 2008, the deficits to the Florida Hurricane Catastrophe Fund (FHCF), Citizens Property Insurance Corporation (Citizens) and the Texas Windstorm Insurance Association (TWIA) would be \$21.2 billion, \$5.7 billion and \$3.6 billion, respectively. Both Citizens and the FHCF would assess private insurers operating in Florida to recoup the necessary funds for the claims they could **not** meet from their reserves. Should this occur, all residential and commercial policyholders in the state will pay a significant portion of these losses through *ex post* recoupment. An open question is whether these policyholders realize the extent of this *ex post* payment.

34. Mitigation has the potential to provide significant cost savings in all four states. In our analysis of the effect of mitigation, we consider two extreme cases – one in which no one has invested in mitigation, the other in which everyone has invested in predefined mitigation measures. For a 100-year hurricane, mitigation would reduce the potential losses by 61 percent in Florida, 44 percent in South Carolina, 39 percent in New York, and 34 percent in Texas. In Florida, the use of mitigation leads to a \$51 billion savings for a 100-year event, and a \$83 billion savings for a 500-year event. Should a 500-year event occur tomorrow, full mitigation would save the Miami-Dade area \$58 billion and the Houston area \$34 billion. These findings are important given the costly capital required for insurers to cover the tail of the distribution of extreme events. Enforcing mitigation significantly reduces, if not eliminates, this tail.

35. Under a scenario where insurers are permitted to charge premiums reflecting risk, the private sector will be able to cover most (if not all) losses from severe hurricanes if homeowners mitigate their property and private reinsurance is in place. In this case, if insurers were to devote 10 percent of their surplus to provide coverage against a 100-year hurricane in a given state, they would be able to cover 100 percent of the market in all four states. For a 500-year event, they would be able to cover 100 percent of the market in New York and South Carolina, 94 percent of the market in Texas, and 66 percent in Florida.

36. Except for Florida, which constitutes a peak-zone for catastrophe exposure, insurers would need to allocate only a small portion of their surplus to provide full coverage under a competitive market if adequate mitigation and private reinsurance were in place. If all single-family dwellings in the state were mitigated, and if private reinsurance and alternative risk transfer mechanisms were in place, based on the *status quo*, the percentage of insurers' surplus necessary to insure all homes against a 100-year hurricane is 1.1 percent in South Carolina, 1.4 percent in New York, 6.7 percent in Texas, and 15.4 percent in Florida.

37. If one determines premiums based on loss costs and adds a 50 percent loading factor to reflect additional expenses (administrative, marketing and claim assessment costs, and cost of capital), coastal communities, which have the highest risk of wind damage from hurricanes in each of the four states we study, will pay significantly more for insurance than other regions in these states. This is particularly true in Texas, where Calhoun, Aransas and Galveston Counties would be charged over nine times the average for the entire state. The ratios for the most hazard-prone counties in each of the other three states are on the order of four to five times the average premium across the state.

Concluding Note on Part III: These findings reveal that in the cities we studied, most people purchase insurance even if they are classified as having income below the affordability threshold. At the same time, most individuals do not mitigate their homes because they cannot justify the upfront investment cost relative to the perceived benefits due principally to myopia, budget constraints and underestimation of the risk. Hence, there is the need for well-enforced building codes, tax rebates, zoning ordinances, and premiums reflecting risk that take the benefits of mitigation into account. If a major hurricane hits Florida in the near future, the state-run insurer, Citizens, will not be able to cover its losses, and all policyholders in the state will be assessed money to help defray its deficit. If insurers are allowed to charge premiums that reflect risk, they will be able to cover most, if not all, of the losses from hurricanes. Prices in some hazard-prone areas will be significantly higher than they are today.

PART IV: CREATING INNOVATIVE SOLUTIONS

The report concludes with proposed strategies to encourage individuals to purchase sufficient insurance and adopt mitigation measures (Chapter 14). This chapter also summarizes two disaster insurance bills which passed the U.S. House of Representatives in the fall of 2007 and are now pending in the U.S. Senate. We pose a set of questions for informing the policy debate with respect to this legislation. Key findings are summarized below.

38. Two principles should guide the development of new disaster insurance programs.

Principle 1: Premiums Reflecting Risk are necessary to provide signals to individuals as to the hazards they face and encourage them to adopt cost-effective mitigation measures. *Principle 2: Dealing with Equity and Affordability Issues* addresses ways to provide special treatment to homeowners currently residing in hazard-prone areas (e.g. low-income uninsured or inadequately insured homeowners).

39. Long-term homeowners insurance would stabilize insurance costs to homeowners in hazard-prone areas. Such a long-term policy could be tied to a mortgage, and home improvement loans can encourage the adoption of cost-effective mitigation measures. A program of insurance vouchers, similar in concept to food stamps, could assist low-income residents in disaster-prone areas to purchase adequate insurance coverage.

40. Several specific insurance-related proposals have been initiated that involve the private and public sectors.

- ***A Coastal Hurricane Zone (CHZ)*** has been proposed with regulations established by the federal government and consistent across states within the CHZ. After several years of operation, any surplus would be redistributed to homeowners, and deficits met through surcharges. Such a system would allow insurers to make long-term commitments of capital to provide coverage against wind damage from hurricanes.
- ***A national catastrophe fund*** has been proposed as a financial backstop for state catastrophe funds and augment private reinsurance.
- ***Auctioned reinsurance contracts*** could be developed by the federal government to cover truly cataclysmic events.
- ***Alternative risk transfer instruments*** offered by the financial market to cover catastrophic losses could be expanded through innovative products, making this market much more liquid than it is today.

41. A data collection and information sharing entity could be created to inform decision makers in the public and private sectors as to the extent of insurance penetration. The United States does not have a national system in place to ascertain demographically who has purchased insurance coverage and how much, and who is uninsured. We propose the creation of a national insurance data collection system to better understand the level of homeowners coverage against future disasters. This system could be implemented at a very small cost via the Internal Revenue Service (IRS), with homeowners answering a few questions about their property insurance coverage on their annual IRS tax returns.

Acknowledgments

This has been a truly collaborative effort with our research partners from Georgia State University, who performed a thorough analysis of the current state insurance regulatory systems and changes occurring over time. They also aggregated the data on homeowners insurance provided by some of our Sponsors, and performed detailed analyses of the demand and supply of insurance coverage under current programs. The Insurance Information Institute provided us with data on the vulnerability of hazard-prone areas and post-Hurricane Katrina legislative and legal actions.

The research team greatly appreciates the detailed data provided by leading insurers on their homeowners policies, data from the offices of state insurance regulators, the analyses undertaken by Risk Management Solutions on potential and expected losses from hurricanes, and the special computer runs on insurance groups' premiums and catastrophe exposure undertaken by the rating agency A.M. Best. The state funds in Florida (Citizens Property Insurance Corporation, and the Florida Hurricane Catastrophe Fund) and in Texas (the Texas Windstorm Insurance Association) also provided us with detailed information on their coverage and the nature of their operations. The Institute for Business & Home Safety provided us with data on the impact of mitigation measures and building code enforcement on the reduction in hurricane losses. The data from all these firms and organizations enabled us to undertake comprehensive quantitative analyses of supply of and demand for insurance, and to measure the performance of current and proposed insurance and mitigation programs. In addition, the Federal Emergency Management Agency (FEMA) provided the research team with access to the entire portfolio of the National Flood Insurance Program in the state of Florida so we could examine the performance of this program and the nature of coverage in place at a micro-level.

To our knowledge, this is the first time that these types of data have been collected simultaneously for several consecutive years, analyzed and interpreted in the context of existing state insurance regulatory systems and the structure of the property insurance market in the United States.

During the past two years, the research team has had fruitful meetings and discussions with key individuals and organizations interested in developing better risk management strategies for dealing with natural hazards. These include climate scientists, insurers, reinsurers, brokers, banks, trade associations, rating agencies, modeling firms, homeowners and businesses affected by natural disasters, the real estate industry, representatives from Congress and the White House, federal, state and local agencies, insurance regulators, public interest groups, international organizations, and experts from other universities and research institutions in the United States and abroad.

We have benefited from insightful discussions at workshops hosted by the Wharton Risk Center in June and December 2006 in Philadelphia, PA, and in October 2007 in Washington, DC, and from the many comments received on the preliminary findings issued in February 2007, and the first draft of this report, issued in October 2007.

Carol Heller of the Wharton Risk Center has been actively involved in the project over the past eight months, providing research and editorial assistance. Cynthia Anderson, Hannah Chervitz, Carol Heller, and Nikita Stanley all provided logistical support for the meetings and conferences associated with this project over the past two years.

Moving Forward

Our principal purpose in undertaking these in-depth studies is to examine alternative *long-term* sustainable strategies for reducing losses from natural disasters and providing financial support to victims of these events.

We are mindful that new alternative strategies may be extremely difficult to implement at this time, because, except for the California wildfires in the fall of 2007, our country has not experienced any severe disasters during the past two years. There is a tendency for all of us, whether in the role of homeowner, decision maker in a private or public sector organization, or as an elected official at the state, local or federal level to focus on short-term crises. However, our nation remains highly vulnerable to large-scale disasters. For this reason, decisions by Congress and other legislative bodies must be based on a sound long-term conceptual framework and well-documented empirical analyses.

The Sponsors of this study, and the public and private sector organizations with whom we have interacted, are listed on the following page. We look forward to continue working with them and others on the challenges of *Managing Large-Scale Risks in a New Era of Catastrophes*.

Howard C. Kunreuther and Erwann O. Michel-Kerjan
The Wharton School
Philadelphia, PA
March 1, 2008

Project Sponsors (alphabetical order; starting year):

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For information on joining the Wharton Risk Center's *Managing and Financing Extreme Events* initiative as an organization or an individual, please contact Howard Kunreuther or Erwann Michel-Kerjan at Kunreuther@wharton.upenn.edu or ErwannMK@wharton.upenn.edu

This report also benefited from data and ongoing interaction with the following organizations:

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Florida Hurricane Catastrophe Fund (FHCF)
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National Association of Insurance Commissioners (NAIC)
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PART I

CAUSE FOR CONCERN

CHAPTER 1

A NEW ERA: FROM MAJOR EVENTS TO LARGE-SCALE DISASTERS

KEY FINDINGS

There has been a major increase in the cost of natural disasters over the past 15 years.

A comparison of the economic losses due to natural disasters worldwide over time (corrected for inflation) reveals a huge increase: \$53.6 billion (1950-59), \$93.3 billion (1960-69), \$161.7 billion (1970-79), \$262.9 billion (1980-89) and \$778.3 billion (1990-99). The current decade has already seen \$420.6 billion in losses, principally due to the 2004 and 2005 hurricane seasons, which produced historic records.

Property values at risk in hazard-prone areas in the U.S. have drastically increased in recent years.

The key socio-economic factors causing the increased losses are the *development in hazard-prone areas* and *increased value at risk*. The population of Florida was 2.8 million in 1950, 13 million in 1990 and is projected to grow to 19.3 million in 2010. Today, 80 percent of insured assets in Florida are located near the coast, the high-risk area of the state. The insured exposure located in Florida coastal areas only was \$1.9 trillion in 2004 and is growing, increasing the likelihood of severe economic and insured losses from future hurricanes unless cost-effective mitigation measures are implemented. Other coastal states have large property values exposed as well.

The impact of climate change on these increased losses is not clear, but is of growing concern.

Some scientists have suggested that the series of major hurricanes that occurred in 2004 and 2005 might be partially attributable to the impact of a change in climate. However, there is no consensus on this point. Still there is growing concern that global warming might lead to the occurrence of much more intense hurricanes hitting the coast over a shorter period of time, and increase damage to residences and commercial buildings.

Natural disasters involve a large number of key interested parties who often have different agendas and priorities.

These stakeholders include homeowners residing in hazard-prone areas, insurers and reinsurers, banks and other financial institutions, the capital markets, risk modeling firms, rating agencies, the construction industry and developers, the real estate community, other businesses and local, state and federal governments. For each of these stakeholders it is necessary to consider how their values and goals shape their agendas for assessing and managing these risks.

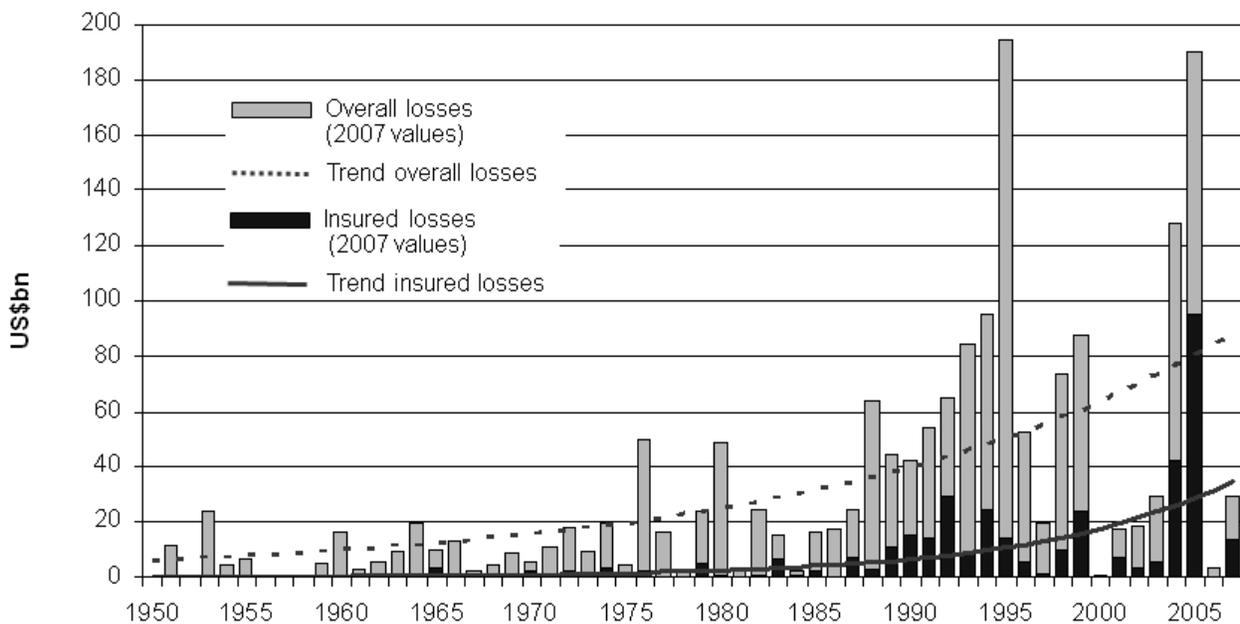
CHAPTER 1

A NEW ERA: FROM MAJOR EVENTS TO LARGE-SCALE DISASTERS

This chapter provides a picture of the increase in catastrophic losses in the United States and the challenges that various stakeholders face in managing the associated risks and costs coming from their different positions and, in some cases, from different interests. Gaining an understanding and appreciation of the perspectives and concerns of these stakeholders is critical to developing and evaluating measures that will improve the management of catastrophic risk.

1.1. Recent Changes in the Impacts of Extreme Events

The economic and insured losses from great natural catastrophes worldwide have increased significantly in recent years as shown in Figure 1.1 (each vertical bar represents the total economic losses, the darker zone, the insured portion of it). A comparison of these economic losses over time reveals a huge increase: \$53.6 billion (1950-59), \$93.3 billion (1960-69), \$161.7 billion (1970-79), \$262.9 billion (1980-89) and \$778.3 billion (1990-99). The current decade has already seen \$420.6 billion in losses, principally due to the 2004 and 2005 hurricane seasons, which produced historic records.



**FIGURE 1.1. EVOLUTION OF “GREAT NATURAL CATASTROPHES” WORLDWIDE, 1950-2007
ECONOMIC VERSUS INSURED IMPACT**

Sources: Data from Munich Re, 2008 Geo Risks Research – in U.S. \$ billion indexed to 2007

Catastrophes have had a more devastating impact on insurers over the past 15 years than in the entire history of insurance. Between 1970 and the mid-1980s, annual insured losses from natural disasters (including forest fires) were in the \$3 to \$4 billion range. The insured losses from Hurricane Hugo, which made landfall in Charleston, South Carolina on September 22, 1989, exceeded \$4 billion (1989 prices). It was the first natural disaster to inflict more than one billion dollars of insured losses in the U.S. There was a radical increase in insured losses in the early 1990s, with Hurricane Andrew in Florida (\$23.7 billion in 2007 dollars) and the Northridge earthquake in California (\$19.6 billion in 2007 dollars). The four hurricanes in Florida in 2004 (Charley, Frances, Ivan and Jeanne) collectively totaled almost \$33 billion in *insured* losses. Hurricane Katrina alone cost insurers and reinsurers an estimated \$46 billion, and total losses paid by private insurers due to major natural catastrophes were \$87 billion in 2005¹. Figure 1.2 depicts the upward trend in worldwide *insured* losses from catastrophes between 1970 and 2007 (in 2007 indexed prices).²

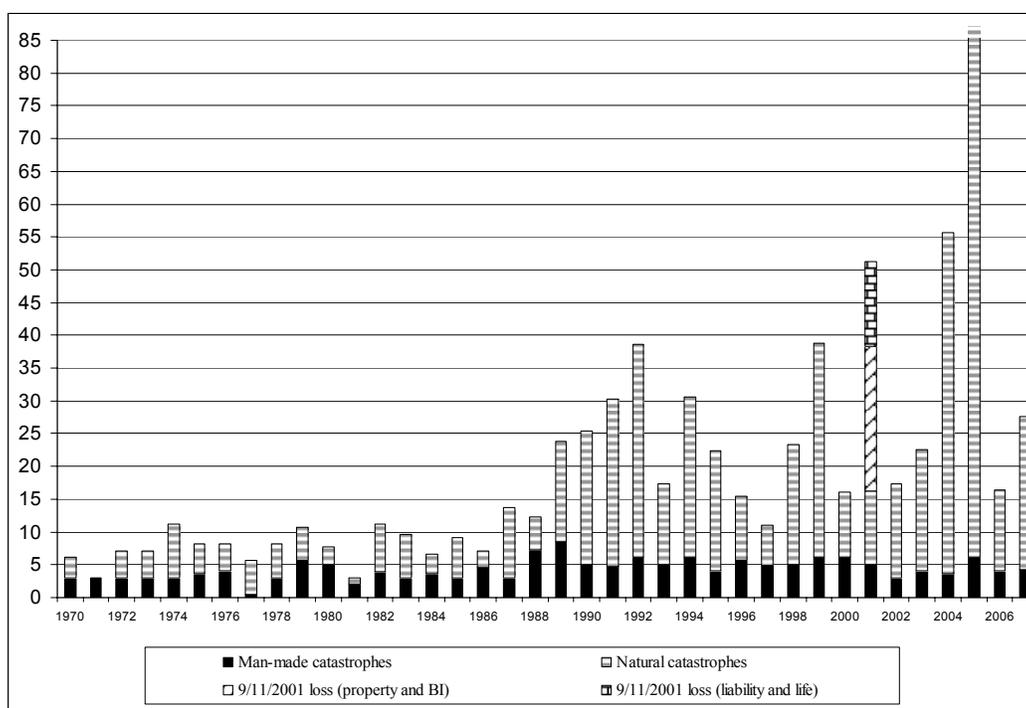


FIGURE 1.2. WORLDWIDE EVOLUTION OF CATASTROPHE INSURED LOSSES, 1970-2007
 (9/11: All lines, including property and business interruption (BI); in U.S. \$ billion indexed to 2007)
 Source: Wharton Risk Center with data from Swiss Re and Insurance Information Institute

¹ This figure excludes payment by the U.S. National Flood Insurance Program (NFIP) for damage due to 2005 flooding (over \$20 billion in claims).

² Munich Re and Swiss Re, the two leading reinsurers in the world, do not use the same definition of catastrophic losses. Natural disasters inflicting insured losses above \$38.7 million or total losses above \$77.5 million are considered a major catastrophes by Swiss Re (we use this threshold in Figure 1.2); Munich Re considers a higher threshold, which explains the difference between Figures 1.1 and 1.2. For example, when Munich Re estimated insured loss from natural disasters at about \$42 billion in 2004, Swiss Re’s estimate was over \$52 billion. As a result, most figures used in the literature regarding the evolution of catastrophe loss actually underestimate the real effect on insurers. We appreciate Swiss Re’s and Munich Re’s willingness to share their 2007 estimates prior to their publication.

Table 1.1 reveals the 20 most costly catastrophes for the insurance sector since 1970 (in 2007 dollars). Of these 20 major events, 10 occurred since 2001. Hurricane Andrew and the Northridge earthquake were the first two disasters that the industry experienced where losses were greater than \$10 billion (designated as *super-cats*) and caused insurers to reflect on whether risks from natural disasters were still insurable. To assist them in making this determination, many firms began utilizing catastrophe models to estimate the likelihood and consequences to their insured portfolios from specific disasters in hazard-prone areas (Grossi and Kunreuther, 2005).³ With the exception of the terrorist attacks on September 11, 2001, all of the events in the top 20 were natural disasters. More than 80 percent of these were weather-related events – hurricanes and typhoons, storms, and floods, with nearly three quarters of the claims in the United States (U.S. events are in bolded text) (see Section 1.2 for a discussion on the question of attribution).

TABLE 1.1. THE 20 MOST COSTLY INSURED CATASTROPHES IN THE WORLD, 1970-2007⁴

U.S.\$ Billion (indexed to 2007)	Event	Victims (Dead or missing)	Year	Area of Primary Damage
46.3	Hurricane Katrina	1,836	2005	USA, Gulf of Mexico, et al.
35.5	9/11 Attacks	3,025	2001	USA
23.7	Hurricane Andrew	43	1992	USA, Bahamas
19.6	Northridge Earthquake	61	1994	USA
14.1	Hurricane Ivan	124	2004	USA, Caribbean, et al.
13.3	Hurricane Wilma	35	2005	USA, Gulf of Mexico, et al.
10.7	Hurricane Rita	34	2005	USA, Gulf of Mexico, et al.
8.8	Hurricane Charley	24	2004	USA, Caribbean, et al.
8.6	Typhoon Mireille	51	1991	Japan
7.6	Hurricane Hugo	71	1989	Puerto Rico, USA, et al.
7.4	Winterstorm Daria	95	1990	France, UK, et al.
7.2	Winterstorm Lothar	110	1999	France, Switzerland, et al.
6.1	Winterstorm Kyrill	54	2007	Germany, UK, NL, France, et al.
5.7	Storms and floods	22	1987	France, UK, et al.
5.6	Hurricane Frances	38	2004	USA, Bahamas
5.0	Winterstorm Vivian	64	1990	Western/Central Europe
5.0	Typhoon Bart	26	1999	Japan
4.5	Hurricane Georges	600	1998	USA, Caribbean
4.2	Tropical Storm Alison	41	2001	USA
4.2	Hurricane Jeanne	3,034	2004	USA, Caribbean, et al.

Sources: Wharton Risk Center with data from Swiss Re⁵ and Insurance Information Institute

Losses due to natural catastrophes and man-made disasters in 2006 were far below the losses in 2004 and 2005. Of the \$48 billion in catastrophe-related economic losses, \$16 billion was covered by insurance (\$11 billion for natural disasters; \$5 billion for man-made). Over the past

³ Grossi, P. and H. Kunreuther (eds.) (2005), *Catastrophe Modeling: A New Approach to Managing Risk*. New York: Springer.

⁴ This table excludes payments for flood by the National Flood Insurance Program in the U.S.; e.g., \$17.3 billion in 2005 as a result of Hurricanes Katrina and Rita.

⁵ Source: Swiss Re, *sigma* No 1/2008 (forthcoming publication on Natural Catastrophes and Man-Made Disasters in 2007: High Losses in Europe.) For more information, see www.swissre.com/sigma. All *sigma* studies are copyright protected, as described on page 2 of each *sigma* issue.

twenty years, only two years had insured losses lower than in 2006 (1988 and 1997) (Swiss Re, 2007).⁶ According to Munich Re, there were 950 natural catastrophes in 2007, the most since 1974. They inflicted nearly \$27 billion in insured losses.

Catastrophic events, which inflicted major insured losses, typically occurred in developed countries where insurance penetration is high. In developing countries where insurance is typically lacking or is just emerging, these disasters can inflict severe economic and human impact (Table 1.2).

TABLE 1.2. THE 10 DEADLIEST CATASTROPHES IN THE WORLD, 1970-2007

Date	Country	Event	Victims (dead or missing)
Nov. 14, 1970	Bangladesh	Storm and flood	300,000
Jul. 28, 1976	China	Earthquake (magnitude 7.5)	255,000
Dec. 26, 2004	Indonesia, Thailand, et al.	Earthquake (magnitude 9); tsunami in Indian Ocean	220,000
Apr. 29, 1991	Bangladesh	Tropical Cyclone Gorky	138,000
Oct. 8, 2005	Pakistan, India, et al.	Earthquake (magnitude 7.6); aftershocks, landslides	73,300
May 31, 1970	Peru	Earthquake (magnitude 7.7); rock slides	66,000
Jun. 21, 1990	Iran	Earthquake (magnitude 7.7); landslides	40,000
Jun. 1, 2003	France, Italy, Germany, et al.	Heat wave and drought in Europe	35,000
Dec. 26, 2003	Iran	Earthquake (magnitude 6.5) destroys 85 percent of Bam	26,271
Dec. 7, 1988	Armenia, ex-USSR	Earthquake (magnitude 6.9)	25,000

Sources: Wharton Risk Center with data from Swiss Re

1.2. The Question of Attribution⁷

The focus of this report is on weather-related events. During the period between 1970 and 2004, storms and floods have been responsible for over **90 percent** of the total economic costs of extreme weather-related events worldwide. Storms (*hurricanes* in the U.S. region, *typhoons* in Asia and *windstorms* in Europe) contributed to over 75 percent of insured losses. In constant prices (2004), insured losses from weather-related events averaged \$3 billion annually between 1970 and 1990 and then increased significantly to \$16 billion annually between 1990 and 2004 (ABI, 2005).⁸ In 2005, 99.7 percent of all catastrophic losses worldwide were due to weather-related events (Mills and Lecomte, 2006).⁹

⁶ Swiss Re (2007), "Natural catastrophes and man-made disasters in 2006," *sigma*, No 2.

⁷ This section is based on Kunreuther, H. and E. Michel-Kerjan (2007), "Climate Change, Insurability of Large-Scale Risks and the Emerging Liability Challenge," *Penn Law Review*, 155(6): 1795-1842.

⁸ Association of British Insurers (ABI) (2005), "Financial Risks of Climate Change," June 2005.

⁹ Mills, E. and E. Lecomte (2006), "From Risk To Opportunity: How Insurers Can Proactively and Profitably Manage Climate Change," *Ceres*, August 2006.

What are the key drivers of the increase in these losses? More specifically, what role have socio-economic factors played? How is a change in climate likely to affect the number and severity of catastrophes in the future?

Increased Development in Hazard-Prone Areas

There are at least two principal socio-economic factors that directly influence the level of economic losses due to catastrophic events: *degree of urbanization* and *value at risk*. In 1950, approximately 30 percent of the world’s population lived in cities. In 2000, about 50 percent of the world’s population (6 billion) resided in urban areas. Projections by the United Nations show that by 2025, that figure will have increased to 60 percent based on a world population estimate of 8.3 billion people. Figure 1.3 depicts the increase in population by county in the U.S. between 1990 and 2000. One can observe a significant increase in high risk areas.

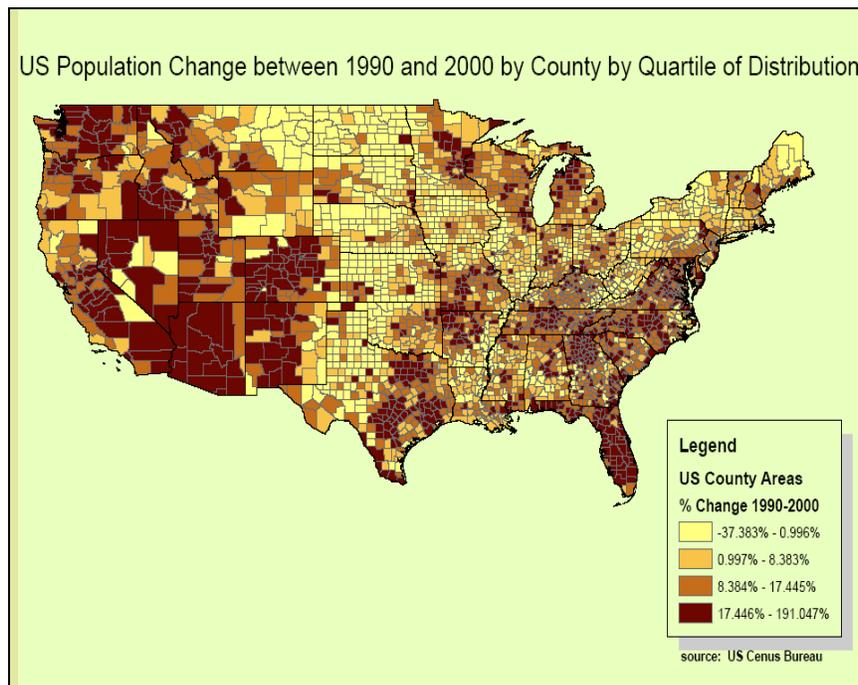


FIGURE 1.3. EVOLUTION OF THE U.S. POPULATION BETWEEN 1990 AND 2000

Source: Data from U.S. Census Bureau

In 2003, 53 percent of the nation’s population, or 153 million people, lived in the 673 U.S. coastal counties, an increase of 33 million people since 1980, according to the National Oceanic Atmospheric Administration—yet coastal counties, excluding Alaska, account for only 17 percent of U.S. land area. And the nation’s coastal population is expected to increase by more than 7 million by 2008, and 12 million by 2015 (NOAA, 2004).¹⁰

In hazard-prone areas, this urbanization and increase of population also translates into increased concentration of exposure. The development of Florida as a home for retirees is an example. According to the U.S. Bureau of the Census, the population of Florida has increased

¹⁰ Crossett, K.M., T.J. Culliton, P.C. Wiley, and T.R. Goodspeed (2004), “Population Trends Along the Coastal United States: 1980-2008,” National Oceanic and Atmospheric Administration, NOAA’s National Ocean Service, Special Projects: Silver Spring, MD.

significantly over the past 50 years: 2.8 million inhabitants in 1950, 6.8 million in 1970, 13 million in 1990, and a projected 19.3 million population in 2010 (almost a 700 percent increase since 1950), increasing the likelihood of severe economic and insured losses, unless cost-effective mitigation measures are implemented.

Florida also has a high density of insurance coverage, with most houses covered against windstorm losses and about one-third insured against floods under the U.S. National Flood Insurance Program (NFIP),¹¹ according to a study undertaken by Munich Re (2000).¹² In 2004, (the most recent available data) the modeling firm AIR Worldwide estimated that nearly 80 percent of insured assets in Florida are located near the coasts, the high-risk area in the state (Figure 1.4). This represents \$1.9 trillion of insured exposure located in coastal areas (commercial and residential exposure) (Figure 1.5). Insurance density is thus another critical socio-economic factor to consider when evaluating the evolution of insured loss due to weather-related catastrophes.

These factors will continue to have a major impact on the level of insured losses from natural catastrophes. Given the growing concentration of exposure on the Gulf Coast, another hurricane like Katrina (Figure 1.6) hitting the Gulf Coast is likely to inflict significant direct losses (property damage) and indirect losses (business interruption) unless strong mitigation measures are put in place.¹³

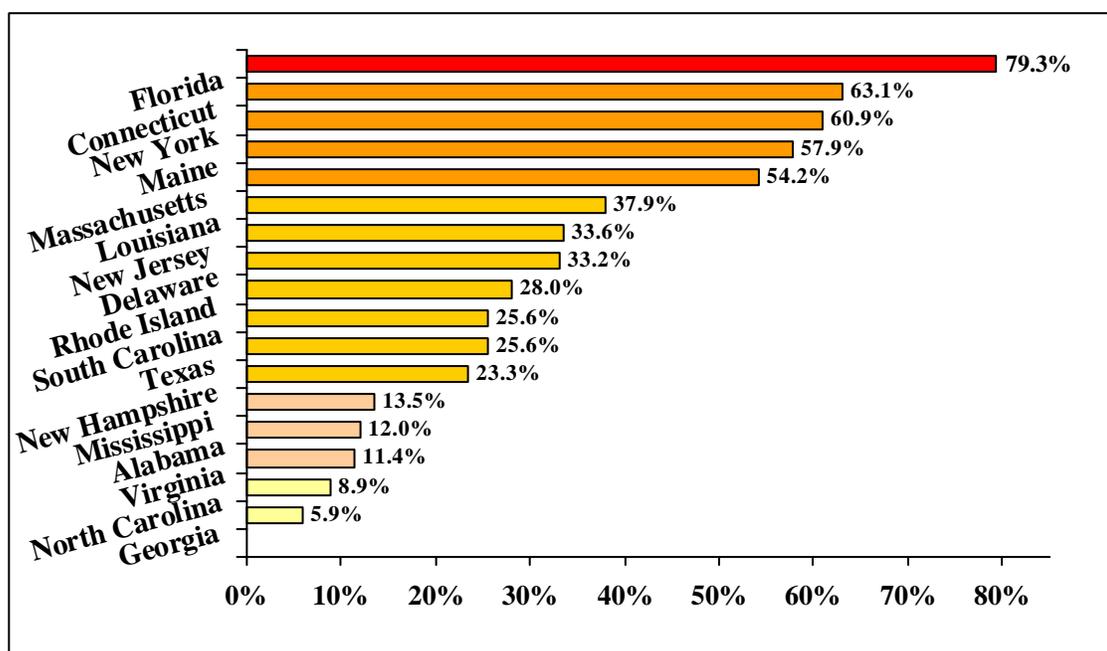


FIGURE 1.4. INSURED COASTAL EXPOSURE AS A PERCENTAGE OF STATEWIDE INSURED EXPOSURE AS OF DECEMBER 2004 (RESIDENTIAL AND COMMERCIAL PROPERTIES)

Source: Data from AIR Worldwide Corporation

¹¹ The NFIP is a public insurance program created in 1968. Insurers play the role of intermediaries between the policyholders and the federal government. Following Hurricane Katrina, the program had to borrow \$20 billion from the federal government in 2006 to meet its claims. Congress is considering modifying the program substantially. For a more detailed discussion of the NFIP, see Chapter 4.

¹² Munich Re (2000), "Topics 2000. Natural Catastrophes – The Current Position," Special millennium issue.

¹³ For additional data on the economic impact of future catastrophic hurricanes, see The Financial Services Roundtable, *Blue Ribbon Commission on Mega-Catastrophes Comprehensive Report*, Chapter 2 (2007).

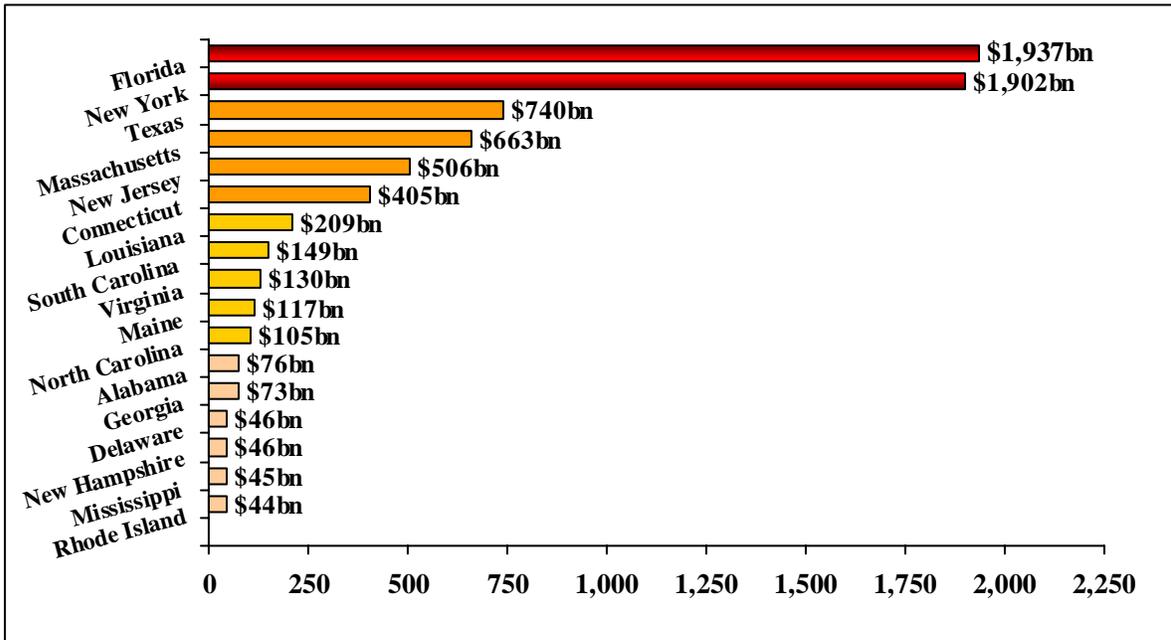


FIGURE 1.5. TOTAL VALUE OF INSURED COASTAL EXPOSURE AS OF DECEMBER 2004
 (IN \$ BILLION; RESIDENTIAL AND COMMERCIAL PROPERTIES)
 Source: Data from AIR Worldwide Corporation

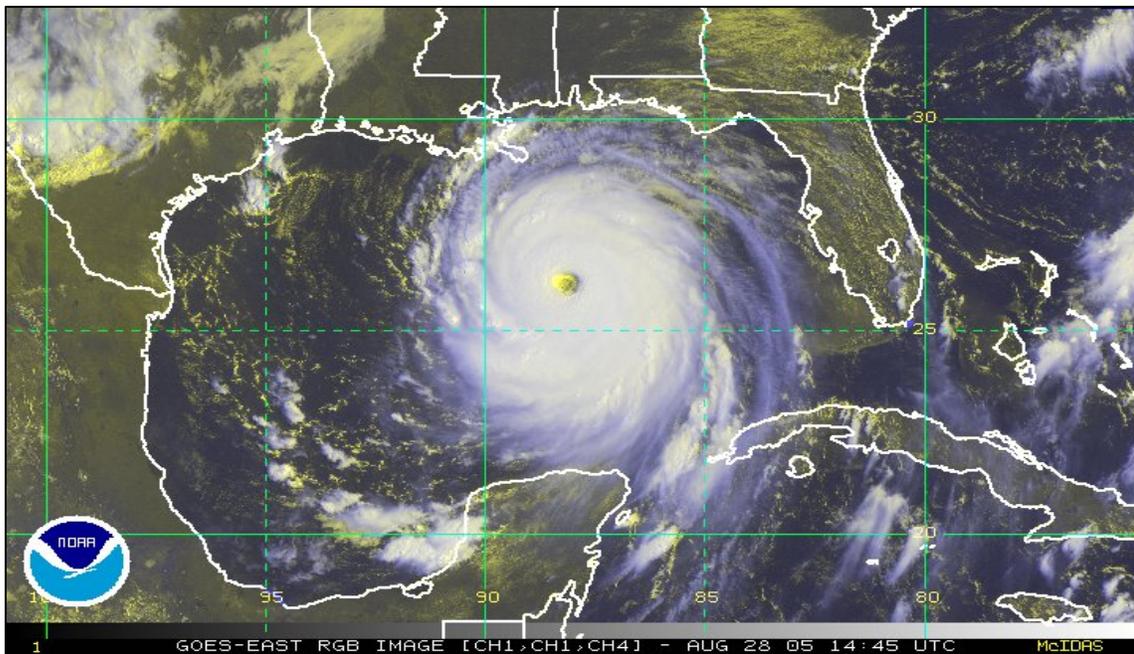


FIGURE 1.6. LARGE-SCALE DISASTERS: HURRICANE KATRINA AS OF SUNDAY AUGUST 28, 2005
 Source: National Oceanic and Atmospheric Administration

Table 1.3 illustrates the cost of major hurricanes that occurred in the U.S. in the past century, adjusted for 2004 inflation, population and wealth normalization, that is, an estimate of what each of these hurricanes would have cost had they hit in 2004 (total direct cost).¹⁴

**TABLE 1.3. TOP 20 HURRICANE SCENARIOS (1900-2004)
RANKED USING 2004 INFLATION, POPULATION, AND WEALTH NORMALIZATION**

Rank	Hurricane	Year	Category	Cost (\$ billion) in 2004
1	Miami (Southeast FL/MS/AL)	1926	4	101.97
2	ANDREW (Southeast FL and LA)	1992	5	81.20
3	North Texas (Galveston)	1900	4	43.15
4	North Texas (Galveston)	1915	4	37.54
5	Southwest Florida	1944	3	31.81
6	New England	1938	3	23.78
7	Southeast Florida	1928	4	23.45
8	BETSY (Southeast FL and LA)	1965	3	19.46
9	DONNA (FL/Eastern U.S.)	1960	4	17.54
10	CAMILLE (MS/Southeast LA/VA)	1969	5	16.99
11	AGNES (FL/Northeast U.S.)	1972	1	15.46
12	CHARLEY (Southwest FL)	2004	4	15.10
13	DIANE (Northeast U.S.)	1955	1	15.00
14	IVAN (Northwest FL/AL)	2004	3	14.43
15	HUGO (SC)	1989	4	14.20
16	CAROL (Northeast U.S.)	1954	3	13.23
17	Southeast FL/LA/AL	1947	4	12.79
18	CARLA (North and Central TX)	1961	4	12.20
19	HAZEL (SC/NC)	1954	4	11.72
20	Northeast U.S.	1944	3	9.97

Sources: Data from U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)

¹⁴ These estimates might vary, depending on underlying assumptions over such a long period of time, such as inflation, population growth, and wealth normalization in the studied area; moreover, mitigation and building codes will have an important impact on total losses.

Climate Change and Hurricanes: Likelihood Versus Intensity¹⁵

There have been numerous discussions and scientific debates as to whether the series of major hurricanes that occurred in 2004 and 2005 might be partially attributable to the impact of a change in climate.¹⁶ Without passing judgment on this issue, we summarize the key questions and the scientific evidence presented to address them.

Is a change in climate likely to affect the number and severity of weather-related catastrophes? One of the expected effects of global warming will be an increase in hurricane intensity. This has been predicted by theory and modeling, and substantiated by empirical data on climate change. Higher ocean temperatures lead to an exponentially higher evaporation rate in the atmosphere which increases the intensity of cyclones and precipitation.

Emanuel (2005)¹⁷ introduces an index of potential destructiveness of hurricanes based on the total dissipation power over the lifetime of the storm. He shows a large increase in power dissipation over the past 30 years and concludes that this increase may be due to the fact that storms have become more intense, on average, and/or have survived longer at high intensity. His study also shows that the annual average storm peak wind speed over the North Atlantic and eastern and western North Pacific has increased by 50 percent over the past 30 years.

A paper by Webster et al. (2005)¹⁸ published a few weeks later, indicates that the number of Category 4 and 5 hurricanes worldwide has nearly doubled over the past 35 years.¹⁹ In the 1970s, there were an average of about ten Category 4 and 5 hurricanes per year globally. Since 1990, the number of Category 4 and 5 hurricanes has averaged 18 per year. Focusing only on the North Atlantic (Atlantic-Caribbean-Gulf of Mexico), Category 4 and 5 hurricanes have increased from 16 in the period of 1975-1989, to 25 in the period of 1990-2004 (a 56 percent increase). The Webster, et al. (2005) study concludes that “global data indicate a 30-year trend toward more frequent and intense hurricanes.” This significant increase in observed tropical cyclone intensities, linked to warming sea surface temperatures that may be associated with global warming, has been shown in another study published recently (Hoyos et al., 2006).²⁰

But this is not to say that there is consensus by scientists on the relationship between hurricane activity and global warming.²¹ In a perspective article published in *Science*, Landsea et al.

¹⁵ This subsection is based on Kunreuther, H. and E. Michel-Kerjan (2007), “Climate Change, Insurability of Large-Scale Disasters and the Emerging Liability Challenge,” *Penn Law Review*, 155(6): 1795-1842.

¹⁶ For more details on the scientific evidence regarding climate change and its impact see Stern Review (2006), *The Economics of Climate Change*, H.M. Treasury, December, and Intergovernmental Panel on Climate Change (2007), *Climate Change 2007*, January.

¹⁷ Emanuel, K., (2005), “Increasing destructiveness of tropical cyclones over the past 30 years,” *Nature*, 436(4): 686-688, August.

¹⁸ Webster, P., G.J. Holland, J. Curry and H.R. Chang (2005), “Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment,” *Science*, 309: 1844-1846, September 16, 2005.

¹⁹ Category 4 hurricanes have sustained winds from 131 to 155 miles per hour; Category 5 systems, such as Hurricane Katrina at its peak over the Gulf of Mexico, have sustained winds of 156 mph or more.

²⁰ Hoyos, C., P.A. Agudelo, P.J. Webster, and J.A. Curry (2006), “Deconvolution of the Factors Contributing to the Increase in Global Hurricane Intensity,” *Science*, 312: 94-97, April 7, 2006.

²¹ See for instance the exchange between Pielke R., Jr., C.W. Landsea and K. Emanuel (2005) in *Nature*, 438, 22/29 and Chan, J. (2006), Comment on “Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment,” *Science*, 311: 5768, 1713, March 24, 2006 and Webster P.J., J.A. Curry, J. Liu, G.J. Holland (2006), Response to Comment on “Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment,” *Science*, 311, 1713c, 24 March, 2006.

(2006)²² point out that subjective measurements and variable procedures make existing tropical cyclone databases insufficiently reliable to detect trends in the frequency of extreme cyclones. This conclusion is reinforced in a recent summary of articles on global climate change by Patrick Michaels, past president of the American Association of State Climatologists, who notes that all studies of hurricane activity that claim a link between human causation and the recent spate of hurricanes must also account for the equally active period around the middle of the 20th century. Studies using data from 1970 onward begin at a cool point in the hemisphere's temperature history, and hence may draw erroneous conclusions regarding global climate change and hurricane activity (Michaels, 2006).²³

A reanalysis of global tropical cyclone data since 1980 that addressed inaccuracies related to the interpretation of satellite recordings was published in 2007 (Kossin et al., 2007).²⁴ The reanalyzed data shows a lack of global trend in the number and percentage of Category 4 and 5 hurricanes and power dissipation index (PDI) globally, thus contradicting the results of Webster, et al., 2005. An increase in PDI and in the number and proportion of Category 4 and 5 hurricanes was still found for the Atlantic. While this supports the results of Emanuel (2005)²⁵ for the Atlantic, the lack of a global increase in tropical cyclone activity despite the increase in tropical sea-surface temperatures in all basins "poses a challenge to hypotheses that directly relate globally increasing tropical sea surface temperatures to an increase in long-term mean global hurricane intensity" (Kossin et al., 2007).²⁶ The Atlantic also appears to be characterized by large natural variability on the multidecadal scale with a shift to a more active phase around 1995 (World Meteorological Organization, 2006; Goldenberg et al., 2001).²⁷

The current debate in the scientific community regarding changes in the frequency and intensity of hurricanes and their relationship to global climate change is likely to be with us for a long time to come. The results to date do raise issues for the insurance industry to the extent that an increase in the number of major hurricanes over a shorter period of time is likely to translate into a greater number hitting the coasts, with a greater likelihood of damage to a much larger number of residences and commercial buildings today than in the 1940s.²⁸

²² Landsea, C.W., B.A. Harper, K. Hoarau, J.A. Knaff (2006), "Can We Detect Trends in Extreme Tropical Cyclones?" *Science*, 313: 452-454, July 28, 2006.

²³ Michaels, P. (2006), "Is the Sky Really Falling? A Review of Recent Global Warming Scare Stories," *Policy Analysis*, 576, August 23, 2006, Washington, DC: The Cato Institute.

²⁴ Kossin, J.P., J.R. Knapp, D.L. Vimont, R.J. Murnane, B.A. Harper (2007), "A globally consistent reanalysis of hurricane variability and trends." *GRL* 34.

²⁵ Emanuel, K. (2005), "Increasing destructiveness of tropical cyclones over the past 30 years." *Nature* 436(4): 686-688, August.

²⁶ Op. Cit.

²⁷ World Meteorological Organization (2006), Statement on Tropical Cyclones and Climate Change. WMO 6th International Workshop on Tropical Cyclones, San Jose, Nov. 2006; Goldenberg, S.B., C.W. Landsea, A.M. Mestas-Nunez, W.M. Gray (2001), "The recent increase in Atlantic hurricane activity: causes and implications," *Science*, 293, p. 474.

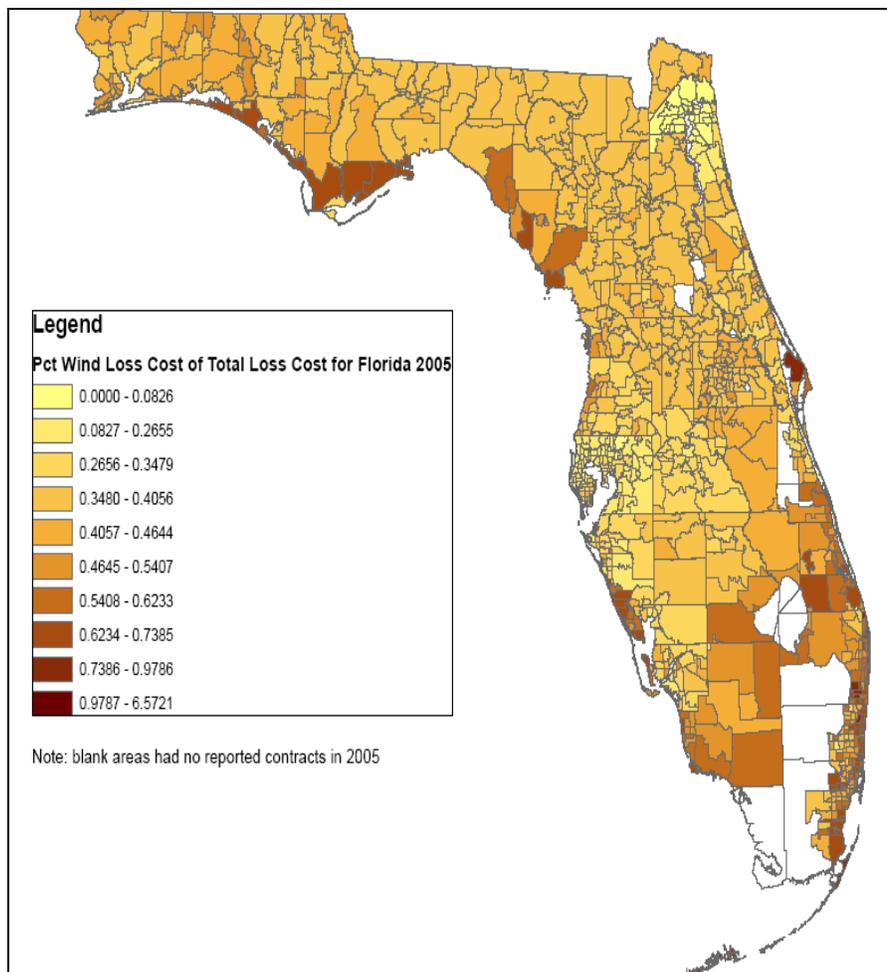
²⁸ For more discussion on this issue see Mills, E. (2005), "Insurance in a Climate of Change" *Science* 308: 1040-44, August 12, 2005, and Höpfe, P. and R. Pielke (eds.) (2006), *Report of the Workshop on Climate Change and Disaster Losses*, May 25-26, Hohenkammer, Germany, October.

1.3. Focus of the Study: Florida, New York, South Carolina and Texas

This study focuses on mitigating and financing catastrophic risks from hurricanes and flood-related damage in the U.S. Some attention needs to be paid to two other dimensions:

The international dimension – The operation of insurance and reinsurance markets worldwide will have impacts on the U.S. market. Some of the key features of insurance programs developed abroad for dealing with disasters may also be relevant for the U.S.

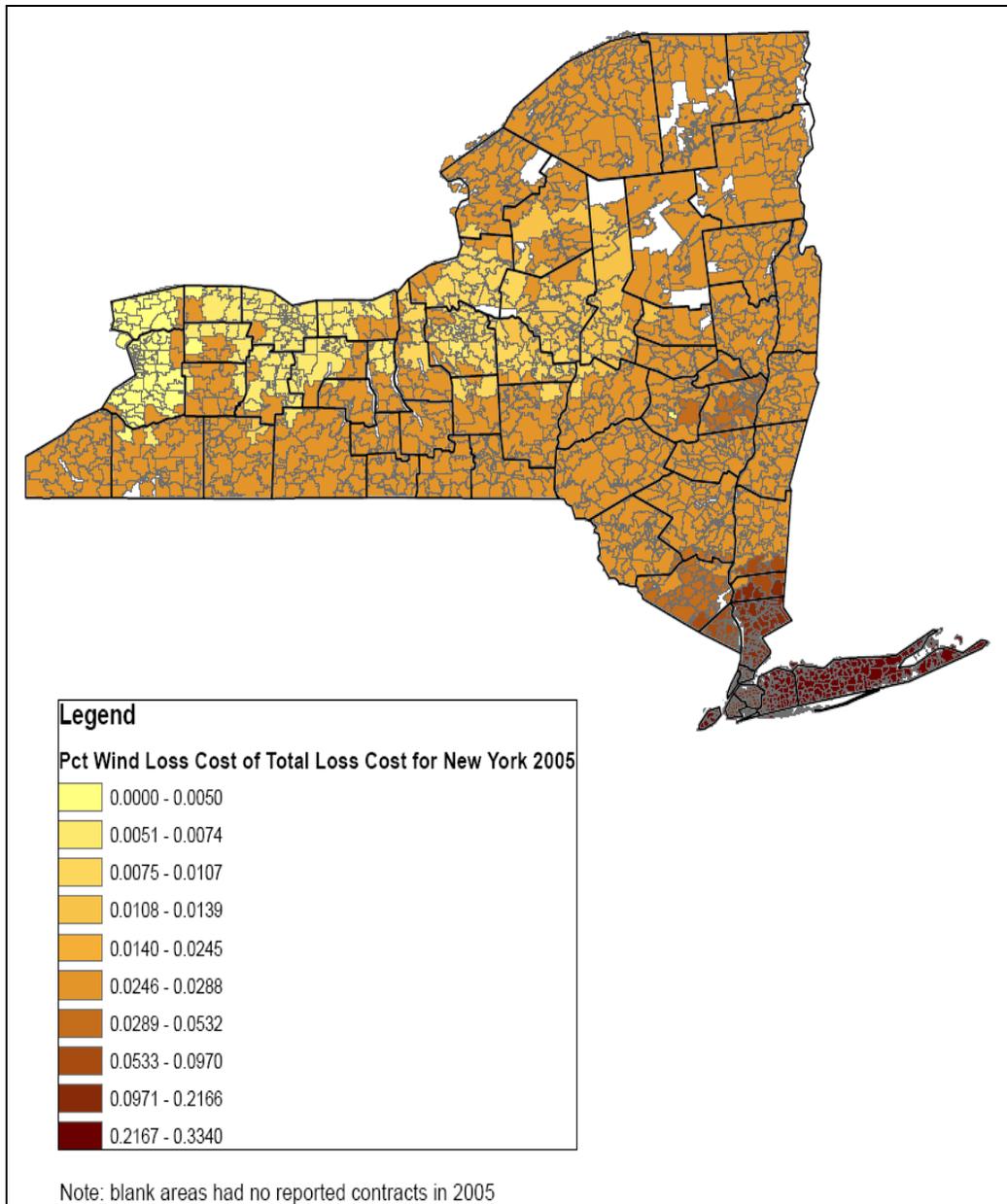
The local dimension – Local and state decisions highlight issues for the national debate regarding alternative disaster insurance and mitigation programs. This report provides an analysis of the market and regulatory status in four states: Florida, New York, South Carolina and Texas. Figures 1.7-A through 17-D depict the risks of wind damage from hurricanes in relation to total loss costs for different parts of these states.²⁹



**FIGURE 1.7-A. FOCUS OF THE STUDY:
 THE STATE OF FLORIDA**

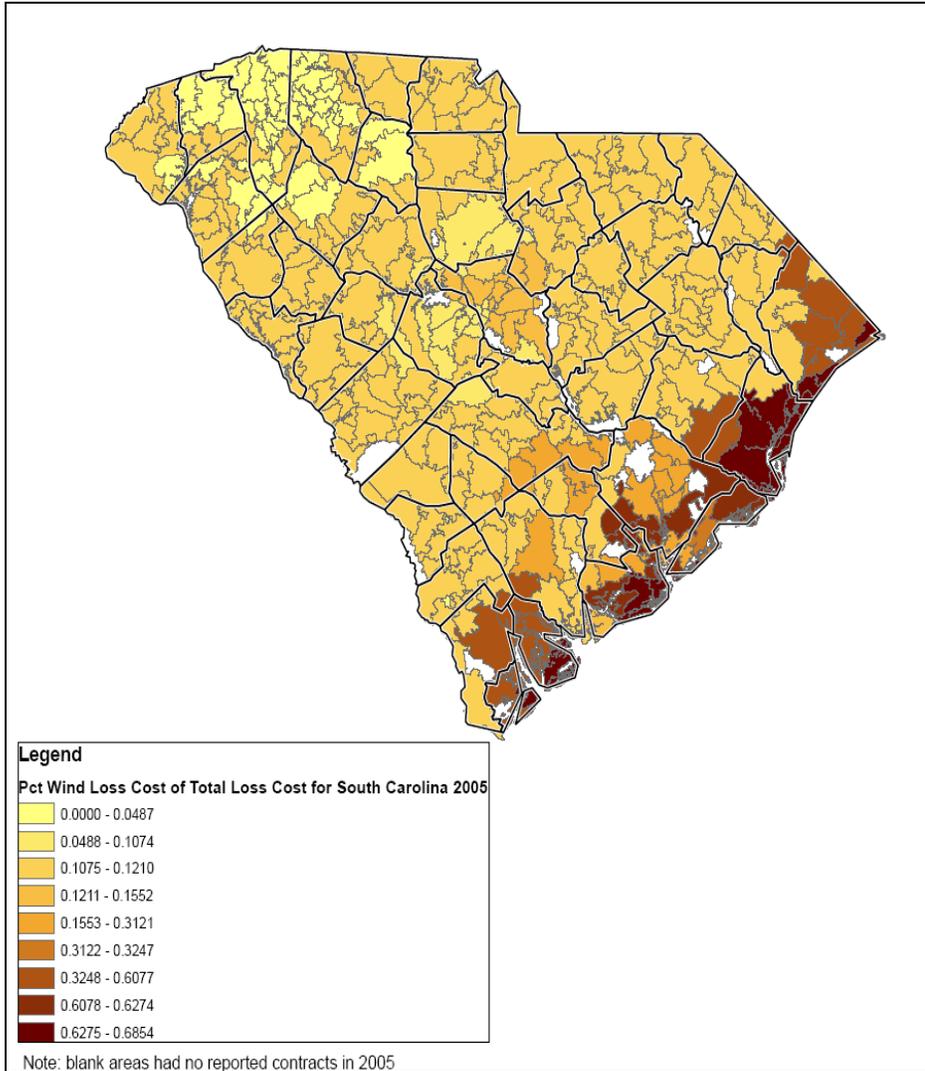
Sources: Georgia State University, Center for Risk Management and Insurance, and Google

²⁹ We were not able to access similar data for Texas, so the Texas map (Figure 1.7-D) shows only counties and major cities for this state.



**FIGURE 1.7-B. FOCUS OF THE STUDY:
THE STATE OF NEW YORK**

Sources: Georgia State University, Center for Risk Management and Insurance, and Google



**FIGURE 1.7-C. FOCUS OF THE STUDY:
THE STATE OF SOUTH CAROLINA**

Sources: Georgia State University, Center for Risk Management and Insurance, and Google

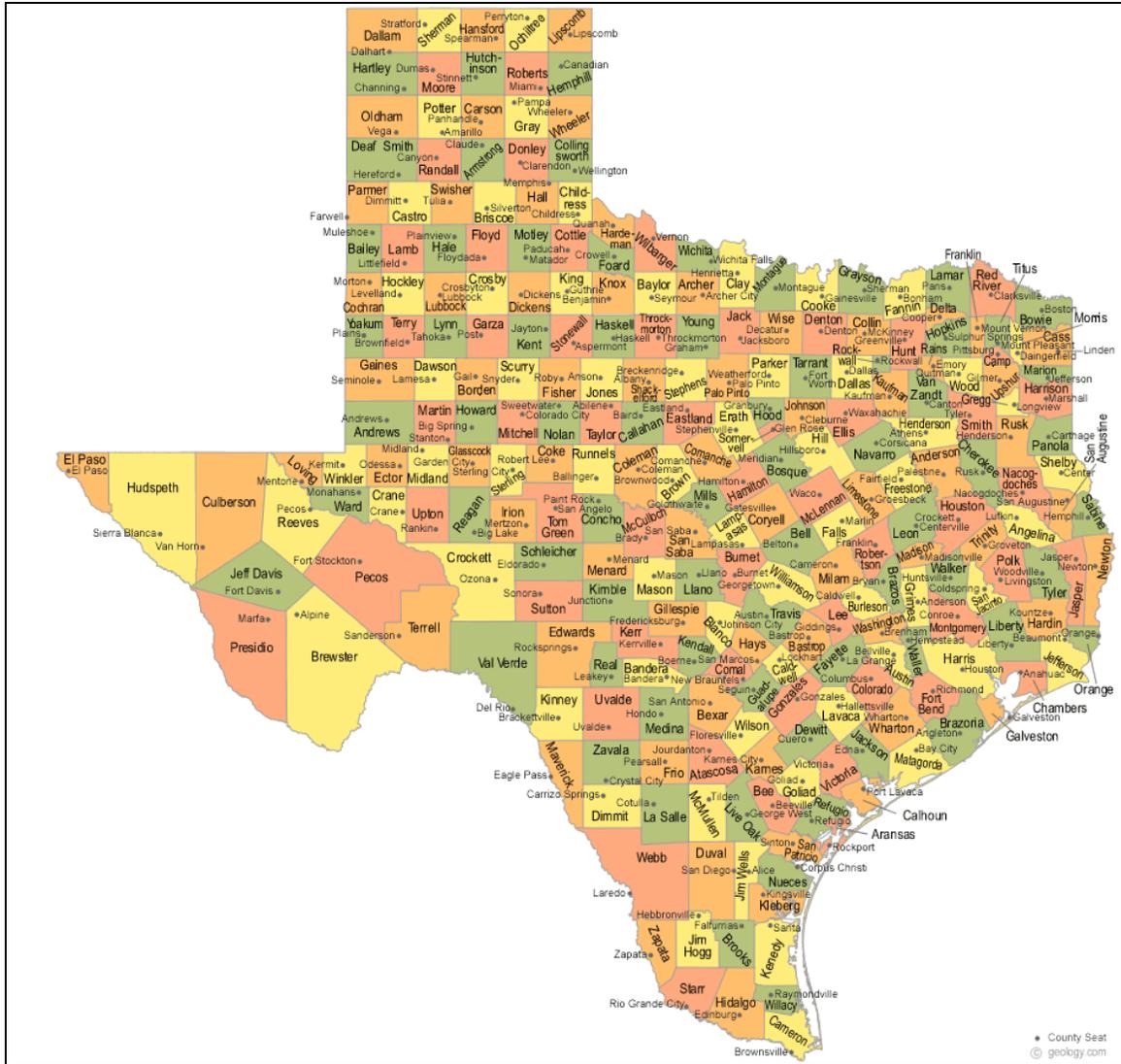


FIGURE 1.7-D. FOCUS OF THE STUDY:
THE STATE OF TEXAS
Source: Google Earth

1.4. Key Interested Parties

In this section we discuss the roles of key interested parties as they relate to mitigating and insuring residential property against losses from natural disasters: construction and real estate, homeowners, banks and financial institutions, state and local governments (including insurance commissioners), insurers, reinsurers, brokers, capital markets, modeling firms, rating agencies, and investors that provide capital to insurers and reinsurers.

Construction and Real Estate

Real estate agents, architects, developers, engineers, contractors and other service providers play an important role in the management of risk from catastrophic events. In regions prone to natural disasters, federal or state regulations require real estate agents to inform the new homeowner of potential hazards. For example, the Alquist-Priolo Act requires that potential home buyers be told the location of their home relative to an earthquake fault line. But a study by Palm (1981)³⁰ revealed that most home buyers did not understand or recall the risk warning. The National Flood Insurance Program (NFIP) is required to analyze and map the level of flood risk in different areas, including designating 100-year floodplains or zones. By federal law and regulation, the lender must require the borrower of federally-insured mortgages to purchase flood insurance if the building is in a 100-year flood zone.

However, the NFIP has been criticized recently for having inaccurate maps. For example, a four-year study of the Pennypack Creek Watershed by the Center for Sustainable Communities at Temple University revealed that flood danger zones have changed significantly in Bucks, Montgomery and Philadelphia Counties in Pennsylvania.³¹ Although enforcement of the flood insurance requirement has improved, it is not clear whether compliance is up to the standards set by law. In June 2002, the GAO reported that the extent to which lenders were required to enforce mandatory purchase requirements was simply unknown.³²

Engineers and contractors play a significant role in managing risks in high-hazard areas. Most of them have an interest in designing structures built to high standards and in having their structures certified by reputable building officials to protect themselves from liability in the case of life or property loss. Developers, on the other hand, have an interest in selling homes at the lowest possible price, and need to be convinced that the extra costs associated with designing a house to higher standards will not adversely affect demand for their homes.

Of course, developers' interests and perspective will be affected by how much buyers value construction measures that reduce the vulnerability of structures to natural perils.

³⁰ Palm, R. (1981), *Real Estate Agents and Special Studies Zones Disclosure*. Boulder: Institute of Behavioral Science, University of Colorado.

³¹ Meaner, M. (ed.) (2006), *Pennypack Watershed Study*. Temple University, Center for Sustainable Communities, Ambler, PA, August.

³² U.S. Government Accountability Office (2002), "Flood Insurance: Extent of Noncompliance with Purchase Requirements is Unknown," GAO-02-396 Washington, DC, June 21, 2002.

Homeowners in Hazard-Prone Areas

People relocating to disaster-prone areas may be unaware of or underestimate the hazards that they face, and hence do not focus on the importance of having a well-designed home that protects them against hurricanes, floods and earthquakes. Prior to a disaster, many individuals perceive its likelihood as sufficiently low that they believe, "It will not happen to me." As a result, they do not feel the need to voluntarily invest in protective measures, such as strengthening their houses or buying insurance. It is only after the disaster occurs that these same individuals claim they would like to have undertaken protective measures (Kunreuther, 2006).³³ To illustrate, the Department of Housing and Urban Development (HUD) reported that 41 percent of damaged homes from the 2005 hurricanes were uninsured or underinsured. Of 60,196 owner-occupied homes with severe wind damage, 23,000 (38 percent) did not have insurance against wind loss.³⁴

Banks and Financial Institutions

Banks and other financial institutions enable individuals in the United States to purchase a home or business by providing mortgages, so that the buyer has to use only a limited amount of his or her own capital. The property is the collateral in the event that the owner defaults on the mortgage. Lenders play a role in managing catastrophic risks by requiring insurance as a condition for a mortgage to protect their investment should the structure be destroyed by a catastrophe and the homeowner decides to walk away from the property. In principle, lenders should be interested in insurance against catastrophic property damage regardless of cause. Lenders can also influence buying decisions with loan covenants or by varying interest rates – actions that could be used to encourage investments in cost-effective mitigation measures. Federal laws and regulations also are intended to compel or encourage lenders and their agents to require adequate property insurance coverage against all natural perils, except earthquakes or earth movement.

State Governments

State governments play a critical role in establishing building codes and assuring these standards are effectively implemented. Building codes are often characterized as "poorly enforced" in hazard-prone areas. Insurance experts, according to the Insurance Information Institute, have indicated that 25 percent of the insured losses from Hurricane Andrew in 1992 could have been prevented through better building code compliance and enforcement (Insurance Research Council and Insurance Institute of Property Loss Reduction, 1995).³⁵ Many communities have inadequate staffing and training to enforce these codes effectively. In Dade County, the area struck by Hurricane Andrew, there were, at the time, only 60 building inspectors. These 60 inspectors were required to conduct multiple inspections on an average of 20,000 new buildings each year. This translates into an average of 35 inspections per day for each inspector, a near-impossible task when driving time, report writing and other administrative tasks are taken into account.

³³ Kunreuther, H. (2006), "Disaster Mitigation and Insurance: Learning from Katrina," *The Annals of the American Academy of Political and Social Science*, 604: 208-227.

³⁴ U.S. Government Accountability Office (2007), *Natural Disasters: Public Policy Options for Changing the Federal Role in Natural Catastrophe Insurance*, Washington, DC: GAO, November. p. 25.

³⁵ Insurance Research Council and Insurance Institute of Property Loss Reduction (1995), *Coastal Exposure and Community Protection: Hurricane Andrew's Legacy*. Wheaton, III: IRC, and Boston: IIPLR.

Local governments also control land use and can forbid new construction in areas that might be seen as too highly exposed to specific natural hazards. In reality, however, land use regulation often suffered pressure for new construction to sustain economic growth. For instance, after Hurricane Camille destroyed the Richelieu Apartment complex in Pass Christian, Mississippi in 1969, a shopping center was built in the same location, housing a Winn Dixie and a Rite-Aid, among other retail businesses. Although the shopping center was leveled again by Hurricane Katrina, real estate developers already have plans to rebuild on the site, most likely a condominium development this time (Wharton Risk Center, 2005).³⁶

In the United States, insurance is regulated at the state level with the principal authority residing with insurance commissioners. Primary insurers are subject to solvency regulation and rate and policy form regulation. *Solvency regulation* addresses the question as to whether the insurer or reinsurer is sufficiently capitalized to fulfill its obligations if a significant event occurs which inflicts major losses on its policyholders. *Rate and policy form regulation* refers to the price and terms of the insurance contract. Unlike insurers, reinsurers licensed in the United States are subject only to solvency regulation. Foreign reinsurers are also not price-regulated and are subject to differing degrees of solvency regulation, depending upon the state in which they are domiciled (see discussion in Chapter 7 on reinsurance pricing).

Insurance commissioners often regard solvency as a principal objective even if it means requiring higher premiums or other insurer adjustments (e.g., reducing their catastrophe exposures). On the other hand, insurance regulators face political pressure to keep insurance premiums “affordable” and coverage readily available. In balancing solvency and consumer protection goals, insurance regulators are required by state law to ensure that rates are adequate but not excessive and not unfairly discriminatory. Regulators’ assessment of insurers’ rates and other practices involves some degree of subjectivity which can result in rate restrictions that reduce the supply of insurance or cause other market problems and distortions. “Parameter uncertainty” and different opinions on the level of risk of loss can lead to disagreements between insurers and regulators over what constitutes adequate rates and appropriate underwriting practices.³⁷

State legislatures, governors and the courts also play a significant role in the regulation of insurers and insurance markets. Consequently, insurance regulators are subject to a number of constraints on their authority and discretion, and the other branches of state government may impose their preferences on how state laws, regulations and policies govern insurers and insurance markets. Ultimately, all elected officials and their appointees are subject to the will of the voters – if government officials act contrary to the preferences of voters, they could be replaced by officials who will obey the voters, even if their actions are economically unsound.

State governments also have created and operated catastrophe insurance programs following large-scale disasters to supplement private insurance and reinsurance. Following the Northridge earthquake of January 1994, many insurers in California stopped selling new homeowners’ policies. This led to the formation of the California Earthquake Authority (CEA) in

³⁶ Wharton Risk Center (2005), “Lessons from Katrina: Déjà vu All Over Again,” *Risk Management Review*, Fall 2005.

³⁷ See Klein, R.W. (1995), “Insurance Regulation in Transition,” *Journal of Risk and Insurance*, 62: 263-404; Grace, M.F., R.W. Klein and Z. Liu (2005), “Increased Hurricane Risk and Insurance Market Responses,” *Journal of Insurance Regulation*, 24: 2-32; and Klein, R.W. (2007), “Catastrophe Risk and the Regulation of Property Insurance: A Comparative Analysis of Five States,” Working Paper, Georgia State University, December, for a more detailed discussion of insurance regulatory policies in general and specific to natural disaster risk.

1996, which limited the losses that insurers can suffer from a future earthquake (Roth, Jr., 1998).³⁸ Florida created the Citizens Property Insurance Corporation replacing its prior wind pool. Louisiana formed the Louisiana Citizens Property Insurance Corporation. Florida and Louisiana are the only two states to have implemented these "new" residual market structures in which a state sponsored corporation acts as a stand-alone insurance company.

Many states continue to maintain traditional wind pool or beach plan structures (also known as joint underwriting associations). Most Gulf and eastern seaboard states have such plans, but each plan has its own variations. Many of these plans do not have the claims-paying capacity to cover obligations in the event of a major hurricane. Some states, including North Carolina and several New England states, are struggling to pay administrative and overhead costs, even though they have not experienced a major catastrophic event in recent years. If a major hurricane struck one of these states, the state underwriting association would be forced to levy assessments against insurers, which would in turn pass this *ex post* assessment to all their policyholders.

Florida also has two state facilities that exert great influence over the insurance market. Following Hurricane Andrew in 1992, the Florida government formed the Florida Hurricane Catastrophe Fund (FHCF) that reimburses a portion of insurers' losses following major hurricanes (Lecomte and Gahagan, 1998).³⁹ The FHCF is a state-run facility that provides reinsurance for personal and commercial residential properties. All insurers are required to participate in the FHCF. We discuss the FHCF and the Citizens Property Insurance Corporation in more detail in Chapters 3 and 13. The state also has the Florida Insurance Guaranty Association (FIGA) that pays the claims of insolvent insurers. For example, FIGA is currently financing the insolvency of the Poe Financial Group which failed in 2005 as a result of hurricane losses.

Federal Government

The U.S. federal government has not been directly involved in providing insurance against natural disasters, with the exception of flood damage, which is provided through the National Flood Insurance Program (NFIP) established in 1968 and operated by the Federal Emergency Management Agency (FEMA). The NFIP experienced a major financial crisis following the storm surge and flooding from Hurricane Katrina, and had to borrow over \$20 billion from the U.S. Treasury. Chapter 3 discusses the challenges associated with distinguishing losses due to wind (covered by the private sector) and those due to water damage (mostly covered by the NFIP); Chapter 4 discusses the flood insurance program in more detail.

The federal government also plays a key role in the aftermath of natural disasters by providing federal relief to non-insured and underinsured (residents and small business), cities and local governments through low-interest loans, grants and tax benefits. Many have turned to the Small Business Administration (SBA) for low-interest loans to repair their damaged property. Homeowners and renters can borrow up to \$40,000 for repairing household and personal effects, and up to \$200,000 to repair or replace a primary residence. The interest rates on SBA disaster

³⁸ Roth, R.J. Jr. (1998), "Earthquake Insurance Protection in California," in H. Kunreuther and R. Roth, Sr., (eds.), *Paying the Price: The Status and Role of Insurance Against Natural Disasters in the United States*, Washington, DC: Joseph Henry Press: pp. 67-95.

³⁹ Lecomte, E. and K. Gahagan (1998), "Hurricane Insurance Protection in Florida," in Kunreuther, H. and R. Roth, Sr. (eds.), *Paying the Price: The Status and Role of Insurance Against Natural Disasters in the United States*, Washington, DC: Joseph Henry Press: pp. 97-124.

loans cannot exceed 4 percent for those who are unable to obtain credit elsewhere, or 8 percent for those who can get other credit. As of January 31, 2007, SBA approved over \$5 billion in disaster loans for homeowners and renters after the 2005 hurricanes, at an interest subsidy cost of almost \$800 million to the federal government.⁴⁰ 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 who suffered losses to property will have to make payments and, if they cannot do so, will have to find other sources of assistance for housing or losses to wealth.

Under the current system of disaster assistance, the governor of the state(s) can request that the President declare a “major disaster” and offer special assistance if the damage is severe enough. Although the President does not determine the amount of aid (the House and Senate do), the President is responsible for a crucial step in the process. This raises questions as to what are the key drivers of such a decision, and whether some states are more likely to benefit from such declarations than others, and when.

Additionally, federal tax policy governing the deduction of uninsured catastrophe losses suffered by individuals and households, and insurers’ reserves for catastrophe losses, affect the risk mitigation incentives of property owners and insurers’ ability to finance catastrophe losses. Quite surprisingly, current tax policy with respect to uninsured disaster losses has received little attention to date, as it creates disincentives for efficient disaster risk management. This issue is discussed in Chapter 12.

Attention must also be given towards consideration of a federal reinsurance program covering natural catastrophes. A Congressional initiative, the Brown-Waite Buchanan Homeowners’ Insurance Protection Act was introduced in January 2007 to the House of Representatives and referred to the House Committee on Financial Services. This bill creates a federal funding facility that sits on top of state residual market and state catastrophe funds to finance residential losses that exceed the “claims-paying capacity” of the state funds.⁴¹ The bill passed the House at the end of 2007, and is now pending in the U.S. Senate.

Insurers

Insurers provide financial protection to those facing the risks of potentially large losses from catastrophic events (e.g., earthquake, hurricanes, terrorist attack) by charging a relatively small fee (“premium”) to those who seek such protection, and agreeing to pay all or a portion of the financial losses incurred from the covered events (as specified in the insurance contract signed by the insurer and its insured). Insurers who write policies for a large number of properties in a single geographic area face the possibility of large losses from a single event. Due to the potential impact of such losses on their surplus, insurers need to limit the amount of coverage they provide to property owners and employers in these hazard-prone areas in order to keep the chances of severe losses at an acceptable level. Insurers are more willing to provide coverage when they can estimate the likelihood of the events against which they are offering protection and the extent of losses they will incur.⁴²

⁴⁰ U.S. Government Accountability Office (GAO) (2007), *Natural Disasters: Public Policy Options for Changing the Federal Role in Natural Catastrophe Insurance*, Washington, DC: GAO, November. p. 16.

⁴¹ U.S. House of Representatives (2007), “A Bill: Homeowner’s Insurance Protection Act,” H.R. 91, 110th Congress, 1st session, Washington, DC: January 4.

⁴² See Grace, M.F., R.W. Klein and Z. Liu (2006), “Mother Nature on the Rampage: Implications for Insurance Markets” Presented at the National Bureau of Economic Research, February 2006; and Grace, M.F. and R.W. Klein

The amount of coverage that insurance companies are willing to write depends on the firm's capital management, regulatory approvals of rates, availability and price of risk transfer instruments and the insurer's appetite for risk. Some insurers will retain a large amount of the risk while others will protect themselves against catastrophe losses through reinsurance, catastrophe bonds and other risk transfer instruments.

Reinsurers

The amount of coverage an insurer is willing to provide against risks in different hazard-prone areas partly depends on how much of its exposure it can transfer to reinsurers and at what cost. Reinsurers provide protection to private insurers in much the same way that insurers provide coverage to their policyholders. They charge a premium to indemnify an insurance company against a layer of catastrophic losses which the insurer would otherwise be responsible for covering. Reinsurers are also concerned with their concentration of risk, and manage their exposure in catastrophe-prone areas to keep the chances of severe losses at an acceptable level. Large reinsurers who operate worldwide can diversify their risk geographically and per line of coverage much more easily than most insurers can. Still, reinsurers as well as insurers must cover the cost of capital committed to catastrophe risk and this cost increases with the level of risk and the demand for capital.

Reinsurers typically play a key role in sharing a significant portion of the insured losses with the insurers. For example, reinsurers shared about 50 percent of insured losses due to Hurricane Katrina. As a result of the 2004 and 2005 hurricane seasons, the price of catastrophe reinsurance in the U.S. significantly increased in 2006 and capacity was scarce. After a non-hurricane season in 2006, prices started to soften during 2007 and again at January 2008's renewals and there are indications that considerably more capacity is available now to cover cat risks than during 2006.

Brokers

Brokers link those demanding financial protection with those who supply coverage. The broker can facilitate transactions between firms who would like to buy insurance and those who are willing to offer policies. Similarly, the broker can bring together insurers who want coverage against catastrophic events and reinsurers who are in the business of providing this protection. For medium to large businesses, the broker normally represents the insurance buyer. Brokers also play an important role in advising clients on risk and crisis management strategies.

Capital Markets

Capital markets have emerged in the 1990s to complement reinsurance in covering large losses from natural disasters through new financial instruments, such as industry loss warranties, catastrophe bonds and, more recently, sidecar reinsurers (see Chapter 8 for more details).

Several forces combined to make these new instruments attractive. The shortage of reinsurance following Hurricane Andrew in 1992 and the Northridge earthquake in 1994 led to higher reinsurance prices and made it feasible for insurers to offer catastrophe bonds with high enough interest rates to attract capital from investors. In addition, the prospect of an investment that is uncorrelated with the stock market or general economic conditions is also attractive to

(2006), "After the Storms: Property Insurance Markets in Florida, Center for Risk Management and Insurance," Working Paper, Georgia State University, for a more detailed discussion of insurers' considerations and actions in dealing with correlated loss exposures and catastrophic risk.

capital market investors. Finally, catastrophe models emerged as a tool to more rigorously estimate loss probabilities, so that disaster risk could be more accurately quantified and priced than in the past.

Following Hurricane Katrina, there has been a significant increase in the number and volume of catastrophe bond issuances and the creation of sidecars, but the total volume of financial protection remains somewhat limited compared to what is currently provided by traditional reinsurance. Hence, there is a need to assess the constraints on the availability and volume of securities that diversify catastrophe risk and how the use of these vehicles could be expanded to augment reinsurance capacity.

Modeling Firms

Many insurers and reinsurers have turned to firms that specialize in the business of modeling catastrophic risks to assist them in determining how much coverage to offer for losses from natural disasters and other extreme events, and what premiums to charge. Over the past ten years, these companies, such as Risk Management Solutions (RMS), AIR Worldwide, and EQECat, have become important players in the field of catastrophe insurance and reinsurance. These firms were subject to some criticism for failing to increase their risk assessment in advance of the 2004-2005 storm seasons. It should be noted that catastrophe modeling and risk assessment faces a number of informational challenges as well as market and regulatory acceptance. For instance, the Florida Commission on Hurricane Loss Projection Methodology refused to certify RMS's medium-term view of hurricane activity filed in 2006 that reflected the recent increase in hurricane frequency and intensity being experienced in the Atlantic basin. RMS had to modify its model, so its estimates of hurricane activity rates for the next five years are now based on a straight historical average of the number of hurricanes recorded since 1900, rather than a forward-looking estimate (RMS, 2007).⁴³

Ultimately, it may have been necessary to experience the recent increased hurricane activity for modeling firms to adjust their models. Due to parameter uncertainty, it is always difficult to know whether a given model has accurately estimated the true underlying risk of loss and associated probability distributions.

Rating Agencies

Rating agencies, such as A.M. Best, Standard & Poor's, Moody's, and Fitch, provide independent evaluations of insurers' and reinsurers' financial stability and their ability to meet their obligations to policyholders. The rating assigned to an insurer or reinsurer has significant consequences on the premiums it can set and its ability to raise capital. For example, many large publicly-traded companies are required to deal only with insurers that have a rating above a certain minimum level. Similarly, insurers are less willing to cede their risks to a poorly rated reinsurer. A low rating has an impact on the premium an insurer or reinsurer can charge or the amount of coverage it is able to sell. It is also likely to have a negative effect on the share price of publicly-traded firms. In the wake of the 2004 and 2005 hurricanes in the Gulf Coast, several major rating agencies have moved to adopt more stringent standards, which will effectively require some insurers to carry more capital just to maintain the same rating.

⁴³ RMS (2007), "Hurricane Model Re-Certified by Florida Commission," Press release, June 25.

Investors Providing Capital to Insurers and Reinsurers

The large increase in insured losses in the last ten years, the changes in the catastrophe risk models in 2006, and the more stringent requirements by rating agencies have important consequences for determining the insurability of hurricanes and other natural disasters. Moreover, recent catastrophes have revealed a much higher degree of volatility for any given portfolio than in the past. This will also have an impact on the cost of capital provided to insurers and reinsurers by investors. With higher volatility, investors will demand a higher return on equity. This requires insurers and reinsurers to restrict their coverage, charge higher premiums and/or improve their exposure management.

SUMMARY OF CHAPTER 1

This introductory chapter highlights the major changes that have occurred in recent years with respect to losses from natural disasters. Between 1970 and the mid-1980s, annual insured losses from natural disasters worldwide were in the \$3 to \$4 billion range. The four hurricanes in Florida in 2004 (Charley, Frances, Ivan and Jeanne) collectively totaled almost \$33 billion in insured losses, and Hurricane Katrina alone cost insurers and reinsurers an estimated \$46 billion (excluding flood claims paid by the National Flood Insurance Program).

A number of interested parties play a role in mitigating losses from natural disasters and providing funds for aiding victims during the recovery period. The chapter highlights the responsibilities and challenges facing the construction and real estate sectors, homeowners, small businesses, banks and financial institutions, state and local governments (including insurance commissioners), insurers, reinsurers, brokers, capital markets, modeling firms, rating agencies, and investors. In order to evaluate alternative strategies for providing insurance, reinsurance and mitigating disaster losses, it is important to understand the values and goals of these different interested parties, as well as the constraints under which they operate.

CHAPTER 2

CATASTROPHE RISK AND THE REGULATION OF PROPERTY INSURANCE: A COMPARATIVE ANALYSIS ACROSS STATES

KEY FINDINGS

Insurance market regulation varies significantly across states. Differences in market regulation across states constitute a challenge for the development of a coherent national strategy. Florida has significantly tightened its grip on insurers' rates and other market practices in response to heavy political pressure from coastal property owners and other interest groups. Regulatory responses in other coastal states have been less restrictive, but that could change depending on market developments and political pressure.

Underwriting regulation. Regulators may seek to impede or challenge insurers' decisions to non-renew policies and/or not write new policies. They can do this by requiring insurers to justify their decisions, as well as through other restrictions and mandates. Underwriting restrictions/mandates undermine insurers' efforts to manage their catastrophe exposures and can ultimately drive insurers out of a state as well as discourage entry by other insurers. Regulation of price, underwriting and policy terms are closely related. Regulation that goes beyond protecting consumers from truly unfair practices to artificially suppressing premiums and impeding other necessary market adjustments can ultimately worsen rather than improve market conditions for consumers if insurers reduce their supply of coverage.

A wind/water controversy emerged in the aftermath of Hurricane Katrina, creating further uncertainty related to the issues of insurer liability. Coverage for flood damage due to rising water is explicitly excluded in homeowners insurance policies, but coverage for these losses is available through the federal government's National Flood Insurance Program (NFIP). Nevertheless, lawsuits have been filed in Louisiana and Mississippi for damage alleged by insureds to have been caused by wind, and alleged by insurers to have been caused by water. Although insurers eventually won these cases, some companies have been reluctant to write new homeowners policies in these states, given the uncertainty of contract enforcement.

-over-

KEY FINDINGS, cont.

There has been significant growth in residual market mechanisms that provide coverage to property owners who are not able to obtain insurance from private insurers. Florida's property insurance residual market mechanism, the Citizens Property Insurance Corporation (Citizens), has experienced significant growth in recent years, with legislative changes in 2007 allowing Citizens to compete with private insurers. Citizens has now become the largest provider of wind coverage in Florida. It can pass virtually all its deficit to private insurers in the state through *ex post* assessments. The growth of Citizens, combined with the expansion of the Florida Hurricane Catastrophe Fund in 2007, are effectively socializing a large portion of the catastrophe risk in the state. Residual market mechanisms in other coastal states have also grown, but to a much lesser degree than in Florida. Texas has had a wind pool for many years and created a FAIR Plan in 2003. South Carolina has a wind pool but not a Fair Plan, and New York has a Fair Plan.

CHAPTER 2

CATASTROPHE RISK AND THE REGULATION OF PROPERTY INSURANCE: A COMPARATIVE ANALYSIS ACROSS STATES⁴⁴

2.1. Introduction

The regulation of insurance companies and insurance markets plays a prominent role in the management of catastrophe risk. Each state exercises considerable authority over insurers' entry and exit, financial condition, rates, products, underwriting, claims settlement and other activities. Regulatory constraints and mandates in these areas can have significant implications for how property insurance markets function and property owners' incentives to control their risk exposure. Although there are limits to regulators' power, there is virtually no aspect of insurance markets and insurance company activities that they cannot attempt to control or at least influence. At the same time, prudent regulators will seek to confine their intervention to areas where it is warranted and will aid the proper functioning of insurance markets. Ultimately, regulators cannot dictate market outcomes, but their policies can either support more efficient insurance markets or create significant market problems and distortions.

Regulators also do not function within a political vacuum. Regulators must work with the other branches of government, and most regulators who ignore political considerations will tend to have a short tenure in office. In the tense atmosphere currently surrounding property insurance in hurricane-prone areas, regulators and legislators are subject to strong pressures from different sides. Insurers have sought to raise their rates, adjust their exposures and modify policy terms to cover their costs and manage their catastrophe risk. On the other side, coastal property owners and other groups (e.g., developers and realtors) with vested interests are unhappy about higher insurance premiums and the tighter supply of coverage. Unfortunately, in Florida, the political pressure from these groups has influenced government officials to employ unwise policies that further undermine the private financing of catastrophe risk and shift this burden to *all* insurance policyholders as well as taxpayers in the state. In determining regulatory policies, government officials in some states seek a course which will neither destroy insurance markets nor devastate their political support – a path that may or may not prove to be attainable. Nonetheless, strong debate and differences of opinion exist (among insurers, politicians, and other stakeholders) about what regulatory policies should be. It is necessary to understand both economic theory and political-economic reality in evaluating regulatory policies and how they might be improved.

This chapter outlines important regulatory institutions and policies, examines the pros and cons of different regulatory policies, and assesses how regulators have responded to market developments and how they may act in the future. Given time and information constraints, it is not feasible to fully analyze all the relevant developments in this chapter, but hopefully it

⁴⁴ This chapter is based on Klein, R.W. (2007), "Catastrophe Risk and the Regulation of Property Insurance: A Comparative Analysis of Five States," Working Paper, Georgia State University, September.

establishes a framework that can be used to further evaluate regulatory policies. This chapter is intended to be a companion to Chapter 3, which examines developments (structure, conduct and performance) in property insurance markets affected by hurricane risk.

The next section reviews the government framework that overlays property insurance markets which includes, but is not limited to insurance regulation, *per se*. Sections 2.3 and 2.4 examine market and financial/solvency regulation in greater detail and how they affect property insurance markets subject to catastrophe risk. This examination focuses on four key states – Florida, New York, South Carolina, and Texas. All coastal states are facing increased market pressures, but these states were chosen for the study in order to contrast a range of market conditions and regulatory policies. Section 2.3 also reviews the wind versus water controversy and related litigation. Section 2.5 evaluates the administration of residual market facilities and other government insurance/reinsurance mechanisms in the selected states.

2.2. Overview of the Institutional Framework for Government Intervention

A number of government institutions and policies affect property insurance markets and the management of catastrophe risk. The regulation of insurers and insurance markets is a principal area of attention and the primary focus of this chapter, but it is important to note the significance of other elements of the governmental framework, such as the legal system and tax policy, among others. These different elements interact, and policies in one area can affect the objectives of other elements. Ideally, the full range of government institutions and policies should be coordinated to achieve the best possible outcomes in terms of the performance of insurance markets and efficient catastrophe risk management.

Legislative, Regulatory and Judicial Roles and Authorities

An extensive institutional structure has been developed to perform insurance regulatory functions in the United States. This institutional structure is primarily based within the insurance departments of each state and their respective laws and regulations, policies and procedures, and resources. In addition, the National Association of Insurance Commissioners (NAIC) serves as a vehicle for the individual state regulators to coordinate their activities and share resources to achieve mutual objectives. Further, state legislatures and state and federal courts play important roles in the overall regulatory structure. The federal government also has selectively intervened in certain aspects of insurance regulation.⁴⁵ This section reviews the roles and authorities of branches and levels of government that together determine how insurers and markets are regulated.

Each of the 50 states, the District of Columbia and the five U.S. territories has a chief government official responsible for regulating insurance companies and markets. This individual has the authority and responsibility to ensure that insurance companies do not incur excessive

⁴⁵ The McCarran-Ferguson Act (enacted in 1945) still serves as the principal federal statute that establishes the framework for state and federal roles in regulating insurance. The Act delegates most of the regulatory authority to the states but also retains the authority of the federal government to supersede state regulation where it specifically chooses to do so. Over the years, the federal government has imposed laws and policies in certain areas and could do so in the future. Legislation to create an optional federal regulatory charter for insurers has been introduced but has not been enacted. Other legislation has been introduced to establish a federal reinsurance program for natural catastrophes, and related bills and proposals have been introduced or discussed (see Chapter 14.)

financial risk, nor treat policyholders unfairly. More specifically, insurance commissioners oversee insurers’ admission and licensing, solvency and investments, reinsurance activity, transactions among affiliates, products, prices, underwriting, claims handling, and other market practices. Regulators also oversee producers’ licensing and their market practices, along with certain other areas related to insurance company and market functions. However, it should be understood that insurance commissioners’ authority is limited in some respects and that various other public and private institutions are part of the insurance regulatory system. Regulators operate within a broader governmental framework that influences and constrains their actions.

Most commissioners are appointed by the governor (or by a regulatory commission) for a set term or “at will,” subject to legislative confirmation. Ten states elect their insurance commissioners, who are more autonomous in the sense that they do not take orders from their governors (see Table 2.1).

TABLE 2.1. STATE RATE REGULATORY SYSTEMS FOR HOMEOWNERS INSURANCE

State	Rating system	Commissioner Selection	State	Rating system	Commissioner Selection
Alabama	Prior Approval	Appointed	Montana	File & Use	Elected
Alaska	Flex Rating	Appointed	Nebraska	File & Use	Appointed
Arizona	Use & File	Appointed	Nevada	Prior Approval	Appointed
Arkansas	File & Use	Appointed	New Hampshire	File & Use	Appointed
California	Prior Approval	Elected	New Jersey	Prior Approval	Appointed
Colorado	File & Use	Appointed	New Mexico	Prior Approval	Appointed
Connecticut	File & Use	Appointed	New York	File & Use	Appointed
Delaware	File & Use	Elected	North Carolina	Prior Approval	Elected
DC	File & Use	Appointed	North Dakota	Prior Approval	Elected
Florida	File & Use	Appointed*	Ohio	File & Use	Appointed
Georgia	File & Use	Elected	Oklahoma	Use & File	Elected
Hawaii	Prior Approval	Appointed	Oregon	File & Use	Appointed
Idaho	Use & File	Appointed	Pennsylvania	Prior Approval	Appointed
Illinois	Use & File	Appointed	Rhode Island	Flex Rating	Appointed
Indiana	File & Use	Appointed	South Carolina	Flex Rating	Appointed
Iowa	Use & File	Appointed	South Dakota	File & Use	Appointed
Kansas	File & Use	Elected	Tennessee	Prior Approval	Appointed
Kentucky	Flex Rating	Appointed	Texas	File & Use	Appointed
Louisiana	Flex Rating	Appointed	Utah	Use & File	Appointed
Maine	File & Use	Appointed	Vermont	Use & File	Appointed
Maryland	File & Use	Appointed	Virginia	File & Use	Appointed
Massachusetts	File & Use	Appointed	Washington	Prior Approval	Elected
Michigan	File & Use	Appointed	West Virginia	Prior Approval	Appointed
Minnesota	File & Use	Appointed	Wisconsin	Use & File	Appointed
Mississippi	Prior Approval	Elected	Wyoming	No File	Appointed
Missouri	Use & File	Appointed			

Source: NAIC, PCIAA

* The Florida insurance commissioner is appointed but the State Treasurer is elected. In the past, the State Treasurer has assumed a significant role in insurance regulation but that does not appear to be the case in recent years.

However, they must still cooperate with their administrations in order to achieve their objectives. Elected commissioners directly seek voters' political support, while appointed commissioners do this indirectly as part of their governors' administrations. Some empirical studies suggest that states with elected commissioners tend to constrain insurers' rates and other practices to a greater degree than states with appointed commissioners, but this effect appears to be small relative to the impact of other factors and is not necessarily the case for every state with an elected commissioner.

Commissioners can seek to exert considerable control over insurers' conduct through the admission and licensing process. Insurers who fail to comply with regulatory requirements are subject to losing their authorization to sell insurance through the suspension or revocation of their license or certificate of authority. Commissioners may exact fines for regulatory violations that serve as a further financial inducement for compliance. Commissioners also may intervene and seize companies that are deemed to be in hazardous financial condition. Other rules and regulatory actions can constrain or impose mandates on insurers' rates, products and market practices. However, insurers can challenge unreasonable regulatory actions in the courts and respond in other ways to lessen the negative effects of excessive regulatory constraints and mandates.

The measures available give regulators considerable leverage in attempting to force insurers to comply with insurance laws and regulations. Regulators may try to use this leverage to compel insurers to offer catastrophe coverage under more favorable terms to property owners. One way in which states may seek to exercise leverage to extract subsidies is by trying to require an insurer to withdraw from all lines in a state if they seek to withdraw from a particular line, such as homeowners insurance. However, insurers may raise legal challenges to such efforts. It also is not evident that an insurer has ever been forced to make such a withdrawal, but its threat may have had some effect on insurers. In addition, insurance commissioners can exercise public and political influence in their visible role as consumer protectors and insurance experts. The governor and legislature typically look to the insurance commissioner for guidance on key policy issues and legislation, but can choose to enact laws counter to regulators' preferences that they are compelled to enforce.

However, private insurers also have options. Ultimately, they can fully withdraw from a state if forced to take this action or find the regulatory environment intolerable. Also, an insurer exiting home insurance in a state may elect to exit other lines, because total withdrawal may be necessary from a business perspective – they may find it difficult to sell other insurance products to consumers if they are not willing to sell them home insurance. However, in considering withdrawal from a state, an insurer will balance various considerations, such as exit costs, their overall profitability in writing multiple lines of insurance, and their expectations regarding how and when regulatory policies may change for better or worse (Grace and Klein, 2007).⁴⁶ In private insurance markets where consumers can choose among multiple insurers, it is difficult for regulators to force significant cross-subsidies over a sustained period. Furthermore, insurers can respond to regulatory policies affecting one area, (e.g., rates), by making changes in other areas, (e.g., underwriting, quality of service, etc.).

⁴⁶ Grace, M.F. and R.W. Klein (2007), "Hurricane Risk and Property Insurance Markets," unpublished Working Paper, Georgia State University, December. This paper documents insurer withdrawals from Florida.

Hence, insurance commissioners are neither autonomous nor omnipotent and face a number of constraints in exercising their authority. Most importantly, regulators must act within the framework of insurance laws enacted by the legislature. Regulations promulgated by the commissioner are often subject to review and approval by the legislature. Regulatory actions are also subject to review and enforcement by the courts. Furthermore, legislatures can enact laws, and the courts can issue rulings that supersede the regulatory policies of insurance commissioners.⁴⁷ Hence, while regulators can exert considerable power and influence over insurers, producers and insurance markets, they are subject to various checks or overrides that can ultimately determine what regulatory policies will be, with or without the assent of insurance commissioners, and how those policies will affect market outcomes.

Overview of Insurance Regulatory Responsibilities

For the purpose of this chapter, insurance regulatory responsibilities are divided into two primary categories: (1) financial regulation; and (2) market regulation. These areas are discussed in greater detail below. In theory, financial regulation seeks to protect policyholders against the risk that insurers will not be able to meet their financial obligations because of financial distress or insolvency. Market regulation, in its idealized form, attempts to ensure fair and reasonable insurance prices, products and trade practices. Insurance producers (i.e., agents and brokers) also are subject to regulation. Financial and market regulation are inextricably related and must be coordinated to achieve their specific objectives. Regulation of rates and market practices affects insurers' financial performance, and financial regulation constrains the prices and products insurers can reasonably offer. The balancing of market and financial regulatory objectives is especially relevant to catastrophe risk – less stringent solvency requirements can increase the supply of insurance, but insurers “on the margin” can be exposed to greater default risk.

All U.S. insurers are licensed in at least one state and are subject to financial and market regulation in their state of domicile, in addition to other states in which they are licensed to sell insurance. Reinsurers domiciled in the U.S. also are subject to the financial regulation of their domiciliary state. The domiciliary state tends to take the lead in regulating the financial condition and risk of its domestic insurers, but other states in which an insurer operates can take actions which influence the regulation of the domiciliary state. This “second layer” of financial regulation, coordinated through the NAIC, has sometimes forced the hands of domiciliary regulators in taking actions more quickly than they would have if they were not subject to pressure from other states (Klein, 1995).⁴⁸ Of course, the regulation of single-state insurers is essentially immune from this second layer.

In markets that are not adequately served by licensed insurers, some U.S. insurers and non-U.S. insurers write certain specialty and high-risk coverages on a non-admitted or surplus lines basis. These types of coverage are not subject to price and product regulation, because it is presumed that buyers in the surplus lines markets are more sophisticated and, therefore, better able to protect their own interests. States can control the entry of surplus lines carriers by imposing minimum solvency and trust requirements and supervising surplus lines brokers.

⁴⁷ One example of this is the Florida legislature's enactment of a moratorium on policy terminations following Hurricane Andrew.

⁴⁸ Klein, R.W. (1995), “Insurance Regulation in Transition,” *Journal of Risk and Insurance*, 62: 263-404.

Some have proposed the use of non-admitted insurers to provide catastrophe insurance coverage for some properties that are rejected by the voluntary market. Such a proposal must be carefully considered. Surplus lines are not regulated by regulators in the states they operate. Their claims also are not covered by guaranty associations if they become insolvent. Hence, there are additional consumer risks in obtaining coverage from surplus lines insurers and this would be a greater concern for property owners with lower incomes and lower home values.

With the exception of financial oversight by their domiciliary jurisdiction, reinsurers are not generally subject to direct financial and market regulation. Reinsurers are, however, regulated indirectly through the states' regulation of the primary insurers that are ceding risk to reinsurers. Regulators control whether a ceding insurer can claim credit for reinsurance on its balance sheet, which is conditioned on whether the reinsurer is regulated in the U.S. or alternatively, posts collateral to back up its liabilities if it is a foreign reinsurer.⁴⁹ Stiffer rules on when insurers can obtain credit for reinsurance can affect their capacity to handle catastrophe risk and supply insurance.

2.3. Market Regulation

Market regulation encompasses a number of different aspects of insurers' activities, including but not limited to:

- rates
- policy forms/terms (e.g., deductibles, excluded perils, etc.)
- underwriting practices (ability to decline or restrict coverage)
- marketing and distribution
- claims adjustment

This chapter focuses on rates, underwriting, policy forms/terms, and claims adjustment, which are the most critical areas associated with catastrophe risk issues, but it should be noted that regulatory policies governing other areas can be important also.

Rate Regulation

Rate regulatory systems and policies differ considerably among the states. Some attempt to impose binding constraints on rates, while others rely on the market to determine rates. Hence, the degree of regulatory *stringency* – how much regulators seek to suppress overall rate levels or compress rate structures – varies greatly among states. In turn, rate regulatory policies and actions can have significant effects on insurance markets. Suppression of overall rate levels or compression of geographical rate structures can compel insurers to tighten

⁴⁹U.S. regulators are considering changes to this policy that would reduce collateral requirements for foreign reinsurers based on some system of grading the financial condition of the foreign reinsurer and/or the quality of its regulation. See Klein, R.W. and S. Wang, (2007) "Catastrophe Risk Financing in the United States and the European Union: A Comparison of Alternative Regulatory Approaches," presented at the "New Forms of Risk Sharing and Risk Engineering: A SCOR-JRI Conference on Insurance, Reinsurance, and Capital Market Transformations," Paris, September 20-21. Recently, both New York and Florida have proposed to revise the collateral requirements they impose on non-U.S. reinsurers.

the supply of insurance, which decreases the availability of coverage. Also, these policies can reduce insureds' incentives to optimally manage their risk from natural disasters. At the same time, economic and market forces can ultimately trump regulatory policies. Regulators cannot ultimately "force" market outcomes that are at odds with economic realities, (e.g., low rates and widely available coverage in the face of very high risk), without government replacing private insurers as the principal source of insurance coverage.

Types of Rate Regulatory Systems. One aspect of rate regulation is the type of rate regulatory system that state law establishes for particular lines of insurance. There are various types of systems which can be divided into two basic categories: (1) non-competitive rating (NCR) systems; and (2) competitive rating (CR) systems. In non-competitive rating systems, regulators can more easily seek to constrain rates below levels that insurers would otherwise charge, but may choose not to do so. In competitive rating systems, in theory, regulators essentially rely on the market to set rates and do not attempt to constrain rates.

Table 2.1 shows the type of rating system in each state for homeowners insurance. Five types of rating systems are reflected in the table. Under a *prior approval* system, insurers must file and receive approval of their rates from regulators before they can be put into effect. Under a *flex rating* system, rate changes that fit within certain bounds (e.g., a 10 percent change) are typically subject to a file and use or use and file requirement; rate changes that exceed the bounds are subject to prior approval. Prior approval systems are generally placed into the NCR category. Flex rating systems fall into a gray area and their categorization can be a matter of choice that could depend on the tightness of their bounds and how they are implemented.

The other three systems are generally placed into the CR category. Under *file and use* systems, insurers are required to file their rates before they put them into effect, but are not required to get approval of their rates before they become effective. Under a *use and file* system, insurers can put rates into effect and then file them with regulators at the same time or within a certain designated time frame. Under both systems, regulators can retroactively disapprove rates that have become effective, which necessarily requires an insurer to refund all or a portion of rate increases that they have implemented. Generally, under a file and use system, a regulator can tell an insurer that its rates will be disapproved before they become effective, which can preclude the need for refunds. Many states that have file and use or use and file systems have statutes that require regulators to issue a finding that the market is not competitive in order to disapprove insurers' rates but, as discussed below, regulators can administer these systems to constrain insurers' rates in a manner that effectively replicates a prior approval approach. One state – Wyoming – does not require insurers to file their rates with regulators, and is labeled *no file*.

While the types of rating systems are typically placed into one of the two basic categories, one cannot infer how a state actually regulates rates by simply looking at its rating law. Some NCR states may seek to suppress rates below competitive levels and other NCR states may effectively let the market set rates by approving the rates that insurers file. Furthermore, some so-called CR states may employ devices and policies that effectively attempt to constrain rates below what the market would set.

Rate Regulatory Stringency. The degree of rate regulatory stringency can vary among states and cannot be determined solely by their rating laws. Stringency is defined as the degree to which regulators attempt to suppress insurers' prices below competitive levels, or the prices insurers would charge in the absence of regulatory constraints – the greater the relative difference between the rates that insurers seek to charge and what regulators allow, the more stringent we define the regulation to be.⁵⁰ Hence, a state that allows insurers to charge only 50 percent of the rate levels or increases they would otherwise implement would be considered more stringent than a state that allows insurers to charge 90 percent of what the insurers chose to charge.

We also use the terms *rate suppression* and *rate compression* with somewhat different meanings. *Suppression* refers to regulators' attempts to constrain overall rate levels for all classes of insureds. *Compression* refers to the attempts to constrain rate differentials between different risk classes (e.g., high-risk and low-risk territories for home insurance). Rate compression often results in rate suppression, as regulators will typically lower the allowed rating factors for the highest-risk classes while requiring no changes in the underlying base rate or rating factors for the low-risk classes.⁵¹ This ultimately lowers the overall rate level that an insurer can implement.⁵²

A number of factors affect regulatory stringency, including but not limited to:

- The degree to which rate regulation is vulnerable to political manipulation. NCR systems tend to be more vulnerable to manipulation, although CR systems are not immune from political interference.
- The underlying risk of loss. Higher risks and costs tend to put more pressure on regulators to constrain rates in response to political pressures.
- “Philosophies” concerning regulation and the need to constrain insurers. Some states exhibit prevailing philosophies that call for stricter regulation, while others may be more willing to allow market forces to determine prices.
- Economic leverage. The negative consequences of exiting a large market state such as Florida are greater for an insurer than they are for exiting a smaller market state such as Louisiana. Hence, regulators in large states may seek to extract greater concessions from insurers than regulators in small states.
- Regulator selection. There is some evidence that elected regulators are more likely to engage in rate suppression and compression, but studies suggest that this has only a small effect.
- Legislation. Legislatures enact the laws and often approve regulatory rules and hence can substantially influence regulatory policies.

⁵⁰ Researchers have sought to measure regulatory stringency and its effects in different ways. This research suggests that greater stringency may have some effect on the net price of insurance, at least in the short term, or other effects which tend to have negative impacts on consumers.

⁵¹ In theory, insurers might seek to charge higher rates to low-risk insureds to partially or completely offset the effect of constraints on rates for high-risk insureds. However, it would neither be practical nor justified for insurers to set prices for low-risk insureds above actuarially-fair levels.

⁵² Technically, the change in an insurer's overall rate level is calculated as the exposure-weighted average of the changes in the rates for each rate classification.

It is difficult to develop objective empirical measures of regulatory stringency and obtain the data needed to calculate such measures. We have employed various proxies for regulatory stringency, as have others with some success, but the quest continues.⁵³ This chapter presents a more anecdotal discussion of rate regulatory policies.

Rate Regulation in Florida. After Hurricane Andrew, Florida regulators resisted large rate increases and allowed insurers only to gradually raise rates over the decade.⁵⁴ Initially, this policy exacerbated supply availability problems because insurers were concerned about substantial rate inadequacy (Grace, Klein and Kleindorfer, 2004).⁵⁵ Over time, as insurers were allowed to further increase rates, these concerns eased, although it appears that insurers believed that there was still some compression of rates in the highest-risk areas. By the beginning of 2004, most insurers probably viewed their rates as being close to adequate except in the highest-risk areas, and there was not substantial pressure to further increase rates. This began to change after the fourth major hurricane hit the U.S. in 2004.

By 2006, many insurers began to file their first major wave of rate increases in Florida. The magnitude of the rate increases filed varied among areas within the state based on insurers' estimates of the inadequacy of their existing rate structures. High-risk coastal areas received larger percentage increases than low-risk areas. It appears that the initial wave of rate increases were largely approved or allowed to go into effect by regulators. However, as some insurers filed a second wave of rate increases in the latter part of 2006, they began to encounter regulatory resistance.

The disposition of rate filings submitted by State Farm in Florida through 2006 is summarized in Table 2.2. The overall rate level changes filed by State Farm from 1997-2006 ranged from 2.3 percent to 52.7 percent. Two of the filings were challenged by regulators, but State Farm subsequently received its requested rate changes (with certain conditions attached) in arbitration. The largest increase filed – 52.7 percent – was approved by regulators and became effective as of August 15, 2006. We should also note that in several instances, State Farm filed for smaller increases than what was indicated by its actuarial analysis. This can happen for several reasons, including an insurer's desire to soften the impact on consumers and its expectations with respect to what regulators are more likely to approve.

State Farm's rate structure or rate relativities have also been subject to constraints, which we label as *rate compression*. From 2002, its filed rate increases were subject to an individual policy premium cap, typically 42.5 percent. In its filing effective August 15, 2006, the

⁵³ For example, one proxy used is the difference between the rate levels that insurers have filed versus the rate levels that regulators have approved. Another proxy has been survey-based insurer ratings of the regulatory environment in various states. Both measures are imperfect, but some studies have revealed fairly robust results when different stringency measures are tested. See Klein, R.W., R.D. Phillips, and W. Shiu (2002), "The Capital Structure of Firms Subject to Price Regulation: Evidence from the Insurance Industry," *Journal of Financial Services Research*, 21: 79-100.

⁵⁴ This might be labeled as the "sticker-shock" effect. In normal markets, rate increases less than 10 percent tend not to encounter significant resistance. In markets hit by a major hurricane, consumer and regulatory tolerance may even be somewhat greater. However, there is a limit to this tolerance even in markets that are subject to high hurricane risk.

⁵⁵ Grace, M.F., R.W. Klein and P.R. Kleindorfer (2004), "The Demand for Homeowners Insurance with Bundled Catastrophe Coverages," *Journal of Risk and Insurance*, 71: 351-379.

Florida Office of Insurance Regulation (FLOIR) agreed to remove the cap, in exchange for limiting the maximum average base premium increase for any given territory to 165 percent.

More recently in the latter half of 2006 and into 2007, further insurer rate hikes have been challenged and disapproved or reduced by Florida regulators. For example, in the latter half of 2006, rate filings by Allstate, Nationwide and USAA were challenged by regulators. The Allstate Group filed a 24.2 percent increase for Allstate Floridian and a 31.6 percent increase for Allstate Floridian Indemnity. The approved increases were ultimately reduced to 8.2 percent for Allstate Floridian and 8.8 percent for Allstate Floridian Indemnity.⁵⁶ Nationwide filed for a 71.5 percent rate level increase that was disapproved, and it appealed the disapproval to a Florida arbitration panel that ruled in favor of a 54 percent increase. USAA filed for a 40 percent increase but received only a 16.3 percent increase.

Most recently, the FLOIR has taken a position against any further rate increases. In November 2007, the FLOIR issued a notice of intent to disapprove filings for homeowners rate increases of 43.4 percent for Allstate Floridian, 27.4 percent for Allstate Floridian Indemnity, 39.7 percent for Encompass Floridian, and 41.6 percent for Encompass Floridian Indemnity (all members of the Allstate Group). It should be noted that these figures reflect the increases in the overall rate level for the state. We do not know how these filed rate increases varied across different areas of the state, but it is likely that the increases were greater for the higher-risk areas.

**TABLE 2.2. STATE FARM FLORIDA INSURANCE COMPANY
FLORIDA HOMEOWNERS RATE HISTORY: 1997-2006**

New Business Effective Date	Indicated	Filed For	Received
8/15/1997	42.6%	24.1%	24.1%*
1/1/2001	15.6%	7.0%	6.5%
11/1/2001	14.5%	14.3%	14.3%
5/15/2002	26.9%	22.3%	Disapproved**
11/15/2003	6.9%	6.9%	6.9%
9/15/2004	2.3%	2.3%	1.7%
2/15/2005	11.1%	5.0%	5%***
2/1/2006	8.6%	8.6%	8.6%
8/15/2006	52.7%	52.7%	52.7%

* Awarded at arbitration. Following consent order stipulated that State Farm file no other rate increases for at least two years.

**Full 22.3 percent awarded at arbitration subject to several conditions with a cap of 42.5 percent on individual rate increases through second year.

***FLOIR specifically requested that the company file for no more than a 5 percent increase.

⁵⁶ Earlier in 2006, Allstate Floridian received a rate increase of 16.3 percent, and Allstate Floridian Indemnity received a rate increase of 24.4 percent.

A combination of growing consumer displeasure over previous rate increases, as well as the lack of damaging hurricanes in 2006 and 2007 (see Chapter 1) probably began influencing regulators' resistance to additional rate hikes. The further hardening of regulatory policies was foretold in Florida's 2006 elections and was manifested in its early 2007 legislative session. Early in 2007, Florida enacted legislation which sought to increase regulatory control over rates and roll back rates based on changes in the Florida Hurricane Catastrophe Fund (FHCF). The new legislation expanded the reinsurance coverage provided by the FHCF, and insurers were required to reduce their rates to reflect this expansion of coverage which was priced below private reinsurance market rates. This requirement applies even if an insurer does not purchase reinsurance from the FHCF.

Rate Regulation in Other States. Disputes between insurers and regulators over rates have tended to be less significant in other coastal states than in Florida. This may be largely due to the fact that insurers have filed for smaller increases in these states, and previous rates have been lower than in Florida. However, one has to be careful in making overly broad statements about the regulatory environments in these other states as each has its own particular story. The experience of each of the four states we have selected for this study is discussed below.

Of the three other states, Texas may be the most prone to rate filing disputes between regulators and insurers. In May 2006, State Farm filed for an overall rate level increase of 11 percent (23 percent in Dallas County) which was disapproved by regulators. In the latter part of 2006, the state's windstorm pool requested a 20 percent rate increase but regulators reduced it to 4.1 percent. In the summer of 2007, Allstate filed a 5.9 percent rate increase and Farmers filed a 6.6 percent rate increase. The insurance department indicated that it would not approve either rate increase. Farmers chose to withdraw its rate filing, while Allstate has indicated that it will implement its rate increase under the state's file and use rating system.

In reflecting on the situation in Texas, several factors are likely influencing regulatory policies. First, in the early 2000s, many insurers filed for significant rate increases because of concerns about mold claims and the increase in weather-related risks. Second, like Florida, Texas has a large insurance market and, hence, is in a position to try to exercise greater leverage in controlling insurers' prices. Third, Texas has had a long legacy of taking a fairly tough position on insurers' rates and other actions.

In South Carolina and New York, we have not been able to find any reports on insurers' rate filings and their disposition, which suggests that there have not been significant disputes between insurers and regulators on any rate increases that have been filed. A January 2007 report by the South Carolina Department of Insurance noted that the largest approved overall rate level increase in 2006 was 12.4 percent, with increases for coastal areas ranging from 50 to 65 percent (SCDOI, 2007).⁵⁷ Insurers and regulators may not be in exact agreement on rates in these states, but the lower level of risk and market pressure would be expected to narrow the disparity between the rates that are filed and the rates that are approved.

⁵⁷ South Carolina Department of Insurance, (2007), *Coastal Property Insurance Issues in South Carolina*, January.

Comments on Rate Regulatory Policies. In summary, Florida has exhibited the greatest degree of regulatory stringency toward property insurance rates, but its behavior is consistent with its economic and political situation. Rates in coastal areas of Florida were already high, and consumer and voter tolerance in these areas has been strained by the most recent waves of rate increases. Property insurance rate regulation has tended to be more moderate in other states subject to hurricane risk, even after the 2004-2005 storm seasons. Risk and cost pressures have been lower in these states which decreases the tension between insurers' rate needs and what regulators are willing to approve. Finally, regulators in states with smaller markets have been able to exercise less leverage in seeking to extract rate concessions from insurers.

Rate regulation in coastal states still remains fluid as this report is being written. The fact that the U.S. avoided damaging hurricanes in 2006 and 2007 could help to further stabilize state markets and reduce insurer-regulatory disputes on rates. Although regulators appear to be more permissive in states other than Florida, there also may be limits to their tolerance of higher rates.

Issues concerning the pricing of property insurance in coastal areas and its regulation are likely to continue. Insurers argue that the rate increases are necessary, while consumer advocates argue that the rate increases are excessive and should be restricted by regulators. Advocates of binding regulatory constraints on insurers' rates might offer at least a couple of arguments to support their point of view. One argument might be that insurers are "overreacting" to recent losses and have overestimated the increase in hurricane risk. A second argument might be that the lack of regulatory constraints allows too much volatility in insurers' pricing and that regulators need to dampen this volatility.

Some initial responses to these arguments are warranted. It is true that appropriate risk estimates and rate levels/structures are subject to some subjectivity and different opinions. Most experts would probably agree that risk modelers' and insurers' risk estimates are imperfect due to parameter uncertainty. However, insurers voluntarily commit their capital to underwriting property exposures in high-risk areas and their ability to charge what they believe to be adequate rates affects their willingness to continue to commit capital to such a risky venture. Insurers could be right or wrong and their rates may swing depending on their perceptions and risk appetite, but this is inevitable in the face of catastrophe risks characterized by great uncertainty if reliance on private insurance/reinsurance is to continue.⁵⁸

Although it may take some time, market forces and competition should ultimately establish a new equilibrium in terms of prices and the supply of insurance (assuming there is not a further escalation of hurricane risk) if legislators and regulators can loosen the reins on the market. However, pragmatists understand that political-economic factors may not permit this to happen, especially in states subject to significant market pressures, such as Florida. When and where a new equilibrium would be established will also be affected by hurricane risk projections and storm activity over the next several years.

⁵⁸ Proponents of government catastrophe reinsurance might contend that such programs would help to lower and stabilize rates, but insurers' views on the need for such programs differ and this report does not attempt to resolve this debate.

Regulation of Underwriting and Insurance Policy Terms

Regulation of underwriting and insurance policies can have a significant impact on hurricane-prone insurance markets. The regulation of underwriting (e.g., the rules insurers use to select or reject applicants, insurer decisions to reduce the number of policies they renew or new policies they write, etc.) can be somewhat difficult to specify because of the complexity and opaqueness of this aspect of regulation. Some aspects of the regulation of policy terms, (e.g., the maximum wind/hurricane deductibles that insurers are allowed to offer), are more readily discernable, but other aspects may be obscured in the policy form approval process. The regulation of these two areas can be intertwined. For example, regulators may allow insurers to offer a high wind deductible, but may not allow them to mandate a high deductible as a condition for renewing an existing policy or writing a new one.

Regulation of Underwriting. The states have different ways to regulate insurers' ability to use their discretion in accepting new insurance applications or renewing existing policies. At a minimum, regulators may prohibit the use of certain underwriting criteria (e.g., the age of a home or its market value), but the regulation of underwriting can extend significantly beyond such minimum prohibitions. Regulators may constrain insurers' underwriting discretion by more broadly limiting the criteria they can use in underwriting, or interfering with insurers' attempts to reduce their portfolios of exposures to more manageable levels. While there has been some regulatory resistance to insurers' decisions to reduce their exposures, there is generally little that regulators can do to prevent such reductions in the long term.

Regulators may seek to impede or challenge insurers' decisions to non-renew policies and/or not write new policies by requiring them to justify their decisions. The only leverage that a state can employ is to attempt to force an insurer to exit all lines of insurance if it seeks to reduce its property insurance exposures, although an insurer can raise constitutional challenges to such a scenario. This can result in a situation that neither side desires to see taken to its ultimate limit, but each must be prepared to do so in order to exercise bargaining power. The game often involves rate regulation with insurers responding to rate filing disapprovals by tightening their underwriting criteria for providing coverage in high hazard-prone areas. Alternatively, regulators may approve a rate increase conditional on an insurers' agreement to continue to insure a prescribed number of high-risk homeowners.

For example, Florida recently questioned State Farm's announced decision to drop approximately 50,000 homeowners policies in high-risk coastal areas (of its total Florida homeowners book of business of approximately 1 million policies). Regulators issued subpoenas to State Farm officials requiring them to appear and discuss their plans at a hearing in November 2007. The scope of the FLOIR's review of State Farm's actions and plans was expanded to include its non-renewals, multi-line discounts, and withdrawal from the condominium business.⁵⁹ Subsequently, in negotiations with the FLOIR regarding rate adjustments, the FLOIR agreed to terminate its inquiry into the non-renewals and related issues, and the hearing was not held.

Another issue that has recently arisen is whether an insurer can require a homeowner to buy his or her auto insurance from the insurer as a condition for being able to buy homeowners insurance. There have been some media reports of insurers employing this requirement but it is not clear how widespread this is or whether this is something that regulators would allow. It is

⁵⁹ "Fla. Subpoenas State Farm Over Nonrenewal Plans," *National Underwriter*, August 7, 2007.

common for insurers to offer premium discounts to insureds who buy their auto and home insurance from the same company, but this is a different practice which states generally allow.

New York is one state that has recently barred insurers from non-renewing home insurance customers in coastal areas who are not willing to buy their auto and life insurance products as well. The New York action was prompted by complaints from consumers who received non-renewal notices from their insurers that cited this reason, among others, for the non-renewal. Several insurers indicated that they would stop the practice and renew the insureds that they had dropped. According to the New York Insurance Department, insurance tying requirements are prohibited by state law.⁶⁰

Another aspect of underwriting is insurers' movement of some of their exposures into "standard" or "non-standard," as well as single-state companies within their groups. One of the factors prompting this development is that "standard" and "non-standard" companies are allowed to have higher rate structures, and some insurers prefer to use this approach rather than expanding their rate structures within their main or "preferred" companies. Hence, it is a way in which an insurer can effectively raise rates for certain insureds without filing a rate increase that may be disapproved or reduced by regulators. This tactic would be prompted by regulatory constraints on an insurers' need to raise the rates of its preferred company. Regulators may seek to control this tactic by confining the criteria which insurers may use in accepting or declining insureds for coverage in their preferred or lowest-rate companies.

The movement to single-state companies by national insurer groups is motivated by the desire to make the financial performance attributable to a state more transparent and obvious, rather than mixing it with the financial results from other states. Also, if a single-state company were to become insolvent, the parent group could let the company go and not attempt to bail it out with funds from other companies within the group. While this has not occurred to date, some insurer groups may wish to retain this option if the losses of a single-state company were large enough to significantly affect the financial condition of the group, especially if regulators in the state had constrained the company's rates or engaged in other efforts to manage its exposures.

In its recent legislation, Florida has sought to restrain the use of single-state companies and the "segmentation" of Florida losses from insurers' experience in other states. The legislation prohibits the further establishment of single-state insurers by national groups and requires insurer to sell homeowners insurance in Florida if they sell it in other states. These actions could discourage new insurers from entering the state and existing insurers from remaining in the state.

Regulation of Policy Terms/Provisions. Another area in which regulators may constrain insurers' preferences is policy terms, such as wind or hurricane deductibles. Insurers are allowed to offer up to 10 percent wind or hurricane deductibles in Florida for homes with dwelling coverage limits between \$100,000-\$500,000.⁶¹ There is no limit on hurricane deductibles for homes with dwelling limits in excess of \$500,000. Maximum allowed wind/hurricane deductibles can range

⁶⁰ "N.Y. Stops Insurers From Tie-Ins for Coastal Customers," *National Underwriter*, August 27, 2007.

⁶¹ As an element of comparison, the federal National Flood Insurance Program which covers homeowners against flood has a maximum \$5,000 deductible, independent of the level of coverage (see our analysis of homeowners' choice of flood deductible in Section 4.3 of the report).

up to 25 percent in other coastal states. Higher deductibles allow insurers to better manage their catastrophic risk exposure/losses and also allow some homeowners to further lower their premiums by accepting higher deductibles.

Another issue is insureds' ability to have wind coverage excluded from their policy, or allowing insurers to *offer* wind/hurricane exclusions. Florida's 2007 legislation made this option more readily available to buyers of homeowners insurance. While insureds can obtain significant premium savings by opting for a wind exclusion, it does place them in a position of retaining any wind losses they might suffer. Presumably, lenders would not allow someone with a home mortgage to opt for a wind exclusion, but it would be an option for homeowners without a mortgage.

Other Areas of Market Regulation: The Wind/Water Controversy

Current insurance programs for residents in hazard-prone areas in the U.S. are segmented across catastrophe perils. Standard multi-peril homeowners and commercial insurance policies typically cover damage from fire, wind, hail, lightning, winter storms and volcanic eruption, among other common non-catastrophe perils. Coverage for flood damage due to rising water is explicitly excluded in homeowners insurance policies, but coverage for these losses is available through the National Flood Insurance Program (NFIP) (see Chapter 4 for more details on the NFIP). Despite the fact that the NFIP was created nearly 40 years ago, some homeowners contend that they were not aware of this exclusion.⁶²

Insurance disputes following hurricanes inevitably arise over the cause of damage. What portion of the loss is due to wind (covered by a standard homeowners policy) and what damage is caused by rising water from storm surges or flooding? Hurricane Katrina has brought the wind/water issue to the fore since there were a number of residents in the area who had homeowners insurance but not flood coverage, and their damage was at least partially caused by rising water, not wind. By law, lenders (and others associated with home mortgages) are compelled to require flood insurance for homes in designated (100-year) flood zones. However, compliance with this law may not be complete. Furthermore, homeowners who do not have conventional mortgages or have homes outside designated flood zones often do not purchase flood insurance.⁶³ In addition, even those who did have flood insurance and suffered large losses from the rising waters were able to cover only a portion of their losses with their claim payments, because the maximum coverage limit on the structure only (not including contents) of the NFIP is \$250,000 for residential buildings and these homeowners did not purchase excess flood coverage from private carriers (see Chapter 4).

Following Hurricane Katrina, many residents disputed their insurers' assertions that the damage to their homes was caused totally or partially by rising water, contending that it was due to winds from the hurricane. Some property owners also contended that they were not aware of the flood exclusion in their homeowners policy and that the exclusion was not sufficiently clear or enforceable. In fact, many lawsuits were filed in Gulf Coast states following Katrina and other hurricanes. Most of these requested that the courts overturn flood exclusions in their

⁶² There is an understanding between private insurers and the federal government that the NFIP should be the source of flood coverage up to the limits provided by the program. Private insurers then may sell excess flood coverage over the NFIP limits.

⁶³ There has been some criticism of the adequacy of federal flood mapping.

homeowners policies. In a ruling on an Allstate Insurance Company case in April 2006, Judge L.T. Senter, Jr. of the U.S. District Court for the Southern District of Mississippi ruled that “the inundation that occurred during Hurricane Katrina was a flood, as that term is ordinarily understood, whether that term appears in a flood insurance policy or in a homeowners insurance policy. The exclusions found in the policy for damages attributable to flooding are valid and enforceable policy provisions.”⁶⁴ This ruling was viewed as a setback to a class-action lawsuit filed by Mississippi’s Attorney General Jim Hood who claimed that homeowners policies should provide protection against water damage even though there are explicit clauses in the contract that excludes these losses.

State Farm also faced lawsuits in Mississippi, contending that they were responsible for covering flood losses from Hurricane Katrina for which they claimed they were not liable. Although State Farm eventually won its case, it was a costly process and led to their discontinuing selling new policies on homes and small business in the state.⁶⁵

In Louisiana, a group of thirty individuals and one corporation alleged that their real and personal property was damaged or destroyed by the inundation of water into the City of New Orleans that followed Hurricane Katrina. They brought a putative class action against thirteen insurance companies, asserting that their losses were covered by their respective insurance policies. The plaintiffs specifically alleged that “any damages attributable to the levee failures are the result of improper and/or negligent design, construction [or] maintenance of the levees by various third parties and or third party negligence,” and also alleged that “the damage caused by water entering the City of New Orleans...due to the breaches in the levees...neither falls within the subject insurance policies’ exclusions of ‘flood.’” Several other water damage exclusion cases involving levee breaches were consolidated into the *In re: Katrina Canal Breaches Consolidated Litigation* in the United States District Court for the Eastern District of Louisiana.

In November 2006, the United States District Court for the Eastern District of Louisiana, released an 85-page ruling by Judge Stanwood Duval in several consolidated cases in which plaintiffs argued that flood damage “arising out of all levee breaches which occurred in the aftermath of Hurricane Katrina” should be covered, since such flooding is not specifically excluded in the policies. In contrast to the previous case, the judge cited “ambiguous language in the water damage exclusions in some policies” and denied insurers’ attempts to have the lawsuits dismissed.⁶⁶ Indeed, the court held that the exclusion language in several of the policies was insufficiently clear with regard to damage caused by flooding which resulted from man-made causes. The case was in appeal for nine months; on August 2, 2007, the Fifth Circuit Court of Appeals overturned the lower district court’s decision in the *In re: Katrina Canal Breaches Litigation*. The Court of Appeals held the flood exclusions in the various policies were not ambiguous despite the fact they did not distinguish between flooding caused by an act of God and flooding caused by an act of man.⁶⁷

⁶⁴ United States District Court Southern District of Mississippi, Southern Division (2006), *Buente versus Allstate*, Civil action No. 1:05CV712 LTS-JMR L.T. Senter, Jr., Senior Judge, April 11, 2006.

⁶⁵ Treaster, J. (2007), “State Farm Ends New Property Coverage in Mississippi,” *New York Times*, February 15.

⁶⁶ *In Re Katrina Canal Breaches Consolidated Litigation*, No. 05-4182 (E.D. La. Nov. 27, 2006).

⁶⁷ Sources: Property Casualty Insurers Association of America (PCIAA); Lehman Brothers Equity Research; Insurance Information Institute.

Despite these rulings, litigation has not ended. Even with the federal court's affirmation of the validity of flood exclusions in insurers' policies, there are still disputes between insurers and claimants regarding the allocation of losses to the wind and flood perils. The uncertainty associated with the courts' *ex post* re-interpretation of insurance policy terms and language and the adjudication of claim disputes substantially increases insurers' risk. The rates charged for homeowners insurance policies did not account for the payment of flood losses because of the flood exclusion. This places insurers in a difficult position. Being forced to pay for unanticipated flood losses will result in adverse financial consequences. If they file for rate increases to reflect this increased risk, they may not be approved. If rate increases are approved, insureds who have purchased a flood insurance policy through the National Flood Insurance Program will be paying for redundant coverage.

2.4. Financial Regulation

Regulators also are responsible for regulating insurers' solvency and financial condition, including their level of catastrophe risk. Regulators are placed into a position of balancing solvency requirements with their desire to reduce the magnitude of rate increases and preserve the availability of insurance coverage. In markets subject to tight supply and high costs, regulators may sometimes tip the balance further in favor of improving "availability and affordability," since this is the greatest and most immediate concern of consumer-voters.

This kind of regulatory tradeoff is especially relevant to Florida given the market pressures it has faced. Beginning in the mid-1990s, Florida allowed start-up insurers to write a large block of exposures in high-risk areas. In fact, many of these start-up insurers drew a significant amount of their initial capital from payments they received for taking policies out of the residual market. There were also some existing small regional insurers that entered or expanded their writings in the Florida market to absorb the exposures shed by other insurers. These insurers can seek to purchase large amounts of reinsurance to bolster their capacity, but there may be limits to how much they can reduce their risk from writing large concentrations of high-risk exposures. Even the most generous catastrophe reinsurance contracts may still require the ceding insurers to retain a significant amount of risk at lower layers that can only be supported by surplus associated with a more diversified portfolio of exposures.

Fortunately, the lack of significant hurricane losses until 2004 enabled the start-ups to escape their "precarious" position if they chose to do so. They were allowed to drop the policies they took out of the residual market after three years. An analysis by Grace, Klein and Liu (2006)⁶⁸ indicated that a number of the start-ups did substantially reduce their coastal exposures as they were able to do so and sought to increase their geographic diversification across the state to lessen their catastrophe risk. Certain other insurers appeared to exit the Florida market entirely. However, the data indicate that other Florida-concentrated insurers substantially increased their writings which necessarily increased their exposures in high-risk areas.

The diversification strategy appeared to work for those start-up insurers that employed it – none of these insurers were bankrupted or even impaired as a result of the 2004-2005 storm seasons. However, five of the Florida insurers that retained or expanded their concentration of high-risk exposures were placed into receivership after the storms. One could advocate differing opinions on how stringent solvency regulation should be for insurers that are absorbing a large

⁶⁸ Grace, M.F., R.W. Klein and Z. Liu (2006), "Mother Nature on the Rampage: Implications for Insurance Markets," paper presented at the National Bureau of Economic Research, February 20.

number of high-risk exposures. On the one hand, less stringent solvency regulation allows more companies to absorb high-risk exposures, which eases pressure on established insurers to retain these exposures. On the other hand, more lenient solvency requirements can result in insolvencies and the associated costs are passed on to solvent insurers and their policyholders.⁶⁹ From a public policy perspective, allowing small or regionally concentrated insurers to underwrite an excessive number of high-risk exposures creates several problems including moral hazard among overly exposed insurers, as well as diminishing their insureds' incentives to better control their disaster risk.

While new or smaller regionally-concentrated insurers can provide some relief, their capacity tends to be limited, and it is questionable whether they are positioned to safely absorb large concentrations of high-risk exposures. A more prudent strategy would encourage more national, geographically-diversified insurers to each assume digestible shares of high-risk exposures at adequate rates.

2.5. State Insurance Mechanisms

There are three types of state-run or state-sponsored insurance mechanisms: (1) residual market mechanisms; (2) state insurance or reinsurance funds; and (3) guaranty associations. The administration of all three types of mechanisms can have significant implications for the functioning of insurance markets and the management of catastrophe risk. This chapter focuses primarily on residual market mechanisms but the other mechanisms also are discussed briefly. The discussion of residual markets starts with some general observations followed by a more detailed review of developments in the four target states.

Residual Market Mechanisms

General Observations. Although residual market mechanisms may be headed by non-regulators, legislators and insurance regulators effectively control much of what these mechanisms are allowed to do in terms of setting rates and other actions. The principal property insurance mechanisms are state insurance companies, windstorm/beach plans and FAIR Plans.⁷⁰ FAIR Plans operate in more than 30 states and provide full coverage for residential properties that are "unable" to secure coverage in the voluntary market. Florida has the Citizens Property Insurance Corporation that also provides full coverage or wind coverage for residential properties.⁷¹ Windstorm/beach plans exist in several coastal states and provide only wind coverage in certain designated high-risk coastal areas.

The administration and regulation of residual market facilities can have significant effects on property insurance markets and vice versa. The important aspects of residual market administration include rates, eligibility requirements, available coverages and coverage provisions. Suppressing or compressing residual market rate structures, lenient eligibility requirements, and generous coverage terms can cause significant problems. In turn, suppressing or compressing insurers' rates can tighten the supply of insurance in the voluntary market and force more properties into the residual market.

⁶⁹ Some established insurers may still find this preferable if insolvency costs are spread broadly across all insurers and other lines. Also, state and federal laws allow insurers to recover at least some of their guaranty association assessments through rate surcharges and/or tax credits or deductions.

⁷⁰ FAIR is the acronym for Fair Access to Insurance Requirements.

⁷¹ Louisiana established a similar mechanism in 2004.

One problem is the excessive growth of a facility's exposures. It is not uncommon for these facilities to insure 1 to 2 percent of the residential properties in a state. At this level, the facilities are small enough that they do not impose a large burden on the voluntary market or create other problems. In this scenario, residual market mechanisms truly play the role of a "market of last resort." They provide coverage to a small portion of property owners that are unable to secure coverage in the voluntary market.

However, when residual market mechanisms are substantially larger than this, they can impose a significant burden on the voluntary market and potentially lead to the infamous "downward spiral" in which they continue to grow and cause the voluntary market to implode. Residual markets can also function as a temporary safety valve in the event of "supply shocks" but excessive regulatory constraints on the voluntary market and/or mismanagement of residual market mechanisms can create long-term problems.

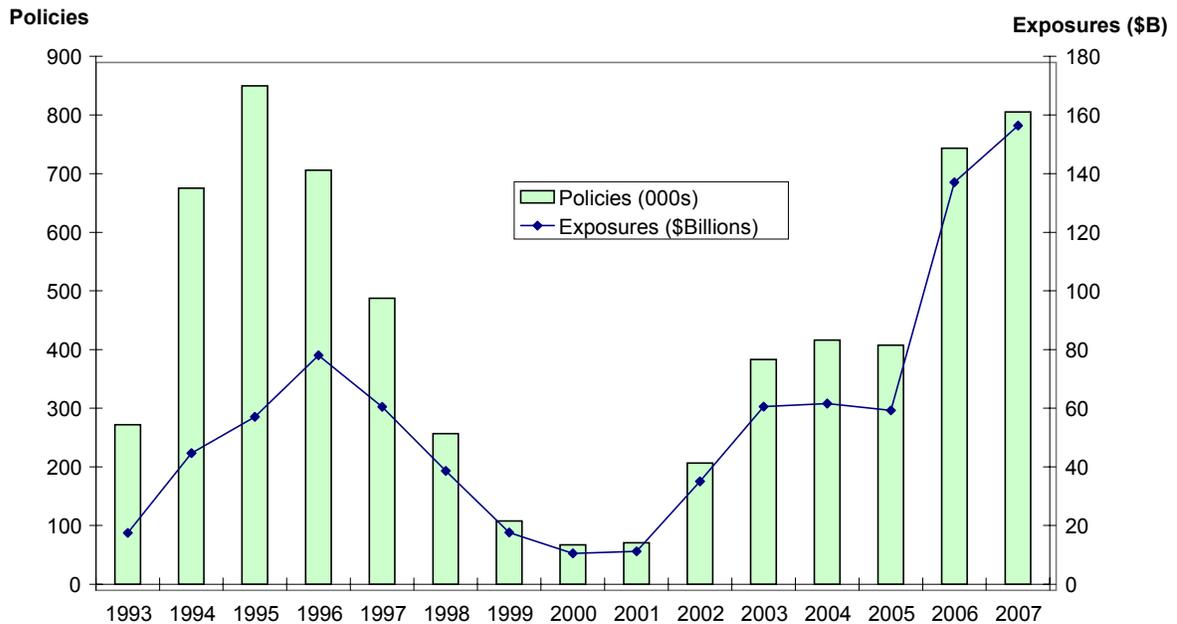
A second problem caused by poor residual market policies is that it can have an artificial depressing effect on voluntary market prices – the residual market rates can effectively impose a ceiling on what private insurers can charge. Also, if availability problems are caused by regulatory constraints on the voluntary market, then at least part of the facility's large book of exposures is artificially created. A third problem is that the residual market's insureds' incentives to lower their disaster risk can be diminished if they do not pay the full cost of the risk they incur. Fourth, a facility can experience financial shortfalls that are assessed back to voluntary market insurers and insureds. Additional short-term growth of residual market mechanisms may be unavoidable during periods of market instability and adjustment, but using them as a long-term source of coverage for a large number of properties can unnecessarily sustain problems in both the voluntary and residual markets.

The regulation of the voluntary and residual markets can become self-reinforcing and lead to the snowballing effect characteristic of the "downward spiral." As the residual market grows at inadequate rate levels, it imposes increasing assessments on a shrinking voluntary market which causes the voluntary market to shrink even further. This kind of scenario is most common for auto and workers' compensation residual markets where the full results of regulatory mismanagement become manifest within a fairly short period of time. This would also be the case for the non-catastrophe component of property insurance voluntary and residual markets. However, the situation is different for the catastrophe risk component of these markets. The highly variable nature of catastrophic losses can enable regulators to suppress residual market rates, but the effects of this policy can be delayed. The timing of voluntary market assessments will be tied with the timing of catastrophic losses. Hence, the assessments can come in chunks when hurricanes occur, which further contributes to the instability of property insurance markets subject to catastrophic loss shocks.

Florida's Residual Market. Florida's property insurance residual market mechanism, the Citizens Property Insurance Corporation (Citizens), has experienced significant growth in recent years with legislative changes in 2007 accelerating that growth. In concept, a residual mechanism should be an insurance source of last resort for property owners who cannot obtain insurance in the voluntary market. Florida's legislation substantially departs from this concept. The significant changes fall into three categories: (1) changes to Citizens' ability to compete with the voluntary market; (2) changes in Citizens' rates; and (3) changes in Citizens' authority to make "emergency assessments" to cover funding shortfalls.

A number of legislative changes were made to expand the coverage offered by Citizens and allow it to compete with the voluntary market (Milliman, 2007).⁷² Importantly, consumers are allowed to purchase a policy from Citizens if a comparable policy would cost 15 percent more in the voluntary market. Further, the legislation rolled back Citizens’ rate increases that were to become effective at the beginning of 2007. Also, the legislation allows Citizens to decrease rates further in 2007, and precludes it from raising rates until 2008. Finally, Citizens’ assessment base was expanded from just property lines of insurance to include all lines of business except workers’ compensation, medical malpractice, accident and health, the national flood insurance program, and the federal crop insurance program. Combined, these legislative changes will further increase Citizens’ size, undermine its “self-funding” based on the premiums it collects, and increase the size and scope of its assessments on other insurance buyers to cover its funding shortfalls.

Figures 2.1-2.3 plot the growth of the residual market in Florida over time for personal residential property and partially reflect the acceleration of its growth due to 2007 legislative changes. Prior to 2002, the residual market in Florida was administered by the Florida Residential Property and Casualty Joint Underwriting Association (FRPCJUA) and the Florida Windstorm Underwriting Association (FWUA). The FUWA provided only wind coverage on coastal homes in certain designated areas, while the JUA provided full coverage or transferred the wind risk to the wind pool in areas where it operated. In 2002, the JUA and FUWA were combined into the Citizens Property Insurance Corporation.



Note: 2007 figures are as of March 31, 2007

FIGURE 2.1. FLORIDA RESIDUAL MARKET RESIDENTIAL POLICIES & EXPOSURES

Source: FRPCJUA & Citizens Property Insurance Corporation

⁷² Milliman, Inc. (2007), *Analysis of Florida Legislative Reform: Special Session*, January 2007, (San Francisco, CA), April 30.

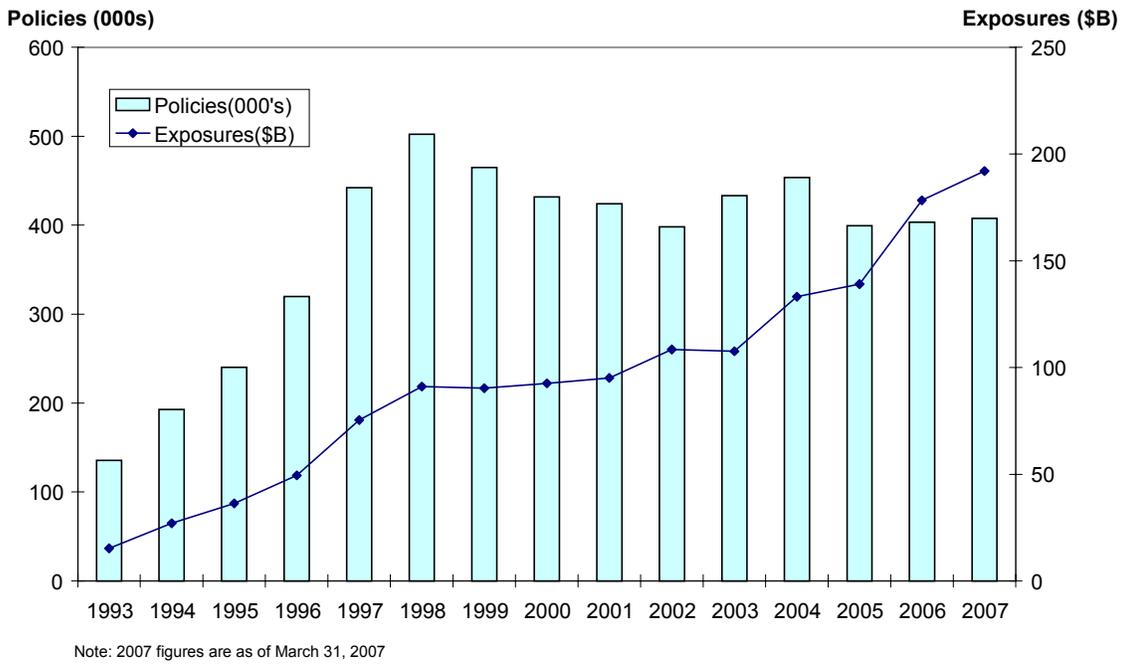


FIGURE 2.2. FLORIDA RESIDUAL MARKET WIND-ONLY POLICIES & EXPOSURES
 Source: FRPCJUA & Citizens Property Insurance Corporation

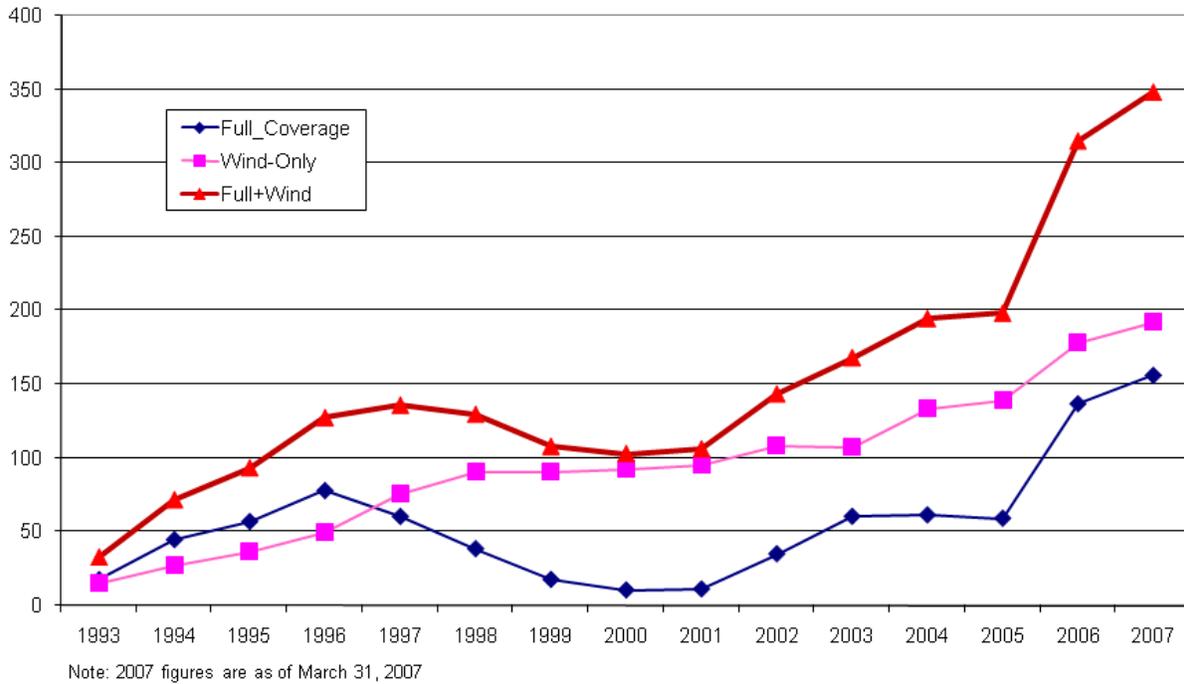


FIGURE 2.3. FLORIDA RESIDUAL MARKET FULL + WIND EXPOSURES (\$ BILLION)
 Source: FRPCJUA & Citizens Property Insurance Corporation

These three figures are designed to provide a consistent historical series on both residual market full coverage and wind-only coverage over the entire period starting in 1992. With Citizens, the wind-only policies are labeled as the “high-risk” portion of its portfolio. Hence, the wind pool’s policies can be compared to Citizens’ high-risk policies to maintain a consistent historical series. Figure 2.4 shows the relative penetration of Citizens’ as a percentage of total statewide premiums.

We can see from these figures that both parts of Florida’s residual market for personal residential property have increased substantially over this time period. For full-coverage policies, the number of policies and the amount of exposures skyrocketed after Hurricane Andrew and then fell from 1995 through 2000 as the start-up insurers took policies out of the facility and pressure on the voluntary market eased. This trend reversed in 2001 when the start-up companies shed policies (after their 3-year requirement ended), followed by the storm seasons of 2004-2005 that reasserted greater pressure on the voluntary market.

As of October 31, 2007, Citizens had 944,719 personal residential policies and 427,586 “high-risk” (i.e., wind-only) policies. Citizens also has 14,224 commercial residential and wind-only policies. Its exposures (i.e., amount of insurance in force) as of March 31, 2007 (the latest date for which exposure data are available) were \$156.4 billion for personal residential policies, \$192.1 billion for high-risk policies, and \$85.8 billion for commercial policies. All of these figures are the highest recorded for Florida residual market policies and exposures. Figure 2.4 also reveals that Citizens’ market share (based on premiums) increased from 11.5 percent to 18.3 percent from 2002 to 2006.⁷³ Its relative market share is presumably much higher at the time of the writing of this chapter. For purposes of comparison, we also calculated and show the residual market shares in the other target states which have been much smaller than in Florida.

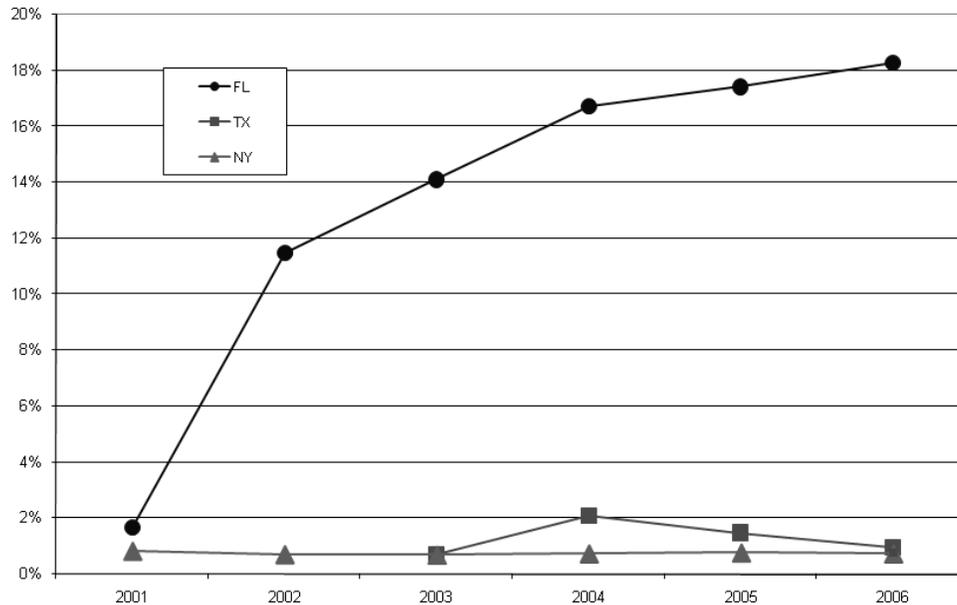


FIGURE 2.4. FAIR PLAN PENETRATION (PERCENT OF TOTAL STATEWIDE PREMIUMS)
 Source: Data from Property Insurance Plans Service Office

⁷³ These data are somewhat imprecise in that they reflect Citizens’ percentage of all property insurance premiums in the state. Also, the Florida data reflect only the residential property JUA in 2001 and Citizens’ market share from 2002-2005 based on all of its premiums, including those for high-risk policies previously insured by the Florida wind pool.

In October 2007, the FLOIR announced that four insurers agreed to take 173,000 policies out of Citizens. The four companies are American Integrity (\$5 million surplus), First Home (\$7.7 million surplus), Landmark One (new company) and Argus Fire and Casualty (\$9 million surplus). This could slow or reverse Citizens’ growth depending on other factors such as voluntary market insurers’ underwriting decisions and the further effects of making Citizens competitive with the voluntary market. Unfortunately, it continues the trend of increasing reliance on smaller, less geographically-diversified insurers who may be subject to severe losses and possible financial difficulty should a severe hurricane occur in the near future.

A question related to the size of the residual market is how its share of property exposures differs in various parts of the state. We would expect availability to be tighter and the residual market relatively larger in the highest risk areas. This is demonstrated in Table 2.3 which shows Citizens’ policies and exposures for personal residential and high-risk policies for Dade, Broward, Palm Beach and Monroe (DBPM) counties (combined) and the remainder of the state for 2003 (December 31) and 2007 (March 31).

TABLE 2.3. CITIZENS PROPERTY INSURANCE CORPORATION. PERSONAL RESIDENTIAL AND HIGH-RISK STATISTICS: 2003 AND 2007

	As of March 31, 2007				As of December 31, 2003			
	Policies	% Total	Exposures	% Total	Policies	% Total	Exposures	% Total
Personal-Residential Total								
Dade, Broward, Palm Beach, & Monroe	337,210	41.9%	78,161,152,996	50.0%	239,461	62.5%	40,635,887,869	80.3%
Rest of State	468,117	58.1%	78,219,827,093	50.0%	143,819	37.5%	19,390,910,445	38.3%
Total	805,327	100.0%	156,380,980,089	100.0%	383,280	100.0%	50,586,798,314	100.0%
High-Risk: Wind Only								
Dade, Broward, Palm Beach, & Monroe	247,122	60.6%	113,798,891,286	59.2%	276,067	63.7%	68,286,388,540	63.5%
Rest of State	160,559	39.4%	78,335,073,455	40.8%	156,989	36.3%	39,328,420,045	36.5%
Total	407,681	100.0%	192,133,964,741	100.0%	433,056	100.0%	107,614,808,585	100.0%

Source: Citizens Property Insurance Corporation

We can see from this table that the number of policies and amount of exposures insured by Citizens in its personal-residential account increased significantly from 2003 to 2007 in the DBPM counties but decreased relative to Citizens’ total policies and exposures. The same is the case for high-risk policies and exposures. Still, these counties continue to account for a large share of the policies insured by Citizens.

This leads to several observations and comments. One would expect a certain increase in the number of policies and the amount of insurance or exposures due to the construction of more homes, as well as increases in policy limits. However, Citizens’ growth is exceeding that of the voluntary market, indicating that it is writing a growing share of all property exposures in the state. Based on the most recent data, it appears that the 2007 legislative changes to Citizens (perhaps coupled with tightening constraints on private insurers) are accelerating its growth. Between the end of 2006 and October 31, 2007, Citizens’ personal residential policies increased from 743,592 to 944,719 – a 27 percent increase in just nine months. During this same period, its high-risk policies increased from 403,509 to 427,586.

What is most striking is Citizens' growth in other areas of the state beyond the DBPM counties. It appears that prior to the 2004 and 2005 storm seasons, other coastal areas were not as great a concern to insurers as southern Florida. This perception appears to have changed significantly after 2003. Hence, other coastal areas experienced a greater change in terms of insurers' adjustment of their exposures – an adjustment that Dade, Broward, Palm Beach and Monroe had already experienced prior to 2004. This probably reflects insurers' recognition that the other coastal areas faced a much higher level of hurricane risk than they had previously assumed. Of course, the vulnerability of other coastal areas was demonstrated by the path of several hurricanes in 2004, and Hurricanes Katrina and Rita in 2005. Hence, these other coastal areas apparently suffered a greater decrease in the availability of coverage than southern Florida. Another likely factor contributing to Citizens' growth, especially outside the southern part of the state, is its transformation into a competitive source of insurance.

As a result of its substantial claims obligations arising from the 2004-2005 storm seasons, Citizens incurred large funding shortfalls of \$1.6 billion for 2004 and over \$2 billion in 2005. The 2004 shortfall resulted in a 6.8 percent surcharge on all homeowners premiums in the state (recoupment against all other insurers in the state who then passed all or portion of it to their policyholders). The Florida legislature appropriated \$715 million in 2006 to reduce Citizens' assessments needed to cover its 2005 deficit. The remainder of the deficit will be collected over a 10-year period in "emergency assessments" on premiums written statewide that will be passed on as surcharges to policyholders. As noted above, most lines written by property-casualty insurers are now subject to assessments. The premium surcharge in 2007 is 2.5 percent and surcharges in subsequent years are expected to be approximately 1.5 percent. In Chapter 13, we analyze the financial sustainability of Citizens under different scenarios of catastrophes that could happen tomorrow.

Residual Mechanisms in Other States. The landscape for residual markets in other target states has been shifting in recent years, although not to the degree that has occurred in Florida. It is important to note certain structural changes that occurred in Texas and Louisiana. Texas has had a wind pool for a long time but it only recently created a FAIR Plan in 2003. Louisiana combined its FAIR Plan and wind pool in 2004 in a new entity titled the Louisiana Citizens Property Insurance Corporation (LCPIC) that is structurally similar to Florida's Citizens. Table 2.4 provides data on the number of habitational policies and total exposures for all state FAIR Plans for 1992 and 2003-2005. Between 1992 and 2005, the number of policies in the state FAIR Plans throughout the country increased by almost 70 percent, and the exposures in 2005 in Fair Plans were almost 3 and one-half times what they were in 1992. Table 2.5 provides comparable information for state wind pools. The target states are in capital letters.

**TABLE 2.4. STATE FAIR PLANS: HABITATIONAL POLICIES AND EXPOSURES
1992, 2003-2006**

State	2006				2005				2004				2003				1992	
	Policies		Exposures (\$000s)		Policies		Exposures (\$000s)		Policies		Exposures (\$000s)		Policies		Exposures (\$000s)		Policies	Exposures (\$000s)
	Number	% Chg.	Amount	% Chg.	Number	% Chg.	Amount	% Chg.	Number	% Chg.	Amount	% Chg.	Number	% Chg.	Amount	% Chg.		
California	193,615	-3.7%	50,577,001	3.9%	201,043	3.1%	48,663,725	8.2%	195,084	3.0%	44,971,851	11.3%	189,486	63.7%	40,423,805	114.3%	115,767	18,866,588
Connecticut	4,682	-7.1%	768,728	1.7%	5,040	5.6%	756,193	11.9%	4,771	29.0%	675,542	NA	3,698	-38.2%	489,282	NA	5,985	754,943
Delaware	2,963	-10.2%	295,795	-3.7%	3,299	-4.6%	307,108	40.8%	3,457	29.4%	218,044	9.6%	2,671	43.3%	199,015	159.5%	1,864	76,679
FLORIDA*	1,409,587	246.0%	408,837,779	589.9%	407,387	-2.2%	59,263,424	-3.8%	416,529	8.7%	61,621,665	1.7%	383,280	160.2%	60,566,798	562.8%	147,315	9,137,395
Georgia	28,167	-4.5%	3,114,897	17.2%	29,491	-3.4%	2,656,721	1.8%	30,518	4.6%	2,610,404	0.2%	29,165	160.8%	2,605,112	291.0%	11,181	666,322
Illinois	9,970	-19.8%	769,000	-16.9%	12,426	-18.9%	925,872	-17.8%	15,318	1.7%	1,126,547	5.7%	15,068	-6.2%	1,065,549	69.1%	16,069	630,297
Indiana	3,633	-21.6%	300,953	-11.3%	4,631	-23.4%	339,389	-35.6%	6,048	23.5%	526,669	38.5%	4,898	60.2%	380,278	324.1%	3,058	89,662
Iowa	1,425	-10.2%	97,079	-11.8%	1,586	0.2%	110,028	-7.7%	1,583	12.8%	119,265	-0.1%	1,403	29.5%	119,403	335.6%	1,083	27,414
Kansas	9,659	29.8%	416,676	27.5%	7,443	8.4%	326,883	12.6%	6,868	30.8%	290,214	19.2%	5,252	-1.0%	243,511	90.2%	5,303	128,062
Kentucky	14,040	-6.3%	141,533	-4.7%	14,985	5.7%	148,488	-1.3%	14,178	16.6%	150,500	20.1%	12,163	-67.9%	125,332	-49.8%	37,857	249,756
LOUISIANA*					134,169	-1.0%	14,895,780	4.5%	135,457	14.3%	14,260,817	45.2%	118,514	2753.0%	9,819,994	5604.9%	4,154	172,132
Massachusetts	216,074	12.6%	68,607,352	27.1%	191,828	24.2%	53,958,244	37.8%	154,438	34.1%	39,162,807	46.5%	115,185	124.1%	26,725,429	442.1%	51,403	4,929,965
Michigan	73,952	-17.8%	10,186,674	-18.3%	89,938	-13.4%	12,473,849	-23.7%	103,895	-1.6%	16,350,703	NA	105,610	-42.1%	18,493,317	-18.2%	182,287	22,611,624
Minnesota	8,600	-14.4%	1,839,520	-15.2%	10,042	-22.5%	2,169,793	-22.2%	12,964	NA	2,790,157	NA	14,712	NA	1,316,637	NA	4,104	152,970
Mississippi	12,080	NA	661,360	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Missouri	8,928	-8.4%	421,162	-8.2%	9,748	-5.4%	458,939	-5.2%	10,302	3.6%	484,165	10.9%	9,945	-51.5%	436,721	16.1%	20,520	376,084
New Jersey	41,974	-11.5%	5,440,130	-7.6%	47,402	-8.2%	5,887,162	-2.9%	51,661	-1.4%	6,065,014	4.6%	52,405	4.8%	5,796,676	56.9%	49,981	3,694,897
New Mexico	12,687	3.0%	671,920	2.2%	12,319	-2.1%	657,182	0.4%	12,579	5.8%	654,556	19.1%	11,894	-1.0%	549,451	-45.6%	12,014	1,010,068
NEW YORK	60,797	-1.1%	12,927,080	7.5%	61,504	-6.8%	12,021,650	7.8%	66,025	0.6%	11,148,869	10.2%	65,603	0.0%	10,119,750	86.8%	65,617	5,417,273
Ohio	59,983	-13.4%	11,309,456	-15.9%	69,233	-9.2%	13,440,019	-8.6%	76,284	10.4%	14,711,595	10.0%	69,088	327.9%	13,374,287	4551.7%	16,145	287,511
Oregon	4,225	-13.7%	322,196	-13.7%	4,893	-10.8%	373,247	-12.1%	5,487	-5.2%	424,494	-3.5%	5,785	-17.8%	439,967	49.9%	7,034	293,527
Pennsylvania	37,386	-9.0%	2,079,026	-5.0%	41,061	-8.2%	2,189,147	-1.8%	44,706	-1.6%	2,228,806	8.7%	45,443	-39.1%	2,050,500	-19.0%	74,657	2,530,159
Rhode Island	21,708	1.1%	4,728,942	349.2%	21,475	15.3%	1,052,631	31.2%	18,625	42.5%	802,452	55.6%	13,067	103.1%	515,815	18.3%	6,433	435,878
TEXAS	109,461	-9.5%	13,320,285	-5.8%	120,913	-33.6%	14,133,423	-37.9%	182,124	51.1%	22,771,896	91.8%	120,536	NA	11,871,417	NA	NA	NA
Virginia	37,058	-0.6%	3,944,094	4.5%	37,274	5.9%	3,774,646	3.8%	35,188	21.4%	3,636,751	30.3%	28,984	105.6%	2,790,798	428.4%	14,098	528,169
Washington	90	-17.4%	33,346	-9.5%	109	-12.8%	36,845	-17.1%	125	-15.5%	44,444	-11.6%	148	-79.1%	50,291	-23.0%	709	65,288
West Virginia	1,364	-10.1%	50,392	-13.8%	1,517	-3.3%	58,432	22.9%	1,568	18.8%	47,541	10.2%	1,320	-16.1%	43,129	22.9%	1,574	35,102
Wisconsin	5,191	-19.7%	NA	NA	6,463	-9.9%	NA	NA	7,172	20.4%	NA	NA	5,959	12.2%	NA	NA	5,313	NA
Total	2,389,299	54.4%	601,859,916	139.7%	1,547,219	-4.1%	251,078,820	1.3%	1,612,954	12.7%	247,895,768	17.7%	1,431,282	66.1%	210,612,264	187.8%	861,525	73,167,765

* Florida figures reflect all policies for 2006; full-coverage policies for previous years. Louisiana figures include both "FAIR Plan" policies and "Coastal" policies.

Source: Data from Insurance Information Institute; Citizens Property Insurance Corporation; and Louisiana Citizens Property Insurance Corporation

**TABLE 2.5. STATE WIND/BEACH POOLS
1992, 2003-2006**

State	2006				2005				2004				2003				1992	
	Policies		Exposures (\$000s)		Policies		Exposures (\$000s)		Policies		Exposures (\$000s)		Policies		Exposures (\$000s)		Policies	Exposures
	Number	% Chg.	Amount	% Chg.	Number	% Chg.	Amount	% Chg.	Number	% Chg.	Amount	% Chg.	Number	% Chg.	Amount	% Chg.	Number	(\$000s)
Alabama	NA	NA	NA	NA	NA	NA	NA	NA	3,121	1.8%	317,691	-6.5%	3,065	5.5%	339,858	80.3%	2,904	188,513
FLORIDA	NA	NA	NA	NA	399,418	-12.0%	139,106,408	4.4%	453,756	4.8%	133,189,592	23.8%	433,056	609.1%	107,614,809	1336.3%	61,074	7,492,298
Louisiana	NA	NA	NA	NA	NA	NA	NA	NA	9,377	5.6%	1,290,585	167.8%	8,881	27.2%	481,890	163.1%	6,984	183,159
Mississippi	28,880	96.3%	5,369,509	186.7%	14,710	NA	1,872,999	NA	14,814	14.3%	1,631,848	77.8%	12,955	164.9%	917,935	198.7%	4,891	307,315
SOUTH CAROLINA	27,082	28.2%	11,179,099	70.0%	21,131	4.2%	6,576,213	9.6%	20,285	14.1%	6,002,519	50.3%	17,776	114.0%	3,993,548	211.9%	8,306	1,280,331
TEXAS	140,375	32.0%	38,313,022	64.6%	106,350	NA	23,279,429	NA	100,299	NA	20,796,686	NA	106,273	105.8%	11,972,502	119.4%	51,638	5,455,790
Total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	582,006	328.6%	125,320,542	740.7%	135,797	14,907,406

Source: Data from Insurance Information Institute; Property Insurance Plans Service Office

Texas

Prior to 2003, Texas had relied on a unique system to deal with property insurance availability problems. Instead of using a FAIR Plan, it permitted the existence of an “unregulated” (or less regulated) property insurance market alongside a “regulated” insurance market. In the unregulated market populated by Texas Lloyds companies, insurers were allowed greater pricing freedom than in the regulated market. The unregulated market was intended to function as the market of last resort for property owners who could not obtain full coverage through the regulated insurance market. At the same time, the Texas Windstorm Association functioned like a conventional wind/beach pool, offering wind coverage in designated high-risk areas.

In the early 2000s, Texas suffered from property insurance availability problems due primarily to issues related to mold claims and other non-hurricane perils. This caused the movement of a large number of property owners from the regulated to the unregulated market. These property owners experienced a significant increase in their premiums, as prices were much higher in the unregulated market. The resulting consumer dissatisfaction and public concerns prompted Texas to establish a FAIR Plan which would be subject to greater government control than the unregulated market. As can be seen from Table 2.4, the Texas FAIR Plan accumulated 120,536 policies by the end of 2003, 182,124 policies by the end of 2004 with number dropping to 109,461 policies by the end of 2006. The size of the Texas FAIR Plan has been relatively small compared to the total state market, with its market share based on premiums of only 0.7 percent at the end of 2006. This small percentage of homeowners policies in the Texas FAIR Plan is likely due to the ability of insurers to adjust their rates and manage their exposure to mold claims.

The Texas wind pool essentially doubled from 1992 to 2003, from 51,638 policies to 106,273 policies, then remained at that level through 2005 and increased to 140,375 policies in 2006. The pool has remained a relatively small but growing portion of the total state market, increasing from 1.08 percent in 2003 to 1.63 percent in 2006. The pre-2003 growth was likely due to coastal development in Texas coupled with the general tightening of the supply of property insurance in coastal areas. Its more recent growth is likely due to insurer retrenchment following the 2005 storm season exacerbated by regulatory resistance to rate increases.

South Carolina and New York

Both South Carolina and New York have experienced some increased market pressure in their coastal areas but this pressure is considerably less than what has been experienced in Florida and other Gulf Coast states. South Carolina has a wind pool but not a FAIR Plan, and New York has a FAIR Plan but not a wind pool.

The South Carolina Wind and Hail Underwriting Association, the official name of its wind pool, has continued to grow over time due to increased coastal development and increasing hurricane risk. It wrote 27,802 policies and \$11.2 billion exposures in 2006. Still, its market share remained low, ranging from 0.34 percent to 0.62 percent over the 2001-2006 period. This reflects the small size of South Carolina’s coastal market in relation the total state market.

The South Carolina Department of Insurance has reported increasing problems with the availability of property insurance in coastal areas (SCDOI, 2007).⁷⁴ As noted above, this is a fairly localized problem for South Carolina, as coastal properties represent a relatively small portion of the total property exposures in the state. Still, coastal availability problems prompted the state to expand the areas covered by the wind pool effective June 1, 2007 and to revamp the pool's rating structure to accommodate the changes.

It is more difficult to assess how much hurricane risk has affected New York's FAIR Plan, if at all, based on publicly available information. The size of its FAIR Plan has remained fairly steady and relatively low over the years, and is probably driven more by urban insurance availability issues than coastal insurance problems. It wrote 60,797 policies and just over \$12.9 billion in exposures in 2006. In relative terms, the market share of the FAIR Plan remained less than 1 percent during the 2001-2006 period.

There has been discussion of creating a New York wind pool, but apparently, coastal insurance availability issues have not been significant enough to compel the legislature to create such an entity. There have been reports of some insurers reducing their exposures in New York coastal areas, but there is no evidence of widespread and substantial cutbacks.

State Insurance Funds

Two states – California and Florida – have special insurance funds designed to bolster the supply of catastrophe coverage. The California Earthquake Authority (CEA) provides earthquake coverage at a primary level to property owners in California. The Florida Hurricane Catastrophe Fund (FHCF) provides catastrophe reinsurance to primary insurers underwriting property coverage in the state. Both mechanisms were created in response to major “crises” in the supply of insurance that occurred after severe disasters. The CEA was established following the Northridge earthquake and the FHCF was established after Hurricane Andrew.

A discussion of the arguments for and against state insurance/reinsurance funds is beyond the scope of this chapter, but the different perspectives can be summarized briefly. Proponents of the FHCF contend that it helps to fill a gap in private reinsurance capacity and/or provides reinsurance at a lower cost. Indeed, the FHCF was established with the support of major insurers in the state. It should be noted that the FHCF can accumulate tax-favored reserves (an option not currently available to U.S. insurers and reinsurers) and can also access credit supported by local bonding authorities. This inherently reduces its costs relative to private reinsurers, but also invites political manipulation of its rate structure.

Opponents of mechanisms like the FHCF question the need to augment private reinsurance, raise concerns about crowding out private reinsurance, and cite the potential for financial shortfalls that can lead to assessments on insurers/consumers and/or taxpayers depending on how the mechanism is designed. Indeed, the FHCF did need assistance to cover its losses from the 2004-2005 hurricane seasons and insurers have grave concerns about 2007 legislative changes to the FHCF that increase the amount of coverage that it provides.

⁷⁴ South Carolina Department of Insurance, (2007), *Coastal Property Insurance Issues in South Carolina*, January.

Under its Mandatory Coverage Program, the FHCF will reimburse a fixed percentage of a participating insurer's losses from each "covered event" in excess of a per event retention and subject to a maximum aggregate limit for all events. The fixed percentage can be 45 percent, 75 percent or 90 percent at the option of the insurer. (See Chapter 13 for a more detailed analysis of the operation of the FHCF). The event retentions and limits vary by insurer according to a formula based on FHCF premiums. There is also an Optional Coverage Below Mandatory Program that provides more limited coverage to certain eligible companies. The cost of FHCF coverage to a participating insurer is based on its estimated share of the FHCF's expected losses and expenses.

An important provision limits the FHCF's obligation to pay losses to the sum of its assets and borrowing capacity. This was initially set at \$11 billion, increased to \$15 billion in 2004 and increased to \$27 billion in 2007 for a "temporary" period of three years. If the FHCF losses exceed its total funding capacity, each insurer would be reimbursed on a pro-rata basis from the funds available according to its share of the premiums paid into the fund for that contract year.

The FHCF is funded by premiums paid by participating insurers and investment income on invested reserves. It also can borrow funds up to a specified limit and impose emergency assessments on other property-casualty insurance premiums in the state if necessary to repay debt. The emergency assessments apply to all property-casualty and surplus lines insurers for all lines except workers' compensation, accident and health, medical malpractice and national flood insurance premiums. These assessments are limited to 6 percent for one single contract year, but can rise to 10 percent depending on "unused assessments" in prior contract years.

The 2004 and 2005 storm seasons required the FHCF to make payments to insureds which tapped and reduced its financial reserves. As of December 31, 2006, it had paid \$3.678 billion for losses arising from the 2004 hurricanes, and \$3.6 billion for losses arising from the 2005 hurricanes. The ultimate estimated payment obligations for these two years are \$3.95 billion for 2004, and \$4.5 billion for 2005 (based on its audited financial statement for year-end June 30, 2007). These loss payouts led to a funding shortfall that prompted FHCF to issue \$1.35 billion in revenue bonds to cover the shortfall, and \$2.8 billion in pre-event notes to provide liquidity for the 2006 storm season (FHCF, 2007).⁷⁵ The bonds will be repaid from a 1 percent emergency assessment for six years on all policies renewed after January 1, 2007.

With the coverage expansion authorized by the 2007 Florida legislature, there are concerns that significant hurricane losses could lead to more emergency assessments on all applicable insurance premiums written in the state (recoupment). (See Chapter 13 for an analysis of FHCF's exposure to different scenarios of hurricane.)

Guaranty Associations

All states have an insolvency guaranty association that is intended to cover the claims obligations of insolvent insurers. A state's guaranty association (GA) is important because it could experience severe stress if one or more insurers with substantial claims obligations became insolvent because of a catastrophe. Many state GAs face some catastrophe risk but Florida's experience is particularly noteworthy. The Florida Insurance Guaranty Association's (FIGA) funding capacity is supported by assessments on property-casualty insurance premiums in

⁷⁵ Florida Hurricane Catastrophe Fund (2007), Fiscal Year 2005-2006 Annual Report (Tallahassee, FL).

the state that are limited to 2 percent annually. Hurricane Andrew resulted in 11 insolvencies, and the corresponding demands on the guaranty fund exceeded its capacity. The guaranty association was forced to fully exercise its 2 percent assessment authority and the legislature authorized it to assess an additional 2 percent to repay funds borrowed to cover its capacity shortfall. The association ultimately paid off its debts in 1997.

FIGA has now been covering the claims obligations of the Poe Group insurers and Vanguard. This has prompted FIGA to exercise its full 2 percent assessment authority to cover its costs for these claims obligations; another 2 percent emergency surcharge was approved in October 2007. In its most recent statements, FIGA stated that it is responsible for handling approximately 43,000 Poe claims with a total estimated cost of \$750 million. Both figures were FIGA records and exceeded the number and cost of claims arising from the Hurricane Andrew insolvencies. FIGA has not yet published any information on claims obligations for Vanguard, which was placed into liquidation on March 27, 2007.

The experience from Hurricane Andrew in 1992 and the 2004-2005 storm seasons reflects the guaranty association's vulnerability to catastrophes and the potential pass-through of insolvent insurers' obligations and risk to other insurers. This risk is increased by the financial vulnerability of "small" Florida insurers with large concentrations of exposures in the state that are not offset by geographic diversification in other parts of the country.

Hence, insurers with significant premium writings in the state, even in lower risk areas and lines of business, retain a secondary exposure to catastrophe losses through their potential obligations to the guaranty fund. Insurers are often allowed to add rate surcharges (extending the burden to policyholders) to cover their GA assessments, but for economic reasons the burden is effectively shared between insurers and policyholders. Furthermore, there is the potential for externalizing some losses to other states, as each state guaranty association is responsible for covering the claims obligations of an insolvent insurer in its jurisdiction, even if the insurer is domiciled in another state. In other words, in the case of insolvency of a multi-state insurer, insolvency costs caused by the regulators in one state can be transferred to other states because of the insolvent insurer's unpaid claims obligations in those states which will be covered by their respective guaranty associations (ultimately insurers, policyholders and taxpayers). Taxpayers also pay a portion of an insolvent insurer's claims obligations, as insurers are allowed to deduct guaranty fund assessments from their federal income taxes. These issues involving catastrophe risk and guaranty associations are not confined to Florida but apply to any state where catastrophic losses could cause insurers to fail.

2.6. Conclusions

The severe storm seasons of 2004-2005 and insurers' resulting reassessment of hurricane risk and related actions (e.g., raising rates, reducing their exposures, etc.) have prompted regulatory reactions in various states. Market pressures and regulatory policies vary among these states. Florida, which faces the greatest risk, has employed regulatory policies that have significantly interfered with market forces. The other states have tended to be more permissive in terms of allowing market adjustments but they may tighten their rate regulation and other restrictions if market conditions do not improve. Florida's actions will likely expose insurance policyholders and taxpayers in the state to significant financial assessments should the state be struck by more hurricanes in the near future. To date, other states have not followed

Florida's course. Florida needs to reevaluate the economic soundness of its current policies, but this reappraisal may not occur until the state experiences a severe hurricane.

The story of catastrophe risk and insurance regulation continues to be written. Those states that are successful in supporting private insurance markets and other beneficial policies (e.g., mitigation) to deal with the hurricane risk may be able to avoid major market dislocations and provide a reasonable supply of catastrophe insurance coverage. Continued research is important to enhance our understanding of the drivers and effects of government policies and how public action can support the efficient management of catastrophe risk.

SUMMARY OF CHAPTER 2

This chapter examines the regulation of property insurance markets affected by catastrophes, particularly the risk of hurricanes and tropical storms. The severe storm seasons of 2004-2005 and insurers' resulting reassessment of the hurricane risk in coastal areas have raised a number of issues and a range of regulatory reactions in various states.

This chapter also reviews and assesses the areas of regulation that affect insurance markets, with a focus on the four states studied in depth – Florida, New York, South Carolina and Texas. Market pressures and regulatory policies vary among these states. Florida faces the greatest hurricane risk, and its regulatory policies have interfered with market forces to the greatest extent. The other states have tended to be more permissive in terms of allowing market adjustments, but there is a chance that some may tighten their regulation if rates continue to rise and the supply of insurance is further reduced.

CHAPTER 3

A MARKET ANALYSIS OF PROPERTY INSURANCE AGAINST HURRICANE RISK

KEY FINDINGS

Cost conditions. The cost conditions facing firms are a major determinant of the number, size and distribution of firms within an industry or market. The problem of correlated risk or catastrophic loss would be expected to lead insurers to charge a higher price for coverage and decrease their market share.

Changes in market share. The combined market share for the top four groups in Florida decreased steadily from 55.3 percent in 1992 to 39.2 percent in 2006. Another significant development in the state during the 1990s was the start-up of new insurers and entries by other established insurers. The other three states in the study (New York, South Carolina and Texas) have experienced less significant changes in market structure than Florida.

Premiums have increased radically in Florida. While the market price of insurance has significantly increased in coastal areas (especially in Florida), insurers are still concerned about earnings volatility and the possibility that their long-term earnings will be negative in high-risk areas. Florida has experienced the greatest absolute increase in the average premium among the studied states, from \$723 at the start of 2002, to \$1,465 in the first quarter of 2007. In coastal areas, premiums have tripled or even quadrupled for some homeowners.

Insurers' cumulative total profits in Florida from 1992-2006 have been *negative* during the entire period. At the end of 2006, insurers were \$11.6 billion in the red (measured on a cumulative basis from 1992-2006) on their Florida homeowners business. Higher insurance premiums, coupled with no hurricane losses in Florida in 2007, have improved insurers' long-term performance but they are still concerned about the future of their operation in this state.

CHAPTER 3

A MARKET ANALYSIS OF PROPERTY INSURANCE AGAINST HURRICANE RISK

The intense hurricane seasons of 2004 and 2005 caused substantial instability in property insurance markets in coastal states, with the greatest pressure in Florida and the Southeast. Other coastal states exposed to hurricanes also have experienced some market pressures and changes. The increased risk of hurricanes striking the U.S. prompted significant changes in these same markets beginning in the early 1990s, but the particularly intense hurricane activity during 2004 and 2005 has led to another wave of market adjustments. Both the loss shocks of the 2004 and 2005 storm seasons, as well as the belief that hurricane risk has risen to a new, higher level (higher than was perceived prior to 2004) have been major drivers of the recent market adjustments. That a severe hurricane has not struck the U.S. since 2005 has been a welcome relief and has allowed insurers and reinsurers to replenish some of their lost capital, but the threat of more hurricanes remains high and is still driving conditions in property insurance markets. It is important to understand how markets have changed in response to recent loss shocks and the increase in hurricane risk in order to develop a more complete picture of the catastrophe risk problem and to evaluate policy options.

This chapter updates and extends a previous analysis of market developments in Florida to other selected states – New York, South Carolina and Texas. Sections 3.1 and 3.2 examine the structure, conduct and performance of the homeowners insurance markets in Florida and the other states, with particular emphasis on recent developments. The chapter concludes with a summary of the key observations and discusses further research. This chapter is drawn from a more detailed analysis of market conditions in coastal states by Grace and Klein (2007).⁷⁶

3.1. Insurance Market Structure

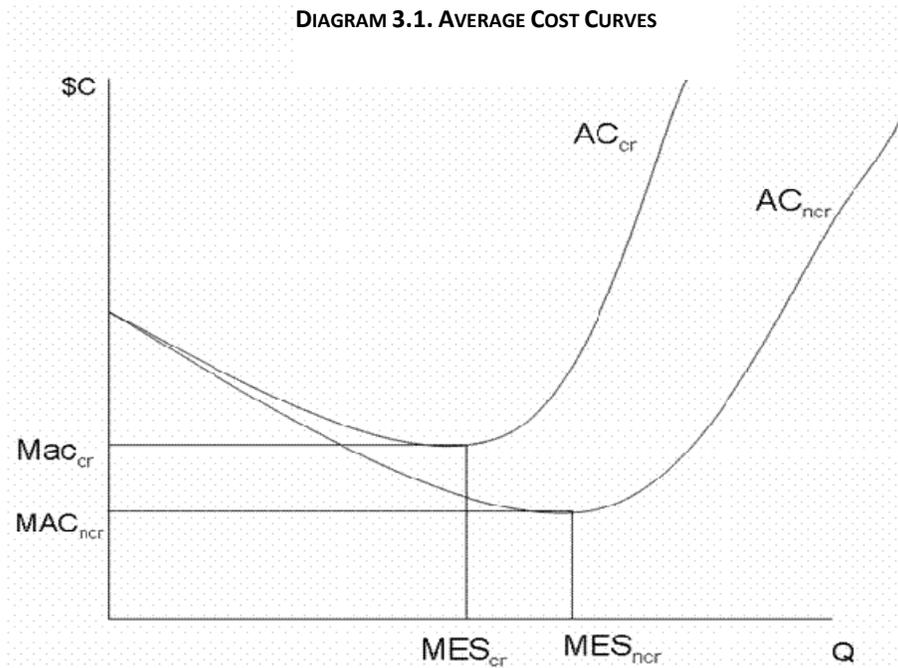
The next three subsections dissect insurance market developments using an established industrial organization approach – the structure-conduct-performance framework. The basic notion underlying this framework is that structure affects conduct, and conduct affects performance. However, it is also understood that the path of effects moves in both directions, i.e., conduct and performance can affect structure. Furthermore, this framework is harnessed to analyze developments in a market that is subject to several factors that are not typically found in other industries, requiring some creative extension and application of standard methods. We look at market structure at both a company and a group level to examine how business is being shifted among companies within the same group, as well as groups' overall market exposure. We also assess market structure using premiums and amounts of insurance as measures of quantity.

⁷⁶ Grace, M.F. and R.W. Klein (2007), "Hurricane Risk and Property Insurance Markets," Working Paper, Georgia State University, December.

Insurer Cost Conditions

The cost conditions facing firms are a major determinant of the number and size distribution of firms within an industry or market. Cost functions in many industries, including insurance, reflect decreasing average costs over an initial range of output and rising average costs beyond this point. The low point in the average cost curve is the minimum efficient scale (MES). This is reflected in the shape of the typical average cost curve, which is convex or U-shaped as shown by AC_{ncr} and AC_{cr} (the average cost curves when there are no correlated exposures ($_{ncr}$) or catastrophe risk ($_{cr}$)) in Diagram 3.1. The explanation for a U-shaped cost curve is that the firm initially benefits from spreading fixed costs over a larger amount of output, but at some point this effect is offset by rising variable costs due to rising input prices or other factors that cause the productivity of inputs to fall as production is pushed beyond a certain level (Varian, 1992).⁷⁷

However, the problem of correlated risk exposures or catastrophic risk adds a significant new dimension to insurer cost functions. As an insurer increases the amount of insurance it sells in a given geographic area, its risk of catastrophic losses increases. This means that variable costs increase as an insurer adds correlated risk exposures. The increase in variable costs can be reflected in the insurers' need to carry additional surplus, buy more reinsurance, or pay a higher return to its owners to compensate them for the higher risk retained by the insurer.



⁷⁷ For example, when production is pushed beyond some point, communication and coordination among workers and units within a firm can suffer, leading to diminishing productivity. See Varian (1992) for an explanation of firm cost functions. Varian, H.R. (1992), *Microeconomic Analysis*, 3rd Edition, New York: W.W. Norton & Company.

The important implications of this concept of insurers' cost functions are two-fold: (1) the cost function pivots upward; and (2) the shape of the cost function changes. Specifically, the slope of the average cost curve to the left of the MES becomes more shallow, the MES shifts to the left (i.e., decreases), and the average cost curve climbs more steeply to the right of the MES. The average cost curve with catastrophic risk is depicted as AC_{cr} in Diagram 3.1.⁷⁸ These changes in an insurer's cost function will compel it to charge a higher price for the insurance it sells, and its maximum efficient scale or output level will be lower than if its loss exposures were not correlated.

In terms of market structure, the catastrophic risk cost factor would be expected to decrease the market shares of the leading insurers, all other things being equal. The leading insurers will find it more costly to acquire a large share of the market than if catastrophic risk were not a factor. Small insurers also may find it difficult to sustain operations in catastrophe-prone markets because they lack sufficient capital and geographic diversification to counter the risk of correlated exposures they would encounter. Hence, we would expect that the market shares of the leading insurers will decrease and some smaller insurers may exit the market. Overall, we would expect measures of market concentration to decrease, as they tend to be based on, or dominated by, the market shares of the leading insurers.

Of course, in the real world, the cost factors that affect the supply of insurance and market structure are more complex than what we have described above. For example, insurers also must consider "economies of scope," e.g., the efficiencies gained from selling both homeowners insurance and auto insurance to the same household. If an insurer is unwilling to sell home insurance to some homeowners, it loses the associated scope economies from selling auto insurance to the same homeowners. Also, these homeowners may decide to move their auto insurance to another carrier. There are other considerations, such as the sunk costs associated with establishing a reputation and distribution networks and adverse regulatory responses. These other factors may dampen the hypothesized structural effects of higher costs due to catastrophic risk but they are unlikely to eliminate them. Hence, we believe that the predictions in the preceding paragraph should still hold.

The Regulatory Factor

The government framework under which firms operate also has significant effects on market structure, conduct and performance. The regulation of insurers is discussed in greater detail in Chapter 2 and Klein (2007)⁷⁹ but we note several important factors here. One such factor is the regulation of insurers' entry into and exit from a market. The evidence suggests that regulators impose some costs on market entry, and these costs, in turn, could impede entry to some degree (Klein, 1995).⁸⁰ In turn, regulators can also make it costly to exit markets. In particular, some states may attempt to require an insurer to exit all lines of business if it seeks to exit a line subject to availability problems, such as home insurance. This policy could delay the exit of insurers from a state market but not ultimately prevent it (Grace, Klein and Kleindorfer,

⁷⁸ MAC_{cr} and MAC_{ncr} refer to "minimum average cost" with and without catastrophe risk respectively. MES_{cr} and MES_{ncr} refer to "minimum efficient scale" with and without catastrophe risk respectively.

⁷⁹ Klein, R.W. (2007), "Catastrophe Risk and the Regulation of Property Insurance: A Comparative Analysis of Five States," Working Paper, Georgia State University, December.

⁸⁰ Klein, R.W. (1995), "Insurance Regulation in Transition," *Journal of Risk and Insurance*, 62: 263-404.

2004).⁸¹ At the same time, raising the cost of exit can have the undesired effect of discouraging entry.

The extent to which regulators constrain insurers' discretion with respect to pricing, policy terms and underwriting can also affect entry and exit and other aspects of market structure. Severe regulatory constraints can deter entry and also hasten insurers' retrenchment or exit from a market. After an initial period of severe regulatory constraints following Hurricane Andrew, it appears that Florida's regulators' approval of gradual rate increases during the 1990s helped to encourage new insurers to enter the market and may also have eased pressure on established insurers to retrench or withdraw from the market (Grace, Klein and Kleindorfer, 2004).⁸² However, regulators' continued compression of rates in some high-risk areas and more recent resistance to further rate increases could push insurers to retrench from the market to a greater degree than they would under more flexible regulatory policies. Regulatory policies in other coastal states appear to have been more accommodating, but there may have been some constraints on insurers' actions in these jurisdictions and regulatory policies in these states could tighten. This will impact on insurers' decisions as to how they approach each state market.

We should also note that the regulation of insurers' financial condition and risk also affects property insurance markets subject to catastrophes in several ways. For example, regulators enforce standards as to how much capital insurers are required to hold, and their use of reinsurance. In theory, regulators should also monitor and impose limits on insurers' catastrophic risk exposures. However, in practice, it appears that regulators have not enforced such a policy. For example, in Florida, small single-state and regional insurers have been permitted to write large amounts of high-risk exposures in coastal areas. This regulatory omission resulted in the failure of five insurers (following the 2004-2005 storm seasons). Other small insurers (with large concentrations of coastal exposures) currently operating could suffer a similar calamity in the event of future hurricanes (Klein, 2007).⁸³

Rating agencies also play a role in monitoring and publishing opinions on insurers' claims paying ability. These agencies have developed their own capital standards and also closely evaluate insurers' catastrophe risk exposure and management. Klein and Wang (2007)⁸⁴ observe that rating agencies tend to apply more stringent standards than insurance regulators. Insurers who receive ratings are likely influenced to a greater degree by rating agencies' standards with respect to catastrophe risk management than regulatory standards. However, the rating agencies typically have not issued ratings for new and smaller, single-state insurers. Hence, the insurers that are at greatest risk in writing property insurance in states like Florida generally are not rated by rating agencies.

⁸¹ It is reasonable to expect that there is a point where the losses from staying in a market exceed the costs from exit, even with the additional constraints on and costs of exit. Also, this regulatory tactic may be used more as a threat than it is actually employed in practice. Grace, M.F., R.W. Klein and P.R. Kleindorfer (2004), "The Demand for Homeowners Insurance with Bundled Catastrophe Coverages," *Journal of Risk and Insurance*, 71: 351-379.

⁸² Ibid.

⁸³ Klein, R.W. (2007), "Catastrophe Risk and the Regulation of Property Insurance: A Comparative Analysis of Five States," Working Paper, Georgia State University, December.

⁸⁴ Klein, R.W. and S. Wang (2007), "Catastrophe Risk Financing in the United States and the European Union: A Comparison of Alternative Regulatory Approaches," presented at the "New Forms of Risk Sharing and Risk Engineering: A SCOR-JRI Conference on Insurance, Reinsurance, and Capital Market Transformations," Paris, September 20-21.

Entries, Exits and Market Concentration

The effects of increased hurricane losses and risk on the structure of the Florida market are still developing and there is a lag in the data available to track market changes. Still, it is important to glean what we can from these data and offer observations on how insurers appear to be adjusting their market positions. We can examine data through 2006 and augment these data with anecdotal observations on insurers’ actions in 2007. We begin by looking at shifts in the market positions of leading writers of homeowners insurance in Table 3.1.

TABLE 3.1. CHANGES IN LEADING INSURERS' MARKET SHARE FLORIDA - 1992, 2000, 2005 AND 2006

NAME	2006			2005			2000			1992		
	R	DPW	MS	R	DPW	MS	R	DPW	MS	R	DPW	MS
State Farm Group	1	1,444,281,352	21.4%	1	1,175,850,317	20.7%	1	583,296,400	20.1%	1	653,427,313	30.5%
Allstate Ins Group	2	524,702,881	7.8%	2	495,663,212	8.7%	3	325,641,465	11.2%	2	436,329,616	20.4%
Tower Hill Ins. Group	3	342,029,077	5.1%	4	285,914,090	5.0%						
Universal Prop. & Cas. Ins.	4	338,419,633	5.0%	8	159,161,458	2.8%	26	25,611,814	0.9%			
USAA Group	5	316,536,807	4.7%	6	253,944,356	44.5%	4	152,088,271	5.2%	3	951,711,018	4.4%
Nationwide Corporation	6	297,439,102	4.4%	5	274,919,617	4.8%	5	144,675,744	5.0%	5	88,595,495	4.1%
Liberty Mutual Group	7	221,726,692	3.3%	7	172,197,758	3.0%	10	51,714,570	1.8%	12	32,534,992	1.5%
ARX Holding Corp Group	8	216,582,227	3.2%	13	116,834,632	2.1%	25	27,120,693	0.9%			
Universal Insurance Group	9	186,151,076	5.0%	18	81,510,111	1.4%						
American International Group	10	161,500,150	2.4%	11	119,271,708	2.1%	15	38,442,829	1.3%	53	3,771,785	0.2%
Chubb & Son, Inc.	11	155,669,694	2.3%	10	124,290,363	2.2%	8	68,324,921	2.4%	6	62,874,910	2.9%
St Johns Ins. Co, Inc.	12	146,404,816	2.2%	25	64,285,117	1.1%						
United Prop. & Cas. Ins. Co.	13	138,913,586	2.1%	16	104,987,215	1.8%	36	14,473,319	0.5%			
Hartford Fire & Casualty Group	14	136,547,181	2.0%	12	117,479,131	2.1%	7	76,738,521	2.6%	9	49,288,247	2.3%
St Paul Travelers Group	15	131,197,512	1.9%	9	124,905,507	2.2%	6	92,445,712	3.2%	4	89,664,452	4.2%
Gulfstream Prop. & Cas. Ins. Co.	16	118,088,454	1.7%	17	93,418,769	1.6%						
21st Century Holdings Group	17	115,574,807	1.7%	20	77,513,454	1.4%						
Florida Peninsula Ins. Co.	18	114,706,859	1.7%	42	20,290,645	0.4%						
GeoVera Holdings Ins. Group	19		1.6%	14	111,695,287	2.0%						
First Protective Ins. Co.	20	89,864,708	1.3%	32	37,847,420	0.7%	43	10,928,140	0.4%			

Source: NAIC Financial Database

Table 3.1 ranks the top 20 homeowners insurers (on a group basis) in Florida in 2006 and also shows their market rankings (R) and market shares (MS) (in terms of direct premiums written, DPW) for the years 1992, 2000, 2005 and 2006. We do **not** include the Citizens Property Insurance Corporation in this aspect of our analysis as it is a residual market mechanism and our interest here is in the voluntary market in which insurers compete and make decisions about how much insurance they are willing to supply. We can see from this table that there have been dramatic changes in the Florida market since 1992. The top two groups in 2006 – State Farm and Allstate – were also the top two groups in 1992 and 2000. However, their combined market share has dropped from 50.9 percent in 1992 to 31.3 percent in 2000, to 29.2 percent in 2006. It is apparent that these two insurers have significantly reduced their “relative presence” in the Florida market (as measured by premiums). This development is not surprising given these insurers’ expressed need to limit their catastrophe exposures to what they consider more sustainable levels.

It is also interesting to note that while State Farm's market share has slightly increased since 2000, Allstate's share declined from 11.2 percent to 7.8 percent. This appears to be consistent with Allstate's declared intention to substantially reduce its concentration of exposures in high-risk areas to a level that it believes is more economically viable.⁸⁵ Other mid-tier insurers appear to have essentially maintained the same market shares over this period through 2006.

Another significant development has been the entry/expansion of some insurers, as other companies have retrenched or withdrawn from the market. Ten of the top 20 groups in 2006 entered the market after 1995 and seven of these insurers entered the market after 2000. Two important factors were the start-up of a number of new insurers in Florida during the 1990s and entries by other established insurers. The retrenchment or exit of some insurers created opportunities for other insurers to fill the gap.

However, entry into the Florida market carries risk, especially for smaller insurers with large portions of their exposures in the state. This was demonstrated by the rapid rise of the third and fourth leading groups in 2005 – the Poe and Tower Hill groups. Poe was bankrupted by the 2004-2005 storm seasons and is being liquidated. Tower Hill has been more diversified, with business throughout the Southeast, but it also has received increased scrutiny due to its large number of exposures in Florida. Two other insurers were placed into receivership – Vanguard and Florida Select. This demonstrates the drawbacks of relying heavily on local or regional insurers to fill large gaps left by larger, national insurers. Smaller insurers can bolster their capacity with extensive use of reinsurance, but this comes at a cost along with some retention of risk at a primary level. Hence, there is a limit as to how many high-risk exposures they can underwrite without substantially raising their risk of insolvency.

The story of the Poe companies is a good illustration of the “go for broke” strategy that some insurers employ when they encounter financial difficulty. Poe insured more than 300,000 homes, with most concentrated in the high-risk areas of Palm Beach, Broward and Miami-Dade Counties. Despite major losses from the 2004 storms and declining capital, Poe aggressively added more policies in 2005, gambling that it would not incur more storm losses. Such gambling is encouraged by a regulatory system in which an insurer can shift its losses to the state (i.e., insurance consumers and taxpayers) through the insolvency guaranty association. The insurer reaps the potential upside of such gambles while subjecting the public to the potential downside. This scenario became reality when the Poe companies became insolvent after the 2005 storm season, generating approximately \$750 million in guaranty association assessments.

Other national insurers have remained in the market but have limited the amount of their exposures. This may reflect a more reasonable strategy of acquiring small, “digestible” shares of a large but risky market by more broadly diversified insurers with greater amounts of capital. This phenomenon also poses less insolvency risk to the state. Unfortunately, Florida's regulatory policies may discourage national insurers from writing otherwise reasonable amounts of business in the state. The associated trends in market concentration in Florida from 1992-2006 are shown in Table 3.2.

⁸⁵ See, for example, “Allstate Considers More Cancellations,” *Tampa Tribune*, May 19, 2006.

TABLE 3.2. HOMEOWNERS INSURANCE MARKET CONCENTRATION - FLORIDA: 1992-2006

Year	CR4	CR8	CR20	HHI
1992	55.3%	70.9%	85.2%	1,440
1993	59.5%	71.6%	86.6%	1,438
1994	60.0%	71.9%	86.7%	1,236
1995	60.2%	72.2%	87.4%	1,406
1996	57.5%	71.5%	87.0%	1,266
1997	50.0%	63.8%	82.9%	1,046
1998	51.3%	64.9%	83.1%	920
1999	50.1%	62.7%	80.0%	846
2000	48.0%	61.2%	78.7%	776
2001	47.5%	60.1%	78.4%	783
2002	46.4%	59.2%	79.6%	829
2003	45.0%	59.9%	81.7%	839
2004	44.9%	61.4%	83.8%	832
2005	42.2%	60.0%	78.7%	714
2006	39.2%	54.5%	75.6%	695

Source: NAIC Financial Database

The combined market share for the top four groups (CR4) in Florida decreased steadily from 55.3 percent in 1992 to 39.2 percent in 2006. The combined market shares for the top eight (CR8) and top twenty insurer groups (CR20) also declined over this period. The Herfindahl-Hirschman Index (HHI)⁸⁶ decreased from 1,440 in 1992 to 776 in 2000, increased, then fell again to an all-time low of 695 in 2006. While the HHI includes all insurers in its calculation, it weights the market shares of the larger insurers more heavily so it is not surprising that it has also declined given the decrease in the market shares of the market leaders.

The decline in market concentration and the relative changes for the market leaders versus the mid-tier insurers is consistent with what we would expect to see based on our discussion of the impact of catastrophic risk on insurers' cost functions and exposure management. It is also consistent with anecdotal accounts of insurers' strategies and actions. One's view of whether this decline in concentration is good or bad depends on one's perspective. Normally, economists associate lower concentration with greater competition, but the situation in Florida's homeowners insurance market is peculiar. While insurers may be competing to maintain a "sustainable" market share, many are not currently seeking to increase their market share through price and product competition. Also, homeowners who have been dropped or rejected by their preferred insurer would not view this as a favorable development.

On the other hand, less concentration implies that there is a greater dispersion of exposures among carriers in Florida which could be viewed as a positive development in terms of greater diversification of risk, at least to the extent that nationally diversified insurers are part of this development. In markets subject to high levels of catastrophe risk, lower concentration levels may be a necessary condition to allow insurers to maintain their catastrophe risk at manageable levels.

⁸⁶ Market concentration is measured by the HHI where a higher value implies greater market concentration.

Another caveat to the observation about market de-concentration in Florida is the movement of exposures from national carriers to smaller state or regional insurers that are not pooling risk across a wide base of countrywide exposures. One aspect of this phenomenon is the movement of exposures to Florida-only companies within the national groups to increase the transparency of their Florida performance. If the smaller state and regional insurers are making good use of reinsurance to diversify and limit their catastrophe exposure, then the positive objective of broader risk diversification might still be achieved. Single-state companies within national groups can receive support from their affiliates in the event of large losses, but as we explain below, these national groups cannot engage in sustained cross-subsidies of their Florida insureds. These are aspects of market structure trends that warrant more investigation. Some homeowners also must find new carriers to underwrite their coverage and others may be forced into residual market mechanisms, at least for a period of time.

The transformation of Citizens into a competitor with the voluntary market could affect private insurers' market shares and market concentration. Had we included Citizens in our market concentration calculations, the market would appear much more concentrated. The excessive growth and size of Citizens is a problem, although it is not the kind normally associated with high concentration in private markets. The problem created by Citizens is that it is now in a position to crowd out private insurers and move more catastrophe risk exposure to the state. This will likely contribute to Citizens' funding shortfalls when more hurricanes strike the state which will, in turn, lead to greater assessments on all property-casualty insureds in the state.

Market structure changes appear to be much less significant in Texas, New York and South Carolina. Table 3.3 provides summary statistics on market concentration changes in several coastal states including the target states. In all of the states listed in Table 3.3, only two or three insurers have moved into the top 20 between 2000 and 2006 (see Grace and Klein, 2007).⁸⁷ The relatively greater stability in these markets may reflect several factors. One is that insurers' plans to adjust their positions are not fully implemented in terms of what the 2006 data reveal. Another factor may be that insurers see less of a need to reduce the number of policies they write in these states. Some of these states also appear to be taking a less restrictive approach to regulation (at least for the present) that may be helping insurers to retain a significant presence in these states. We should also note that the proportion of coastal exposures is considerably lower in these states than in Florida and, hence, coastal risk would be expected to have less of an effect on insurers' statewide market shares.

Table 3.3 also reveals that New York, South Carolina and Texas have experienced less significant changes in market concentration than Florida. The top eight insurers have increased their combined share of the market between 1992 and 2006, however, the HHI has decreased in South Carolina and Texas, but not New York. The increased market concentration in New York probably reflects the consolidation of homeowners insurers countrywide. New York, due to its relatively large market, still remains less concentrated than other states.

⁸⁷ Grace, M.F. and R.W. Klein (2007), "Hurricane Risk and Property Insurance Markets," Working Paper, Georgia State University, December.

The changes in South Carolina and Texas are more difficult to interpret. The decline in their overall market concentration (as measured by the HHI) reflects a more even distribution of the market beyond the largest insurers. This could be due to the increasing competitiveness of smaller insurers and/or the decisions by mid-tier insurers (beyond the top eight) to decrease their exposures in these states.

**TABLE 3.3. MARKET CONCENTRATION IN SELECTED STATES
HOMEOWNERS INSURANCE: 1992 AND 2006**

State	1992		2006	
	CR8	HHI	CR8	HHI
Florida	70.9%	1,440	54.5%	695
New York	56.0%	653	72.6%	914
South Carolina	76.5%	1,506	77.7%	1,159
Texas	78.2%	1,977	80.4%	1,423

Source: NAIC Financial Database, Authors' calculations.

Insurer Exposure Patterns

Insurers' statewide market shares (based on premiums) tell one part of the story on changes in the structure of a state's homeowners insurance market. Another important part of the story is the distribution of insurers' shares of exposures (i.e., the amount of insurance coverage) in different areas in the state – hurricane risk varies significantly among these areas, so this aspect of market structure is important in terms of understanding how insurers are managing their catastrophe risk, as well as the associated implications for homeowners. We have been able to obtain data that allows us to analyze this aspect of market structure for Florida but not the other states.

We acquired data on insurers' exposures by county by year/quarter from the Florida Office of Insurance Regulation (FLOIR). These data are reported by insurers to the FLOIR under its QUASR system. To make the data compilation more manageable, we requested and obtained data for the first quarter of every year from 1997-2006. For 2006, we obtained and used data from the fourth quarter of 2006 to develop a more current analysis. These data allow us to track trends and major changes in the distribution of insurers' exposures at a county level. Figure 3.1 shows a map of Florida counties for reference.

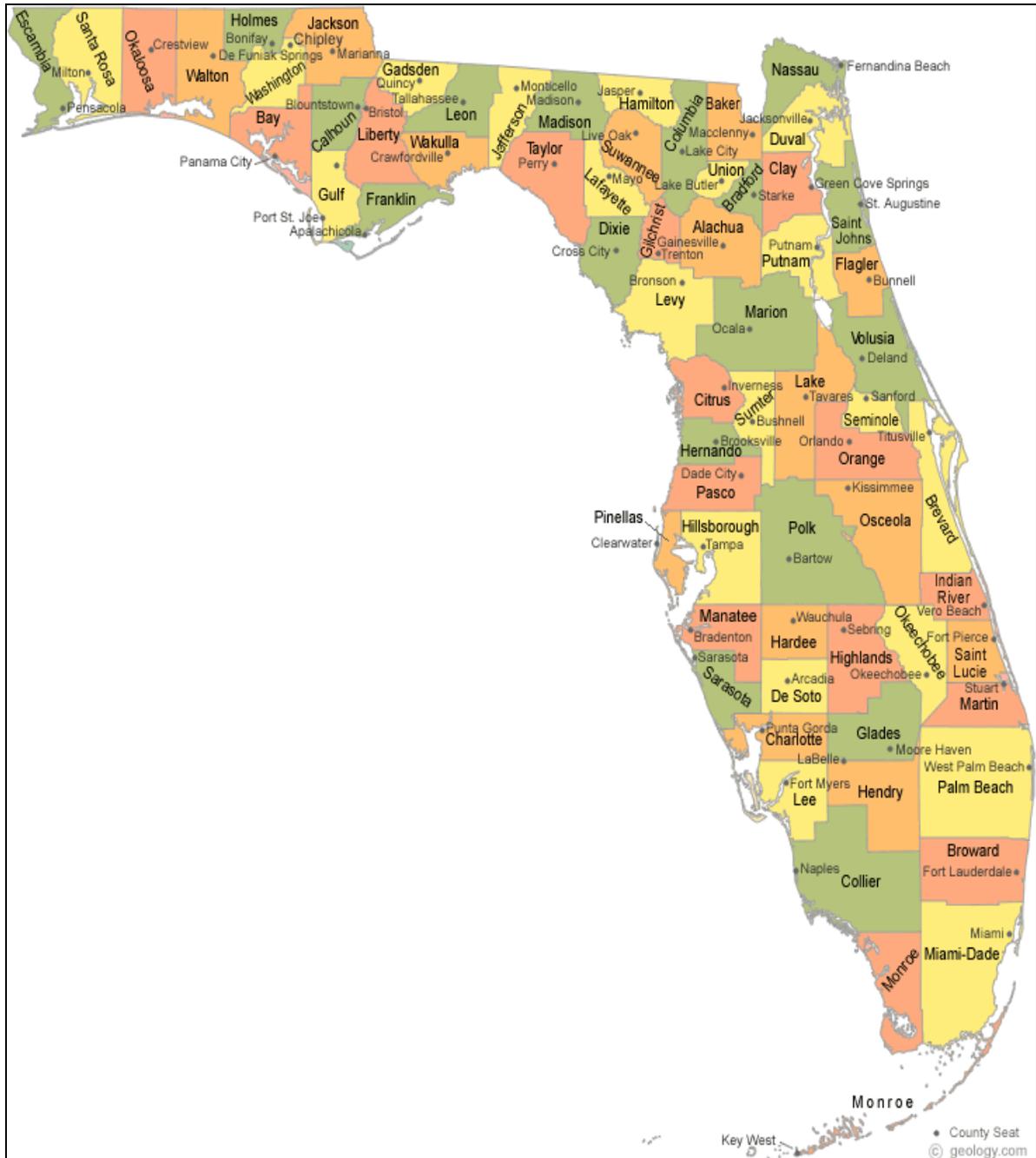


FIGURE 3.1. MAP OF COUNTIES AND MAIN CITIES IN FLORIDA

Table 3.4 compares the company level HHI (based on the amount of insured homeowners' property) by county between 1997 and 2006. Tables 3.5 and 3.6 compare the market shares of the ten leading insurers in Dade County in 1997 and 2006 at a company and group level. Two important developments can be gleaned from these data: (1) there is decreased concentration in the higher risk counties (along the coasts); and (2) the leading insurers in the state have decreased their shares of exposures in the highest risk counties. This is evident in both the company level data and the group level data.

TABLE 3.4. HOMEOWNERS' EXPOSURE COMPANY LEVEL HHIS BY COUNTY IN 1997 AND 2006
COUNTIES RANKED IN DESCENDING ORDER OF HHI

1997						2006					
Rank	County	HHI	Rank	County	HHI	Rank	County	HHI	Rank	County	HHI
1	Taylor	2,903	35	Hernando	1,439	1	Taylor	3,314	35	Hamilton	1,153
2	Hendry	2,459	36	Lake	1,419	2	Desoto	2,930	36	Alachua	1,151
3	Dade	2,373	37	Flagler	1,409	3	Hendry	2,762	37	Osceola	1,142
4	Broward	2,358	38	Pasco	1,370	4	Monroe	2,520	38	Charlotte	1,139
5	Brevard	2,221	39	Bradford	1,346	5	Hardee	2,496	39	Citrus	1,105
6	Desoto	2,197	40	St. Johns	1,341	6	Glades	2,478	40	Liberty	1,087
7	Volusia	2,113	41	Alachua	1,340	7	Baker	2,443	41	Orange	1,068
8	Osceola	2,102	42	Sarasota	1,327	8	Jefferson	2,399	42	Pasco	1,060
9	Polk	1,995	43	Leon	1,319	9	Putnam	2,198	43	Marion	1,050
10	Okeechobee	1,966	44	Putnam	1,278	10	Okeechobee	2,085	44	Santa Rosa	1,045
11	Glades	1,920	45	Jefferson	1,251	11	Bradford	2,050	45	Washington	1,045
12	Palm Beach	1,848	46	Calhoun	1,240	12	Columbia	1,878	46	Gadsden	971
13	Monroe	1,836	47	Bay	1,225	13	Volusia	1,795	47	Lee	953
14	Dixie	1,793	48	Hamilton	1,185	14	Duval	1,710	48	Levy	927
15	Charlotte	1,791	49	Union	1,148	15	Hernando	1,675	49	Pinellas	914
16	Escambia	1,754	50	Nassau	1,138	16	Jackson	1,645	50	Broward	900
17	Highlands	1,701	51	Madison	1,121	17	Lafayette	1,639	51	Walton	883
18	Pinellas	1,670	52	Levy	1,093	18	Sumter	1,632	52	Sarasota	880
19	Seminole	1,664	53	Washington	1,093	19	Polk	1,595	53	Indian River	849
20	St. Lucie	1,660	54	Jackson	1,083	20	Clay	1,573	54	Holmes	825
21	Hardee	1,655	55	Suwannee	1,074	21	Madison	1,543	55	Nassau	814
22	Santa Rosa	1,622	56	Manatee	1,054	22	Dixie	1,511	56	Flagler	801
23	Columbia	1,619	57	Walton	1,032	23	Leon	1,445	57	St. Lucie	797
24	Lee	1,619	58	Marion	1,030	24	Highlands	1,440	58	Dade	777
25	Okaloosa	1,615	59	Holmes	1,022	25	Calhoun	1,419	59	Manatee	718
26	Duval	1,605	60	Sumter	1,022	26	St. Johns	1,414	60	Collier	713
27	Orange	1,588	61	Martin	973	27	Suwannee	1,396	61	Hillsborough	712
28	Clay	1,578	62	Liberty	964	28	Union	1,359	62	Bay	705
29	Baker	1,553	63	Gilchrist	866	29	Seminole	1,300	63	Gulf	687
30	Citrus	1,541	64	Gulf	853	30	Escambia	1,269	64	Martin	666
31	Lafayette	1,535	65	Franklin	778	31	Brevard	1,263	65	Franklin	659
32	Indian River	1,526	66	Gadsden	738	32	Lake	1,234	66	Wakulla	620
33	Collier	1,496	67	Wakulla	730	33	Okaloosa	1,189	67	Palm Beach	594
34	Hillsborough	1,493		Total	1,594	34	Gilchrist	1,169		Total	876

Source: Data from FLOIR; Authors' calculations

TABLE 3.5. LEADING INSURANCE COMPANIES IN DADE COUNTY: 1997 AND 2006

Rank	1997		2006	
	Company	Mkt. Share	Company	Mkt. Share
1	State Farm Fire & Casualty	38.0%	State Farm Florida Ins Co	20.3%
2	Florida Residential Property Jua	29.5%	Citizens Property Insurance Corp	12.2%
3	Allstate Insurance Company	4.1%	Gulfstream Prop & Cas Ins Co	7.5%
4	Liberty Mutual Fire Insurance Co	3.1%	Atlantic Preferred Ins Co	6.2%
5	Allstate Floridian Insurance Co	2.3%	Liberty Mutual Fire Ins Co	6.0%
6	Metropolitan Prop & Cas Ins	2.0%	United Property & Casualty Ins Co	4.5%
7	United Services Automobile Assoc	1.7%	First Home Insurance Company	3.5%
8	Lm Property & Casualty Ins Co	1.7%	Federated National Ins Co	2.9%
9	Usaa Casualty Insurance Co	1.6%	Tower Hill Preferred Ins Co	2.1%
10	Hartford Insurance Co Midwest	1.6%	American Home Assurance Co	2.0%
	Top Ten	85.6%	Top Ten	67.1%

Source: Data from Florida Office of Insurance Commissioner

TABLE 3.6. LEADING INSURANCE GROUPS IN DADE COUNTY: 1997 AND 2006

Rank	1997		2006	
	Company	Mkt. Share	Company	Mkt. Share
1	State Farm Group	38.0%	State Farm Group	20.3%
2	FL Residential P&C JUA	29.5%	Citizens Property Ins Corp	12.2%
3	Allstate Insurance Group	6.6%	Liberty Mutual Insurance Companies	7.8%
4	Liberty Mutual Insurance Companies	4.8%	Gulfstream Property and Casualty Ins Co	7.5%
5	USAA Group	3.3%	Poe Insurance Group	7.3%
6	St. Paul Travelers Group	3.0%	United Property & Casualty Ins Co Inc	4.5%
7	Hartford Insurance Group	2.1%	Tower Hill Group	4.5%
8	MetLife Auto & Home Group	2.0%	First Home Ins Company	3.5%
9	Chubb Group of Insurance Companies	1.8%	HDI U S Group	3.2%
10	Bankers Insurance Group	1.4%	Federated National Ins Co	2.9%
	Top Ten	92.7%	Top Ten	73.6%

Source: Data from Florida Office of Insurance Commissioner

We also see from Tables 3.5 and 3.6 that “new” insurers have moved in to underwrite a significant proportion of exposures in Dade County. These are understandable developments, as the leading insurers have had to reduce their catastrophe exposure to more manageable levels that do not impose excessive financial risk. At the same time, this development raises questions about the financial viability of the smaller, geographically-concentrated insurers when more hurricanes hit the state.

This reinforces an important point. Florida cannot rely on small or geographically-concentrated insurers to underwrite a large number of homes in high-risk areas. A more sustainable approach is to encourage a large number of insurers to each write a “reasonable” number of homes in high risk areas, commensurate with the capacity and risk diversification of each company. Of course, saying this is easier than achieving it. However, if regulators allow insurers to charge fully adequate, risk-based rates and make other reasonable adjustments in their underwriting and policy terms, insurers should be more amenable to writing a manageable amount of high risk exposures.

3.2. Insurance Market Conduct and Performance

Insurers' conduct and, ultimately, market performance or outcomes, are of the greatest interest to various stakeholders. The key outcomes include the price of insurance, the availability of coverage, policy terms, and profitability. For obvious reasons, property owners are most interested in the price of insurance, as this can have a significant effect on their housing costs and budget. They are also interested in the availability of coverage, as this can affect how much insurance they can purchase, the insurers they can purchase insurance from, and whether they will need to obtain coverage in the residual market.

Insurers have a stake in these outcomes, but their profits (or losses) and financial viability are of particular concern. If insurers are unable to recover their cost of capital (at least in the long run), it becomes difficult for them to justify and sustain operations in a market. Also, continuing operations under such conditions can ultimately threaten their financial strength and solvency, with adverse consequences for their owners and all of their policyholders. In this section, we focus primarily on market performance but we also discuss aspects of insurers' conduct to a limited extent.

Prices

The price of homeowners insurance is a primary area of interest and concern. In the aftermath of the 2005 hurricane season, a number of insurers filed and implemented significant rate increases to reflect the higher degree of risk and increased cost of reinsurance (see Chapter 7 for a discussion of the reinsurance market). There are a number of ways to measure prices and price changes – no single measure reveals everything one would want to know, but each provides some information. There are also different definitions of the price of insurance. Economists tend to use a “net price” measure which is the loading added to the expected loss or “pure premium.” Here, we use a “full price” definition that includes the expected loss portion of the premium or rate charged. Consumers, regulators and others tend to focus on the full price rather than the net price.

Some indication of the price increases faced by insureds is provided by Figure 3.2 which plots trends in average homeowners' premiums in the four states being studied for the period of 1st Quarter 2002 through 1st Quarter 2007.⁸⁸ The source of data for this figure is the PCIAA/ISO Fast Track Monitoring System that compiles data on premiums, exposures, and losses on a quarterly basis from a subset of insurers representing approximately 60 percent of the total market countrywide. We calculated the average premium (total premiums divided by insured house-years) for each quarter in the series. It is important to note that these are statewide averages and, hence, will be affected by the geographic distribution of exposures and the factors affecting the different areas within these states. The impact of price increases for coastal homes on a state's average premium will be influenced by the relative proportion of exposures in coastal areas.

⁸⁸ In Figure 3.2 we also include data for the state of Louisiana as an element of comparison.

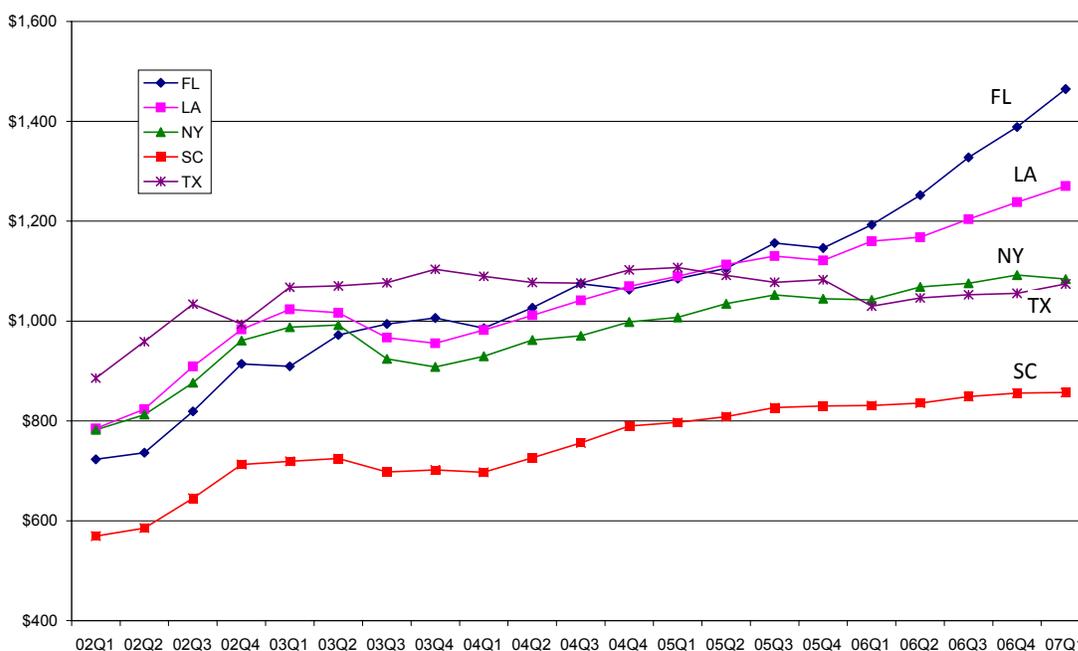


FIGURE 3.2. AVERAGE HOMEOWNERS' PREMIUM TRENDS (1ST QUARTER OF 2002 - 1ST QUARTER OF 2007)
 Source: PCIAA/ISO Fast Track Monitoring System; Authors' calculations

Florida has experienced the greatest absolute increase in the average premium among the states studied, from \$723 at the start of 2002 to \$1,465 in the first quarter of 2007. Texas and New York experienced more moderate relative increases, while the increase in South Carolina has been greatest in relative terms. From the insurers' perspective, the significant price increase in Florida is necessary to finance the higher risk of losses. From the insureds' perspective, the increase is a matter of concern and an additional financial burden. It could compel some homeowners to opt for larger deductibles or other coverage adjustments to lessen the impact of higher rates.⁸⁹ Coastal homeowners' complaints over insurance price hikes also increase political pressures on legislators and regulators to lower prices or at least prevent further increases.

An important caveat in interpreting these average premium trends is they reflect the weighted distribution of the premium increases on all policies in the underlying data. In each of these states, rates vary greatly between the lowest and highest risk area, and the average statewide premium encompasses all areas. We would expect premiums to be significantly higher in the coastal areas, and these areas have likely experienced a higher increase relative to interior areas of the state.

⁸⁹ The average premium will reflect coverage adjustments as it is based on the premiums that insureds actually pay.

There are other data that provide information on average premiums at a sub-state level in Florida. The first set of these data is drawn from “annual statistical data” provided by the Property Casualty Insurers Association of America (PCIAA). These data contain premiums, exposures (house-years), losses and the number of claims by standard rating territory for the years 2001-2005. We calculated average premiums for homeowners HO-3 policies (premium written divided by house-years) for each year and territory shown in Table 3.7 – the territories are ranked in descending order of their average premium in 2005.

We can see from this table that average premiums do vary significantly across the state. The territory comprising Indian River, Martin and St. Lucie Counties had the highest average premium in 2005 – \$2,051 – and also experienced the second largest increase over the period – 130.4 percent. The lowest territory – Jacksonville – had a \$509 average premium in 2005. The comparisons for other coastal states in Grace and Klein (2007)⁹⁰ reveal a similar pattern but the relative differences in average premiums between high and low risk territories are smaller in these states than they are in Florida.

It should be noted that these average premium measures are affected by several factors, including the amounts of insurance on homes and the terms of the policies covering those homes, as well as the rate structures of insurers. Hence, we cannot distinguish from these data how much of the average premium increase is attributable to rate changes. Still, it is reasonable to surmise that rate increases were a major factor causing the differences in the average premiums among territories as well as their increase over time. Also, because the latest year available for these data was 2005, they do not reflect the most recent market changes. We would expect further average premium increases in 2006 and 2007 as insurers’ approved rate changes were implemented.

⁹⁰ Op. Cit.

TABLE 3.7. FLORIDA HOMEOWNERS (HO3) AVERAGE PREMIUMS: 2001-2005⁹¹

Territory	2001	2002	2003	2004	2005
Indian River/Martin/St. Lucie	\$890	\$1,042	\$1,311	\$1,674	\$2,051
Miami	\$1,059	\$1,207	\$1,444	\$1,653	\$1,799
Palm Beach County	\$923	\$1,054	\$1,261	\$1,461	\$1,643
Miami Beach	\$856	\$754	\$881	\$1,404	\$1,589
Broward County	\$985	\$1,043	\$1,171	\$1,320	\$1,491
Broward/Palm Beach	\$715	\$828	\$958	\$1,170	\$1,373
Dade County II	\$1,104	\$1,088	\$1,137	\$1,258	\$1,366
Martin County	\$886	\$1,021	\$1,133	\$1,213	\$1,364
Fort Lauderdale/Hollywood	\$802	\$838	\$920	\$1,023	\$1,146
Tampa	\$631	\$683	\$773	\$916	\$1,108
Hillsborough/Pinellas	\$558	\$625	\$715	\$850	\$1,047
Bay, et al. I	\$634	\$725	\$821	\$912	\$1,039
Key West	\$351	\$216	\$290	\$844	\$1,016
Hialeah	\$1,091	\$1,117	\$979	\$935	\$984
St. Petersburg	\$473	\$554	\$655	\$776	\$976
Pinellas County	\$470	\$451	\$517	\$729	\$881
Bay et al. II	\$516	\$593	\$654	\$709	\$807
Escambia County	\$510	\$607	\$664	\$693	\$787
Polk County	\$533	\$610	\$680	\$704	\$776
Orange	\$540	\$570	\$609	\$670	\$769
Dade County I	\$944	\$832	\$887	\$1,003	\$756
Monroe County	\$379	\$228	\$290	\$664	\$689
Osceola/Seminole	\$561	\$578	\$564	\$567	\$640
Brevard/Volusia	\$455	\$498	\$522	\$545	\$616
Duval County II	\$425	\$451	\$465	\$507	\$612
Duval County I	\$453	\$482	\$519	\$530	\$544
Alachua et al.	\$511	\$511	\$477	\$469	\$523
Jacksonville	\$446	\$468	\$469	\$465	\$509
Mean	\$668	\$703	\$777	\$917	\$1,032
Median	\$560	\$618	\$697	\$847	\$980

Source: Data from PCIAA; Authors' calculations

An alternative approach to measuring sub-state differences and changes in prices is to calculate an average rate per \$1,000 of coverage. This approach is less affected by differences in the amount of insurance, but still confounds other coverage terms with rates. We can employ this approach with the county-level QUASR data for Florida; our calculations for the years 1997 and 2006 are reflected in Table 3.8. The results are quite striking and revealing, as the county with the highest rate was Monroe with a rate of \$34.46; the county with the lowest rate was Clay with a rate of \$2.49. Monroe also experienced the greatest increase from its rate of \$18.98 in 1997. This reflects the high level of risk in Monroe County which includes the Florida Keys.

Counties' rankings differ somewhat between the average premium and the rate per \$1,000. This indicates that differences in the average amount of insurance can mask or offset differences in the price of insurance. While the rate per \$1,000 of coverage controls for the amount of insurance, we would expect this rate to decline with the amount of insurance, all other things equal, because the fixed costs of writing and servicing a policy are spread over a

⁹¹ As noted above, these figures do not include coverage by Citizens.

larger amount of coverage. This likely accounts for some of the differences in counties' rates per \$1,000.⁹²

TABLE 3.8. HOMEOWNERS INSURANCE RATES PER \$1,000 BY COUNTY IN FLORIDA

County	1997	2006	County	1997	2006
Monroe	\$18.98	\$30.70	Hamilton	\$4.14	\$3.78
Dade	\$7.23	\$10.57	Gadsden	\$3.61	\$3.78
Franklin	\$6.42	\$8.13	Lafayette	\$4.36	\$3.71
Gulf	\$4.90	\$7.36	Washington	\$3.81	\$3.70
Broward	\$5.35	\$7.20	Highlands	\$3.24	\$3.62
Palm Beach	\$4.45	\$6.48	Gilchrist	\$3.89	\$3.57
Walton	\$4.47	\$6.29	Liberty	\$4.15	\$3.56
Indian River	\$3.80	\$5.67	Calhoun	\$3.80	\$3.54
Martin	\$3.66	\$5.63	Volusia	\$2.77	\$3.50
Pasco	\$3.07	\$5.15	Polk	\$3.00	\$3.49
Pinellas	\$3.25	\$5.13	Union	\$3.78	\$3.48
Escambia	\$3.68	\$5.01	Suwannee	\$3.91	\$3.46
St. Lucie	\$3.95	\$4.97	Citrus	\$2.98	\$3.40
Collier	\$3.88	\$4.93	Madison	\$4.04	\$3.34
Bay	\$3.64	\$4.83	Jackson	\$3.64	\$3.30
Dixie	\$4.70	\$4.72	Putnam	\$3.60	\$3.22
Okaloosa	\$3.90	\$4.53	Bradford	\$3.41	\$3.17
Lee	\$3.34	\$4.49	Jefferson	\$3.86	\$3.11
Glades	\$3.96	\$4.48	Nassau	\$3.38	\$3.07
Charlotte	\$3.16	\$4.47	Baker	\$3.49	\$2.97
Santa Rosa	\$3.06	\$4.34	Osceola	\$2.67	\$2.97
Brevard	\$3.15	\$4.33	Columbia	\$3.35	\$2.96
Hernando	\$2.84	\$4.32	Flagler	\$2.76	\$2.95
Okeechobee	\$3.54	\$4.29	Seminole	\$2.53	\$2.92
Wakulla	\$4.26	\$4.24	Orange	\$2.66	\$2.91
Hendry	\$3.42	\$4.22	Marion	\$2.98	\$2.90
Holmes	\$3.89	\$4.20	St. Johns	\$2.71	\$2.79
Sarasota	\$3.30	\$4.14	Alachua	\$2.61	\$2.76
Hardee	\$3.87	\$4.08	Sumter	\$3.36	\$2.72
Levy	\$3.93	\$4.02	Lake	\$2.83	\$2.70
Taylor	\$3.76	\$3.97	Duval	\$2.76	\$2.67
Desoto	\$3.55	\$3.96	Leon	\$2.42	\$2.38
Manatee	\$3.37	\$3.87	Clay	\$2.55	\$2.35
Hillsborough	\$3.44	\$3.81	Total	\$3.87	\$4.73

Source: Data from FLOIR; Authors' calculations

In sum, all of these comparisons tell a similar story: (1) the price of homeowners insurance is much higher in some areas of Florida than others; and (2) the price of insurance has substantially increased, especially in the highest risk areas. We see a similar pattern in other states but they have experienced smaller price increases, and the differences between coastal and non-coastal areas are not as great. Of course, this is not a great surprise, but our calculations reveal the magnitude of the differences and changes, and why property owners in

⁹² In Chapter 4 we discuss the premium change in these counties for public flood insurance, which has been less significant in the past few years.

high-risk areas are very unhappy about the rising cost of insurance and are putting increasing pressure on legislators and regulators to “ease their pain,” especially in Florida.

Availability of Coverage

The availability of insurance coverage also is an important performance outcome and an area of attention and concern to property owners, government officials and other stakeholders. “Availability” is a somewhat elusive thing to measure or quantify and can mean different things to different people. The preferred definition might be how easy or difficult it is for homeowners to obtain the coverage they want in the voluntary market from the insurers they prefer, but acquiring this information or even measuring availability so defined is difficult.

Hence, economists tend to use other availability indicators, such as the proportion of uninsured homes or the size of the residual market. However, there are problems with, and caveats to, these measures. It is difficult to obtain data on the proportion or number of uninsured homes, and the lack of insurance on a home may be partly a matter of choice on the part of the homeowner. Also, a home may have insurance, but the amount or breadth of coverage may be considerably less than what the homeowner would prefer. Similarly, the number and proportion of homes/policies in the residual market are affected by a number of factors, one of which is insurers’ willingness to supply insurance. Finally, this measure can confound prices with the “availability” of coverage – some homeowners may choose to obtain insurance in the residual market because it costs less than what they would be required to pay in the voluntary market. This will become an increasingly important factor in Florida, where Citizens’ rates and rules have been changed to make it competitive with the voluntary market.

The discussion of the residual market trends presented in Chapter 2 documents their growth, especially in Florida. This is one of several indicators of the decreased availability of homeowners insurance in coastal areas.

Distribution of Coverage Provisions

The provisions of insurance policies bought by property owners are also of some interest to policymakers and other stakeholders. The various homeowners insurance policy forms are fairly standard among insurers and insureds. The most important provision is the deductible on a policy. To better manage their catastrophe exposure and provide insureds with an option to lower their premiums, insurers have offered larger deductibles for wind or hurricane losses. These larger deductibles are typically expressed as a percentage of the dwelling (Coverage A) limit and could range up to 25 percent or more, depending on the state.

To gain some understanding of the distribution and trend of deductible levels, Table 3.9 shows the distribution of HO-3 policies (house-years) by deductible levels in Florida for 2000 and 2004. These data were obtained from the Insurance Services Office (ISO) and reflect information from insurers reporting statistical data to ISO (which represent approximately 50 percent of the total market). We should also note that, in 2004, the highest wind or hurricane deductible allowed was 5 percent.

As is evident in this table, “large” wind deductibles apply to a large and growing proportion of HO-3 policies in Florida. In 2004, almost 47.4 percent of HO-3 policies (issued by ISO reporting companies) carried a 2 percent hurricane deductible and another 11.9 percent carried a 2 percent wind/hail deductible, up from 43 percent and 3.8 percent in 2000,

respectively. The proportion of policies with smaller deductibles shrunk by almost 12.5 percentage points to 40.7 percent. Interestingly, policies with a 5 percent wind or hurricane deductible represented a very small percentage of all policies in 2004, but this is likely changing. It would be reasonable to expect that the proportion of policies with larger deductibles has continued to grow and is currently at a higher level than that indicated in the 2004 data. Property owners may prefer lower deductibles, but insurers can make these lower deductibles very expensive (in contrast with federally subsidized programs like flood insurance). Hence, a continued trend toward higher deductibles, first evident in the mid to late 1990s (see Grace, Klein and Kleindorfer, 2004)⁹³ would be consistent with this market dynamic.

TABLE 3.9. DISTRIBUTION OF WIND/HURRICANE DEDUCTIBLES IN FLORIDA: 2000 AND 2004

Wind/Hurricane Deductible	Pct. of Total House Years	
	2000	2004
\$1,000 Hurricane	0.46%	0.10%
\$2,000 Hurricane	0.05%	0.02%
\$500 Hurricane	7.25%	4.34%
1% Hurricane	1.51%	0.37%
1% Wind/Hail	0.07%	0.00%
2% Hurricane	43.00%	47.40%
2% Wind/Hail	3.79%	11.87%
5% Hurricane	0.34%	1.11%
5% Wind/Hail	0.01%	0.04%
All Other	43.53%	34.76%

Source: Data from ISO; Authors' calculations

Profitability

Firms' profitability is an important market performance outcome. In an efficient, competitive market, long-run profits would be expected to provide firms a "fair" rate of return equal to their risk-adjusted cost of capital. If firms' profits are too low, it will encourage market exit or retrenchment that could have adverse effects on consumers. On the other hand, if firms sustain high profits over the long term, it would raise questions about the competitiveness of the market.⁹⁴

The problem in insurance markets, especially in lines like homeowners insurance, is that profits can be highly volatile from year to year. In other words, insurers can earn low or negative profits in some years and what appear to be high profits in other years. Still, over the long-run, profits would be expected to "average out" near what would be considered a fair rate of return. This is closer to being the case in homeowners insurance markets that are subject to "normal" weather-related perils, but hurricane-prone markets are subject to much greater volatility and much longer "return periods." Insurers might have been prepared to handle an occasional severe hurricane (e.g., a Hurricane Andrew-level event every 10 years) but not the back-to-back multiple-event years experienced in 2004 and 2005.

⁹³ Grace, M.F., R.W. Klein and P.R. Kleindorfer (2004), "The Demand for Homeowners Insurance with Bundled/Catastrophe Coverages," *Journal of Risk and Insurance*, 71: 351-379.

⁹⁴ The term "long-run" can be ambiguous in the context of catastrophe risk. In homeowners insurance markets not subject to catastrophic risk, 5-10 years might be sufficient for insurers to balance out their profits and losses. However, in homeowners insurance markets subject to catastrophic risk, it may take much longer for profits and losses to balance out (presuming that rates were set at adequate levels). This makes it difficult to assess whether profits approximate a fair rate of return over the long run.

Even the relatively frequent occurrence of more modest levels of hurricane losses in a given year, e.g., \$1-\$10 billion in losses, can drive insurers' state and regional results deep into the red and keep them there for some time. This generates significant concern among their owners (stockholders or member-owners for mutual companies) who do not expect the managers of these insurers to continue to subject their companies to such sustained losses in any segment of their business. For those who would question the problems created by such scenarios, one might ask whether they would be comfortable in having a substantial portion of their savings invested in insurers subject to these kinds of losses.

There are several different profit measures that are used in insurance, including loss ratios, underwriting ratios, operating ratios, profits on insurance transactions, and estimates of the return on equity. We focus on *profits on insurance transactions* (PIT), which is a measure published by the National Association of Insurance Commissioners (NAIC) by line and by state, with some supplemental observations on other profit measures. This PIT measure includes incurred losses, all expenses, investment income attributable to loss and unearned premium reserves (not not surplus), and estimated federal taxes on the income earned (or tax credits on negative income).⁹⁵ The resulting profit (loss) is divided by direct premiums earned to produce a profit rate.

Figure 3.3 plots insurers' annual PIT rates for homeowners insurance in Florida and all Southeast states combined for the period 1992-2006. As can be seen from this figure, insurers earned positive profits in most of the years during this period, but had losses (negative profits) in Florida in 1992, 1993, 2004, and 2005. Insurers generated negative profits of -172.8 percent in 2004 and -62 percent in 2005. The negative profits in these years stemmed from Hurricane Andrew and the hurricanes that struck the state in 2004 and 2005.

Figure 3.4 plots cumulative profits (losses) for homeowners insurance in Florida and the Southeast for the same period, 1992-2006. Each year represents accumulated profits and losses from previous years. We can see from this figure that insurers' profits have been negative over the entire period. Cumulative losses decreased over the period until 2004. If insurers had earned positive profits in Florida in 2004-2005, they would have dug themselves out of the hole created by Hurricane Andrew. Even with more modest losses in 2004, they could have looked forward to eventually generating positive profits for the entire period (barring more hurricane losses), but the heavy storm seasons of 2004 and 2005 quashed any such hopes.

On a cumulative basis, as of the end of 2006, insurers were \$11.6 billion in the red on their Florida's homeowners business (representing -27.7 percent of cumulative premiums earned). Hence, insurers perceive that they are again deep in the hole with respect to their Florida and Southeast operations, and it will require a sustained period of positive profits to recoup these losses. Even if insurers were to earn \$2 billion in profits each year for the next five years, it would not be enough to erase their cumulative deficit; they earned \$1.6 billion in profits in 2006. Even with a return to positive profits, future hurricanes could plunge insurers' results back into a deep hole and this threat continues to affect insurers' caution in approaching property insurance markets in high-risk areas.

⁹⁵ All of the data used in these profit calculations are based on statutory financial statements filed by insurers.

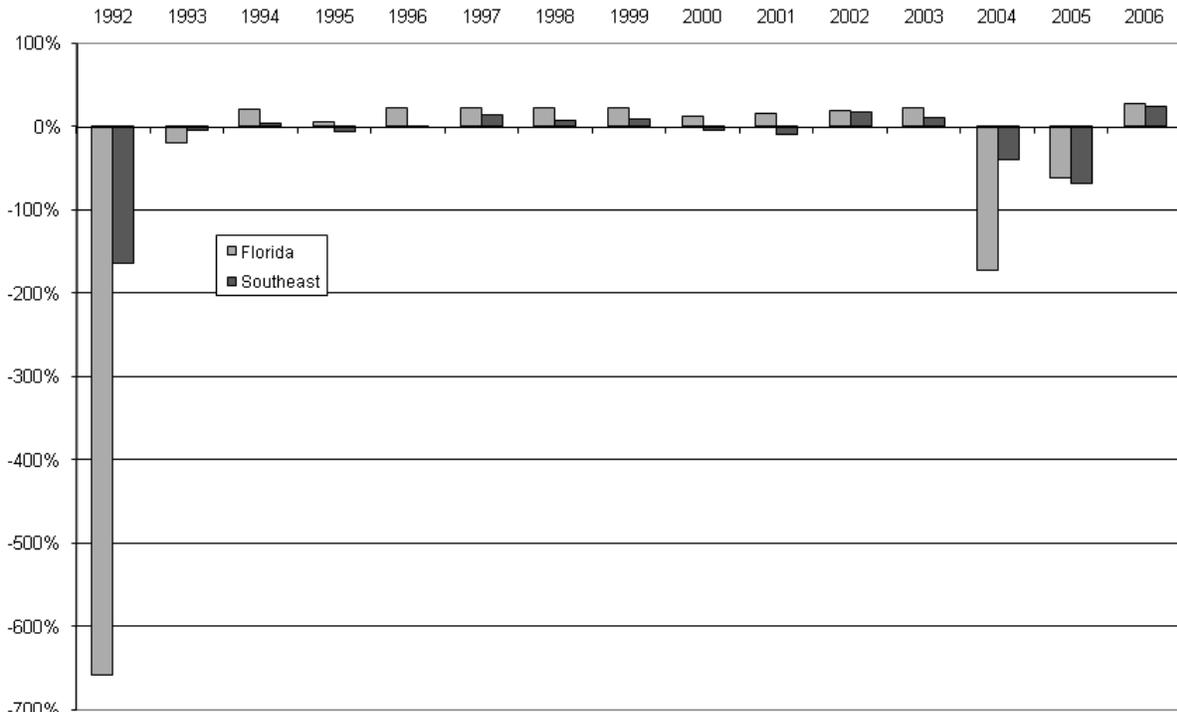


FIGURE 3.3. AVERAGE ANNUAL PROFITS ON HOMEOWNERS INSURANCE TRANSACTIONS: 1992-2006

Source: NAIC Report on Profitability by Line by State

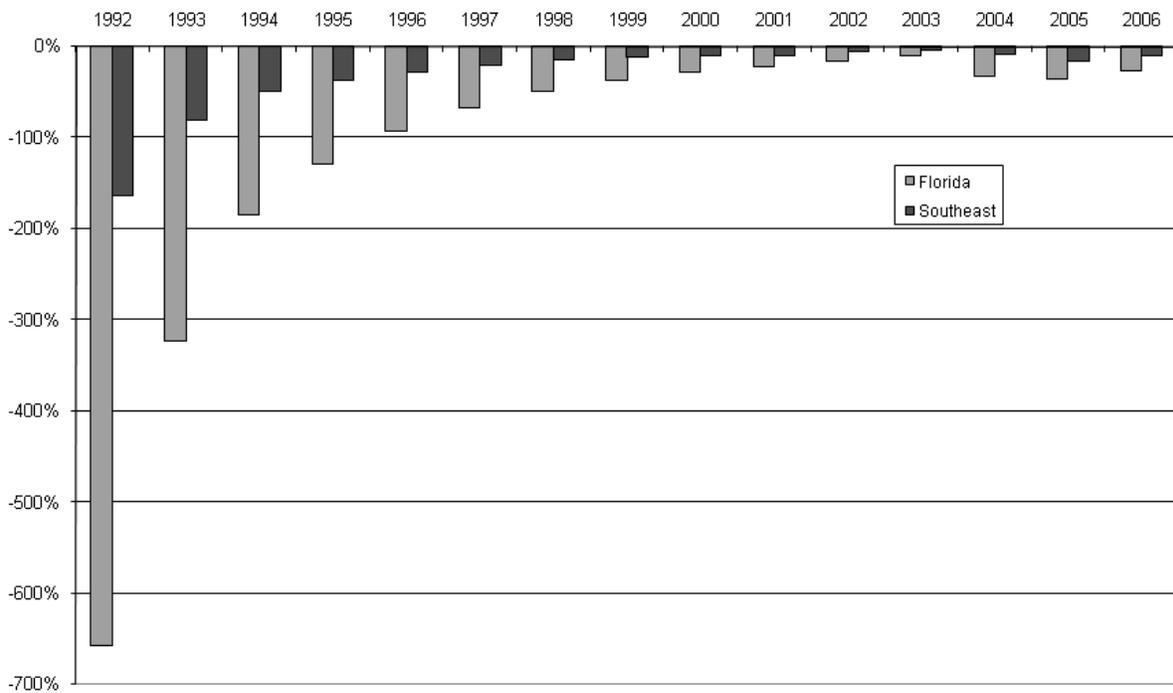


FIGURE 3.4. CUMULATIVE PROFITS ON HOMEOWNERS INSURANCE TRANSACTIONS

Source: NAIC Report on Profitability by Line by State

3.3. Conclusions for the Market Analysis

Our analysis of developments in Florida's and other states' homeowners insurance markets measures the significant changes that are occurring as a result of increased hurricane risk. There has been substantial market restructuring, with leading insurers decreasing their shares of the market and other insurers retrenching or exiting from the market, especially in the highest risk areas. Other insurers are maintaining their relative market positions and some have entered or expanded their business. Overall, market concentration has decreased significantly at a statewide and sub-state level in Florida and to a lesser degree in the other target states.

The price of property insurance also has increased significantly, particularly in the highest risk areas. At the same time, the availability of coverage has tightened considerably, reflected in the growing number of policies and amount of exposures insured in residual market mechanisms. Of the four states we study here, Florida has reported the greatest availability problems. Availability also has been an issue in coastal areas of South Carolina. It is not clear that Texas or New York are experiencing significant problems based on the information available to us. One interesting finding is that the greatest price increases and tightening of availability have occurred in Florida coastal areas with the exception of southern Florida. This suggests that insurers saw a greater need to make larger adjustments in these other coastal areas which had not previously experienced the magnitude of the rate increases and residual market shifts that had occurred in southern Florida prior to 2004.

Finally, it is apparent that insurers suffered substantial losses (negative profits) in Florida in 2004 and 2005 due to the hurricanes that hit the state in these years. Insurers also suffered huge losses in 2005 in Louisiana and Mississippi due to Hurricane Katrina. Prior to 2004, insurers were on the verge of earning positive cumulative profits (following Hurricane Andrew) but the 2004-2005 storms drove them deeper into the red. This has contributed to insurers' price and underwriting adjustments, and concerns about the economic feasibility of writing homeowners insurance in Florida and other high-risk areas under the prices and terms of coverage that preceded these storm seasons. The respite from damaging hurricanes striking the U.S. in 2006 and 2007 will allow insurers to improve their long-run profitability and may ease market pressures. However, hurricane risk remains high, and the potential for significant losses in future years is a substantial concern.

Clearly, there is a need to increase our understanding of how property insurance markets are changing and the factors that are driving the changes. Increasing our knowledge of market conditions and changes will help us better determine what economically-sound strategies might have the most beneficial effects for both insurers and property owners.

SUMMARY OF CHAPTER 3

This chapter provides an updated and extended analysis of the structure and performance of property insurance markets that have been subject to varying degrees of pressure from hurricane risk. Insurance markets in high-risk coastal areas have experienced significant changes and it is important to analyze how they have been evolving in recent years. We focus primarily on Florida and draw some comparisons with New York, South Carolina and Texas. Florida has experienced the greatest pressures and changes in terms of insurer retrenchment, higher prices, diminished availability of coverage and negative profits. The other states have experienced these problems to a lesser degree. This analysis continues to be a work in progress as market conditions are fluid and government/regulatory policies may change over time.

CHAPTER 4

FLOOD RISK FINANCING THROUGH PUBLIC INSURANCE

KEY FINDINGS

The National Flood Insurance Program (NFIP) has seen a significant change in the scope of its operation over the past 15 years:

- From 2.5 million policies in 1992 to over 5.55 million at the end of 2007 (+ 122 percent)
- From \$800 million in premiums collected from policyholders in 1992 to \$2.8 billion at the end of 2007 (+250 percent)
- From \$237 billion in coverage in 1992 to over \$1.1 trillion at the end of 2007 (+364 percent)

There is a huge disparity in flood insurance operations among the states. Florida alone represents nearly 40 percent of the entire NFIP portfolio so the analysis in this chapter focuses on that state.

Choice in flood coverage and its costs per dollar of coverage have changed over time.

Floridians reacted to flood damage caused by the 2004 hurricanes by choosing lower deductibles and higher limits of coverage. Our analysis of several million flood insurance policies reveals that in 2005 almost 80 percent of policyholders chose the lowest possible deductible (\$500). Even though homeowners increased their insurance coverage between 2000 and 2005, almost three-quarters were still below the \$250,000 maximum coverage limit. One reason for this large percentage is that many homes had property values below this limit. On the cost side, the average premium per policy in Florida is among the lowest in the nation. We also find that despite several major flooding episodes in 2004 in Florida, the cost of flood insurance in the state (as measured by the premium paid per \$1,000 of coverage) significantly decreased in all but two counties between 2000 and 2005.

Thirty percent of each dollar paid for flood insurance coverage goes to private insurers participating in the NFIP Write Your Own (WYO) program. These insurers play the role of financial intermediaries between policyholders and the NFIP, but do not bear any of the risk. Over the period 1968-2005, these private insurers received over \$7.4 billion (excluding the loss adjustment expenses for which we do not have data) in fees. On the financial operation of the program, we calculate that prior to the 2005 hurricane season, which inflicted nearly \$18 billion in flood claims, the NFIP had a cumulative deficit of about \$3 billion after 37 years of operation.

CHAPTER 4

FLOOD RISK FINANCING THROUGH PUBLIC INSURANCE⁹⁶

4.1. A Brief History of Flood Insurance

The National Flood Insurance Program (NFIP) originally grew out of a widespread feeling that flood peril was not insurable by private companies. Insurers in the United States claimed that floods could not be insured by the private sector because (1) only particular areas are subject to the risk, so that adverse selection would be a problem; (2) the premiums necessary would be so high that no one would be willing to purchase coverage; and (3) flood losses can be catastrophic, that is, enough premiums could not be collected to cover catastrophic events (Overman, 1957; Gerdes, 1963; Anderson, 1974).⁹⁷

Congress established the National Flood Insurance Program in 1968, noting that “many factors have made it uneconomic for the private insurance industry alone to make flood insurance available to those in need of such protection on reasonable terms and conditions.”⁹⁸ The feeling was that a government program could potentially be successful since it might pool risks more broadly, have funds to jumpstart the program, subsidize existing homeowners while charging actuarial rates on new construction, and tie insurance to land use changes that might lower risks (Grossman, 1958).⁹⁹ The government would also have the capacity to spread losses over time, thanks to the possibility of the program borrowing money from the federal government to cover deficits, something private insurers cannot do.

The NFIP was also enacted in response to the rising cost of taxpayer-funded disaster relief for flood victims. It was originally designed as a voluntary partnership between the federal government and communities. In exchange for enacting floodplain management regulations, property owners in participating communities would be eligible for federal flood insurance. There has not, as of yet, been a comprehensive study of the degree to which local governments comply with the required construction and development regulations, although there are some indications the regulations have reduced damages (Pasterick, 1998).¹⁰⁰

⁹⁶ This chapter is based on Michel-Kerjan, E. and C. Kousky (2008), “Come Rain and Shine: Evidence on Flood Insurance Purchases in Florida,” Joint Working Paper, The Wharton School of the University of Pennsylvania and The Kennedy School of Government, Harvard University, March.

⁹⁷ Overman, E.S. (1957), “The Flood Peril and the Federal Flood Insurance Act of 1956,” *Annals of the American Academy of Political and Social Science* 309 (January): 98-106.; Gerdes, V. (1963), “Insuring Against Flood Peril,” *The Journal of Insurance* 30(4): 547-553.; Anderson, D.R. (1974), “The National Flood Insurance Program: Problems and Potential,” *The Journal of Risk and Insurance*, 41(4): 579-599. Recently, this assessment has been changing. Swiss Re, for example, has argued that floods are insurable by private companies, given an appropriate partnership with government. (See Menzinger, I. and C. Brauner (2002), “Floods are Insurable!” Swiss Reinsurance Company. Zurich. It is interesting to see how different countries have handled the flood hazard differently. For example, private insurers provide flood coverage in the United Kingdom.

⁹⁸ This bill superseded the Federal Flood Insurance Act of 1956 (70 Stat. 1078) by implementing a federally run national flood program (the 1956 act was limited in scope, requiring, for example, that where “reasonably priced” private coverage was available, the federal insurance would not be.

⁹⁹ Grossman, D.A. (1958), “Flood Insurance: Can a Feasible Program Be Created?” *Land Economics*, 34(4): 352-357.

¹⁰⁰ Pasterick, E.T. (1998), *The National Flood Insurance Program. Paying the Price: The Status and Role of Insurance Against Natural Disasters in the United States*. Kunreuther, H. and R.J. Roth, Sr., (eds.) Washington, DC, Joseph Henry Press.

To support local governments, the NFIP maps participating communities, designating flood risks through different flood “zones.” These maps are called Flood Insurance Rate Maps (FIRMs). Buildings that were in place pre-FIRM – before the mapping of flood risk was completed in that area – are given subsidized rates. New construction, built after the risk mapping has been made public, is charged actuarial rates. The expectation was that as the housing stock turned over, fewer and fewer policies would be subsidized. However, around a quarter of properties are still subsidized (Congressional Budget Office, 2007).¹⁰¹ It thus appears that the housing stock is turning over more slowly than predicted, due in part to new construction and renovation techniques that have extended the life of buildings (Pasterick, 1998; Wetmore, Bernstein, et al., 2006).¹⁰² PricewaterhouseCoopers estimates that the number of pre-FIRM properties will decrease to 37 percent of all properties in 100-year flood zones by 2022, down from 64 percent in 1997 (PricewaterhouseCoopers, 1999).¹⁰³ FEMA estimates subsidized policies are 35-40 percent of a full-risk premium, although this is still higher than the premium homeowners would pay if they were charged actuarial rates and complied with construction standards to mitigate flooding (Hayes, Spafford, et al. 2006).¹⁰⁴ Of particular relevance to Florida, the Congressional Budget Office (CBO) found that many subsidized properties in coastal areas (23 percent from their sample of 10,000 properties) were second homes, vacation homes, or rentals (CBO 2007).¹⁰⁵ (For more on the effects of eliminating NFIP subsidies, see PricewaterhouseCoopers, 1999.)

Most of this analysis is based on the risk estimates from FEMA FIRMs. There is some question about the accuracy of these maps, however. Flood risks are not stationary. Development that reduces impervious surface area can increase flooding, as can the channelization of rivers (see, for example Criss and Shock, 2001)¹⁰⁶ and possibly climate change. FIRMs are not updated frequently and thus in some areas, the risk designated on the FIRMs can be a severe underestimate. For example, Temple University researchers undertook a detailed analysis of the Pennypack Creek Watershed in Pennsylvania and found that their assessment designated a larger area comprising the 100-year flood zone than did the existing FIRM (Center for Sustainable Communities, 2006).¹⁰⁷

Federal flood coverage initially was available only via insurance agents who dealt directly with the Federal Insurance Administration (FIA). In 1979, the FIA was placed under the Federal Emergency Management Agency (FEMA), and since 1983, the “direct” policy program has been supplemented with a program known as the Write-Your-Own (WYO) Program. The WYO program allows participating property/casualty insurance companies to write and service the standard Flood

¹⁰¹ Congressional Budget Office (2007), Value of Properties in the National Flood Insurance Program. CBO: Washington, DC. The subsidy applies only to the first \$35,000 of coverage on the building and \$10,000 on contents, although the mean and median claims in 2004 were below these limits.

¹⁰² Op. Cit.; Wetmore, F., G. Bernstein, D. Conrad, L. Larson, D. Plasencia, R. Riggs, J. Monday, M.F. Robinson and M. Shapiro (2006), “An Evaluation of the National Flood Insurance Program: Final Report.” American Institutes for Research. Washington, DC. Subsidized properties only become required to pay actuarial rates when they are damaged at half the property value or are improved creating an increase in value of 50 percent (CBO, 2007).

¹⁰³ PricewaterhouseCoopers (1999), Study of the Economic Effects of Charging Actuarially Based Premium Rates for Pre-FIRM Structures. PricewaterhouseCoopers, LLP.

¹⁰⁴ Hayes, T.L., D.R. Spafford and J.P. Boone (2006), Actuarial Rate Review. Federal Emergency Management Agency: Washington, DC.

¹⁰⁵ Op. Cit.

¹⁰⁶ Criss, R.E. and E.L. Shock (2001), “Flood Enhancement Through Flood Control.” *Geology* 29(10): 875-878.

¹⁰⁷ Center for Sustainable Communities (2006), Pennypack Creek Watershed Study. Center for Sustainable Communities, Temple University.

Insurance Policy in their own names. The premium charged by the private insurer is the same as that charged by the federal government through the direct program. Nearly all of the flood policies issued today are written by 85 companies that write flood insurance through the WYO program. For example, in the state of Florida, nearly 99 percent of all residential policies-in-force over the studied period 2000-2005 were WYO policies.

The WYO program is designed to be a win-win situation for the NFIP and private insurers. The NFIP benefits from the private insurance industry's marketing channels and the presence of many insurers in flood-prone areas. The WYO private insurers process flood claims as well as settle, pay, and defend all claims arising from the flood policies, while the NFIP retains responsibility for underwriting losses. In return, the private insurers participating in the WYO flood program receive an expense allowance (see Section 4.4), and do not bear the risk. In other words, they play the role of a financial intermediary and claims manager on behalf of the federal government.

Despite this potentially synergistic effort between the NFIP and private companies, take-up rates for flood insurance have historically been low. One reason is that private insurance agents do not seem to market NFIP policies (Anderson 1974).¹⁰⁸ Another reason is that individuals are not interested in voluntarily purchasing flood insurance due to behavioral biases in evaluating low-probability risks and/or lack of information (Anderson, 1974; Kunreuther, 1979; Power and Shows, 1979).¹⁰⁹ (See also Chapter 5.) Tropical Storm Agnes in 1972 demonstrated to Congress that very few people were participating in the NFIP, leading to the passage of the Flood Disaster Protection Act of 1973 (Anderson 1974; FEMA 2002).¹¹⁰ This Act limited federal disaster assistance to non-participating communities and also created a mandatory purchase requirement: federally-regulated lenders with mortgages must require flood insurance for the purchase of property acquired or developed in Special Flood Hazard Areas (SFHAs) which are defined as 100-year flood zones. While this led to a large relative increase in policies-in-force (see Figure 4.1), the major 1993 floods in the Midwest revealed that the mandatory purchase requirement was not being widely enforced, and sanctions on lenders were tightened in 1994. The 1994 Act created financial penalties for lenders that did not comply with the mandatory purchase requirement, stated that liability is not altered by sale or transfer of the loan, and mandated that lenders purchase insurance on behalf of the borrower if the borrower fails to do so.

It is difficult to determine how well these regulations are working. Lack of nationwide data on the number of properties in SFHAs makes a complete assessment somewhat difficult. Two recent studies are important in that regard. The first, published in 2004, reveals that in a sample of coastal areas, the participation rate was 49 percent of eligible properties (Kriesel and Landry, 2004).¹¹¹ A 2006 RAND report also estimates that about 49 percent of properties in SFHAs purchase NFIP flood insurance, and 1 percent of properties outside SFHAs purchase insurance, even though one-third of NFIP policies are outside SFHAs (Dixon, Clancy et al., 2006).¹¹²

¹⁰⁸ Anderson, D.R. (1974), "The National Flood Insurance Program: Problems and Potential." *The Journal of Risk and Insurance*, 41(4): 579-599.

¹⁰⁹ Ibid.; Kunreuther, H.C. (1979), "The Changing Societal Consequences of Risks from Natural Hazards." *Annals of the American Academy of Political and Social Science*, 443: 104-116; Power, F.B. and E.W. Shows (1979), "A Status Report on the National Flood Insurance Program, Mid 1978." *The Journal of Risk and Insurance*, 46(2): 61-76.

¹¹⁰ Ibid.; FEMA (2002), National Flood Insurance Program: Program Description. Federal Emergency Management Agency, Federal Insurance and Mitigation Administration. Washington, DC.

¹¹¹ Kriesel, W. and C. Landry (2004), "Participation in the NFIP: An Empirical Analysis for Coastal Properties," *Journal of Risk and Insurance*, 71(3): 405-420.

¹¹² Dixon, L., N. Clancy, S.A. Seabury and A. Overton (2006), The National Flood Insurance Program's Market Penetration Rate: Estimates and Policy Implications. RAND Corporation. Santa Monica, California.

4.2. NFIP Coverage Statistics

National Level

A noticeable effort has been made by the NFIP to increase knowledge of flood risks among the population through local and national education campaigns. FEMA launched a large-scale information campaign in 1995 called “Cover America.” According to FEMA, this campaign generated more than 500,000 inquiries to the NFIP. “Cover America II” was a new campaign launched in 1998. More recently, the NFIP launched FloodSmart, a comprehensive campaign featuring a website (www.floodsmart.gov) that features community risk and estimated premium rates, as well as mitigation measures, and how to enroll in the NFIP.

FEMA’s increased awareness of the flood risk, coupled with a series of major floods in 1992-1993 significantly contributed to increasing the number of flood policies issued by the NFIP.¹¹³ By 1997, the number of policies-in-force reached 4 million, and continued to increase in the following years. A more significant increase started in 2004 and accelerated in the aftermath of Hurricane Katrina and major floods in Louisiana. As of December 31, 2007, 5.55 million policies were in place; that is 750,000 more than were in place 2 years before. These changes are shown in Figure 4.1.

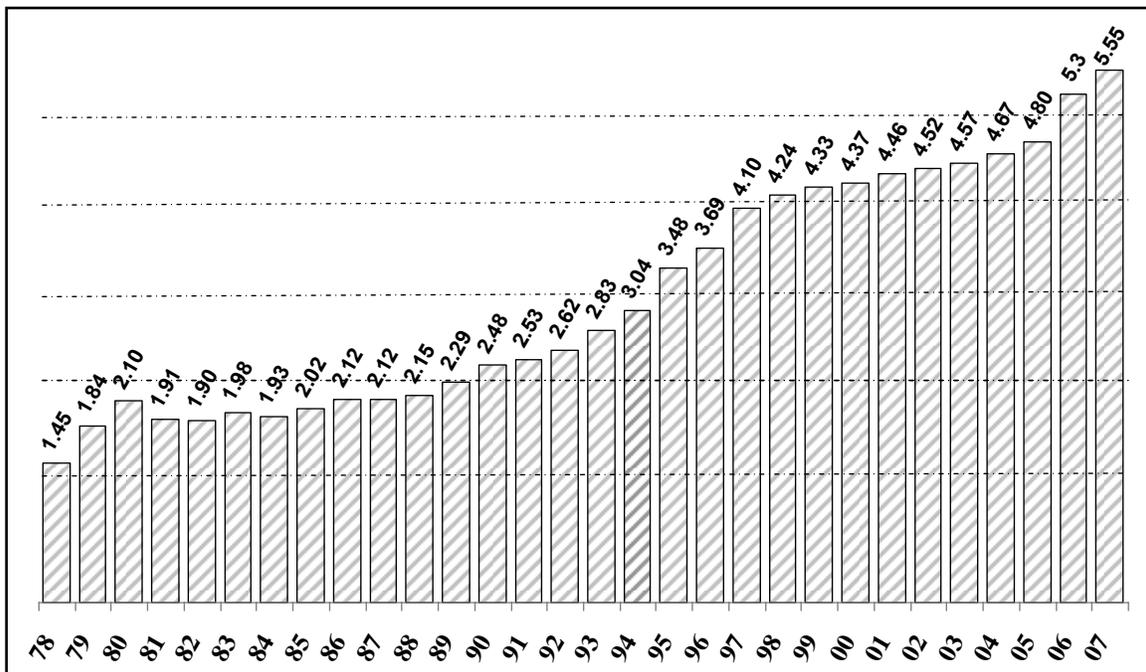


FIGURE 4.1. EVOLUTION OF U.S. NATIONAL FLOOD INSURANCE TOTAL POLICIES-IN-FORCE BY YEAR (IN MILLION POLICIES; 1978 - DECEMBER 2007)
 Sources: Authors’ calculation, Data from FEMA, Department of Homeland Security (NFIPStat, 2008)

¹¹³ Three significant flood events in 1992 (Texas flood, Hurricane Andrew, and a Nor’easter) generated over \$500 million in insured losses; a March storm and the floods in the Midwest in 1993 also generated \$500 million of payments by the NFIP. The Texas floods in October 1994, the Louisiana floods in May 1995, and Hurricane Opal cost the NFIP a total of over \$1.2 billion.

Over the same period, the total value of property insured under the NFIP has been growing rapidly, as depicted in Figure 4.2. In just the past six years, the total exposure (sum of the limits on all policies) has almost doubled. It was \$214 billion in 1990 and \$568 billion nationwide in 2000. In September 2006, it reached 1 trillion dollars, and has continued to grow; it was \$1.1 trillion at the end of December 2007.

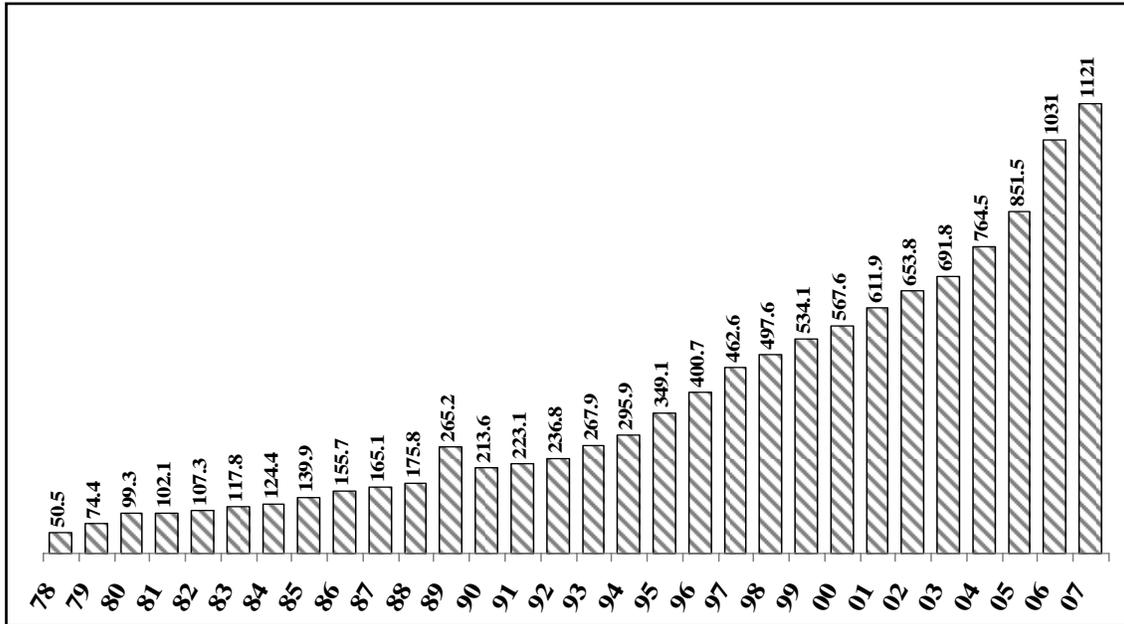


FIGURE 4.2. EVOLUTION OF U.S. NATIONAL FLOOD INSURANCE TOTAL COVERAGE-IN FORCE BY YEAR (IN \$ BILLION; 1978 - DECEMBER 2007)
 Sources: Authors' calculation, Data from FEMA, Department of Homeland Security (NFIPStat, 2008)

Not surprisingly, premiums collected for flood coverage have increased significantly as well, from \$670 million in 1990, to \$1.72 billion in 2000, to \$2.81 billion at the end of December 2007 (Figure 4.3).

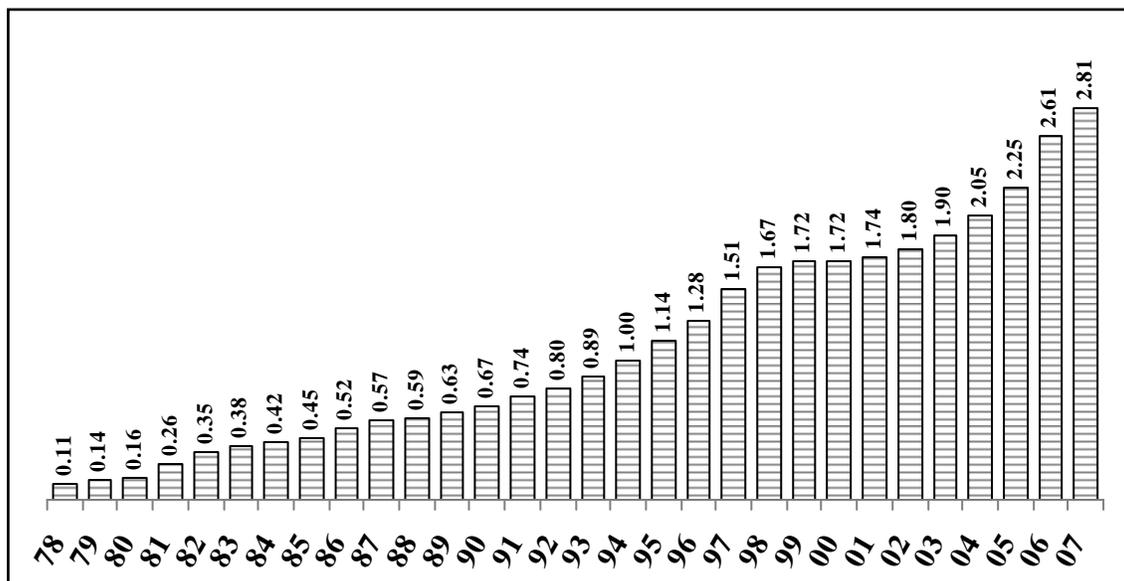


FIGURE 4.3. EVOLUTION OF TOTAL PREMIUMS COLLECTED BY THE NFIP BY YEAR (1978 - DECEMBER 2007)
 Sources: Authors' calculation, Data from FEMA, Department of Homeland Security (NFIPStat, 2008)

State Level

The NFIP does not play the same role in every state. Figure 4.4-A provides the number of flood policies in place for each state as of September 2006, and Figure 4.4-B depicts the growth rate in the number of policies in place between October 1, 2005 and September 30, 2006. The three states where the increase has been most significant are highly exposed to flood hazards, notably Mississippi (+69 percent), Texas (+30 percent), and Louisiana (+27 percent).

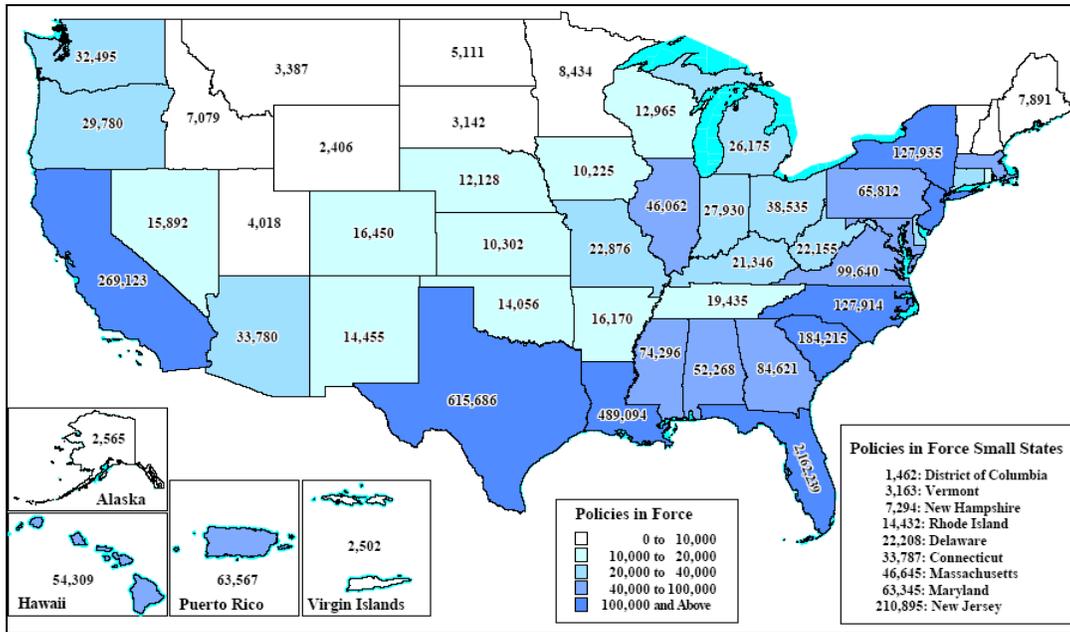


FIGURE 4.4-A. NUMBER OF NFIP POLICIES IN PLACE PER STATE, AS OF SEPTEMBER 30, 2006

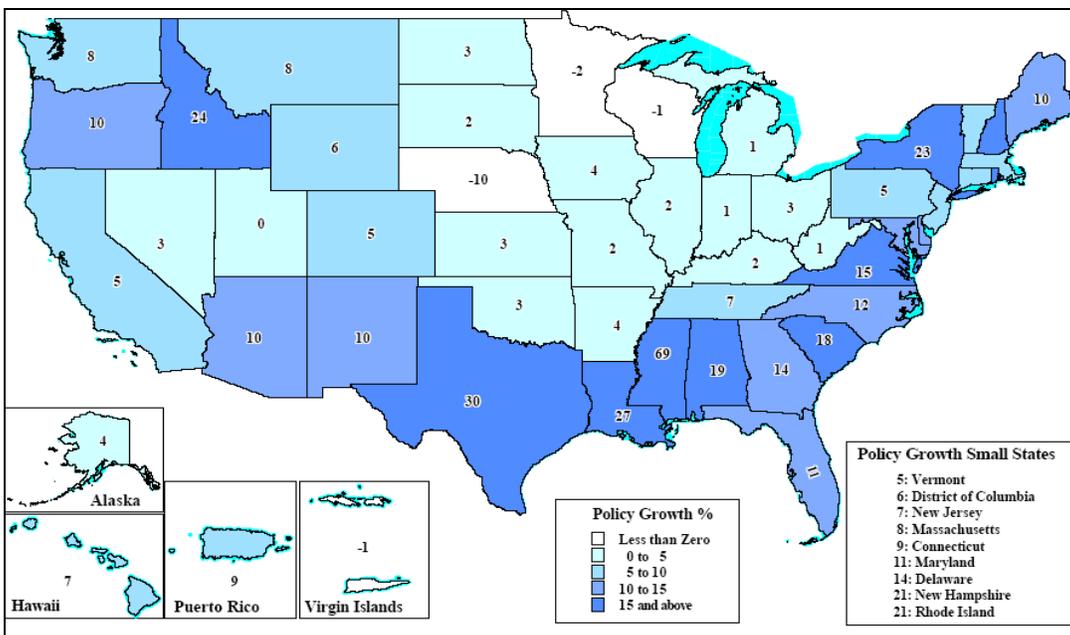


FIGURE 4.4-B. NFIP POLICY GROWTH PERCENTAGE CHANGE PER STATE, OCTOBER 1, 2005 - SEPTEMBER 30, 2006

Source: FEMA

Table 4.1 provides a summary of the top ten states (ranked by the number of flood policies-in-force) for several coverage and pricing measures as of December 31, 2007. We briefly discuss each of them now. Note that these are average figures which do not show the important differences within a state depending on location, exposure to risk, value of the house, and demographics of the homeowner. We will discuss these variables in more detail in the next section, when we analyze the Florida market.

TABLE 4.1. NFIP SUMMARY STATISTICS WITH A FOCUS ON THE TOP 10 STATES (DECEMBER 31, 2007)

	Number of flood policies in place	Quantity of Insurance in place (\$U.S.)	Annual premiums (\$U.S.)	Average premium per policy	Average premium per \$1,000 of coverage	Average quantity of insurance per policy
Nation	5,554,041	1,120,767,708,600	2,810,863,345	\$506	\$2.51	\$201,793
Florida	2,189,759	454,409,776,100	901,071,362	\$411	\$1.98	\$207,516
% nationwide	39.43%	40.54%	32.06%			
Texas	666,920	145,170,577,200	279,895,243	\$420	\$1.93	\$217,673
% nationwide	12.01%	12.95%	9.96%			
Louisiana	502,085	93,608,829,200	286,015,533	\$570	\$3.06	\$186,440
% nationwide	9.04%	8.35%	10.18%			
California	266,171	62,041,065,600	168,952,788	\$635	\$2.72	\$233,087
% nationwide	4.79%	5.54%	6.01%			
New Jersey	223,650	45,945,494,500	159,123,884	\$711	\$3.46	\$205,435
% nationwide	4.03%	4.10%	5.66%			
TOP 5 STATES	3,848,585	801,175,742,600	1,795,058,810	\$466	\$2.24	\$208,174
% nationwide	69.29%	71.48%	63.86%			
South Carolina	197,334	43,090,182,300	101,117,712	\$512	\$2.35	\$218,362
% nationwide	3.55%	3.84%	3.60%			
New York	144,253	31,598,332,600	109,182,682	\$757	\$3.46	\$219,048
% nationwide	2.60%	2.82%	3.88%			
North Carolina	133,955	28,618,309,100	74,043,712	\$553	\$2.59	\$213,641
% nationwide	2.41%	2.55%	2.63%			
Virginia	105,860	23,137,990,700	57,149,668	\$540	\$2.47	\$218,572
% nationwide	1.91%	2.06%	2.03%			
Georgia	88,429	19,465,735,700	49,644,456	\$561	\$2.55	\$220,128
% nationwide	1.59%	1.74%	1.77%			
TOP 10 STATES	4,518,416	947,086,293,000	2,186,197,040	\$484	\$2.31	\$209,606
% nationwide	81.35%	84.50%	77.78%			

Sources: Authors' calculation from FEMA data as of December 31, 2007.

Number of Flood Policies in Place. The state of Florida represents almost 40 percent of the total number of flood policies issued by the NFIP, and the top two states – Florida and Texas – represent over 50 percent of the entire NFIP portfolio. This is thus a highly concentrated market; about 70 percent of policies are located in just five states – Florida, Texas, Louisiana, California, and New Jersey.

Quantity of Insurance in Place. The distribution among the top states remains nearly the same when the dollar value of the coverage-in-place is used as the measure of quantity of insurance instead of the number of policies. Florida alone has \$454 billion of coverage-in-place, over 40 percent of total coverage nationwide. The top five states account for more than \$800 billion of flood coverage, or 71 percent of the national figure; the top 10 states have \$947 billion of flood coverage, or nearly 85 percent of total national coverage.

Total Premiums Collected over the Past Year. With more than \$900 million in premiums collected, the state of Florida represents about one-third of the total \$2.81 billion premiums collected by the NFIP nationwide. The top five states collected \$1.8 billion, or 64 percent of the total premiums.

Average Quantity of Insurance per Policy. The average quantity of insurance coverage per policy varies somewhat by state from the national average of \$202,000. In December 2007, it ranged from \$186,000 in Louisiana to \$233,000 in California; it was \$201,000 in Florida, \$217,000 in Texas, \$218,000 in South Carolina and \$219,000 in New York.

Average premium per policy and per dollar of coverage. At a national level, the average premium collected per policy is \$506, but there are major differences between states. Among the top ten states in Table 4.1, Florida and Texas have by far the lowest average premium per policy ratio (\$411 and \$420, respectively). Louisiana is at \$570 and the state of New York has the highest figure among these 10 states, with an average of \$757 per policy, or about twice that of Florida.

A somewhat better measure of the cost of insurance, though, is the ratio of premium over quantity of insurance purchased. It is interesting to note that despite a radical change over time in terms of new policies and total exposure of the program, the average national homeowner still pays \$2.50 per \$1,000 of flood coverage (an implicit probability of a flood occurring every 400 years, assuming that the price reflects exposure).¹¹⁴ This average ratio varies from state to state and of course, depends on the location where those who purchase flood coverage live, and the characteristics of their home: on average, we find that insurance is cheaper in Florida and Texas (\$1.98 and \$1.93 per \$1,000 of flood coverage, implying a probability of a flood that is less than 1-in-500)¹¹⁵ and more expensive in New York and New Jersey (\$3.46 per \$1,000 of flood coverage, which is equivalent to a 1-in-300 implicit probability of flooding).¹¹⁶

¹¹⁴ The price does, of course, vary by flood zone, but averaging across all policies at the national level is also telling.

¹¹⁵ Given that the premiums also included fees paid for administrative expenses to insurers participating in the WYO program, the implicit probability of flooding is actually even lower than that.

¹¹⁶ Prices for NFIP insurance are set nationally and vary by flood zone (see Appendix 4-A) and characteristics of the house. They do not vary by state or locality so the numbers reported here reflect the variety in flood risk by state, variation in the composition of who buys insurance, and of course, how much coverage is bought per policy – a function of the value of homes.

4.3. Analysis of Flood Insurance in the State of Florida

We now turn to our analysis of flood insurance in the state of Florida. Florida represents – well above any other state – the largest portion of the NFIP portfolio. With almost 40 percent of the policies-in-force in the United States, Florida is a natural “laboratory” to study in order to better understand the functioning of the NFIP and the characteristics of homeowners who choose to buy flood coverage. Moreover, this state is also highly exposed to hurricane risks where there is a possibility of water damage that would be covered by the NFIP. It has also the highest concentration of exposed value in high-risk areas of any state in the country. Florida is thus of particular interest to many policymakers.

In this section we address four questions regarding flood insurance in Florida:

- (1) *What are the characteristics of the buyers of flood insurance in Florida?*
- (2) *How much coverage do Floridians buy?*
- (3) *What factors determine claims payments?*
- (4) *How much does flood insurance cost in Florida? How has that cost evolved over the period 2000-2005?*

Data Collected to Undertake the Study

To answer these four questions we compiled data from several sources. The first one is a dataset of over 7.5 million flood insurance policies provided to us by the National Flood Insurance Program (NFIP).¹¹⁷ It has all the policies-in-force in the state of Florida for six consecutive years (2000-2005): over 1.21 million policies in 2000, 1.24 million in 2001, 1.26 million in 2002 and 2003, 1.29 million in 2004, and 1.37 million in 2005.

The dataset has identifying information removed, such as household addresses, preventing us from doing a household-level analysis, but it does have the postal zone, city, and county in which the policyholder is located. The dataset contains a variety of variables relating to the policy, such as coverage bought, premium paid, and deductible chosen. The data also has the flood zone the policy is located in, the Community Rating System (CRS) rating of the community (more on this below), the type of policy (single-family, commercial, etc.), and for some policies, information on the house, such as whether it has a basement or whether it is elevated.

From the NFIP we also received a claims dataset that contains all claims in Florida through August 31, 2006. The dataset again has identifying information removed. It includes information on the claim, such as the date of the loss, what catastrophe it is associated with, the amount of damage, how much was paid, etc. It also contains information on the house and contents associated with the claim, such as structural features of the house and the value of the house and contents.

Finally, we also drew on data from the 2000 U.S. Census. This gave us demographic information at the county level, such as median income and median value of owner-occupied housing. While these figures have certainly evolved since 2000, that is the most recently available Census data. Measures such as these were used to better understand the factors driving the decision to purchase insurance.

¹¹⁷ We thank Tim Scoville and Ed Pasterick for sharing this dataset and the claims dataset for the purpose of our research project and for helpful discussions on the practical operation of the program.

First Question: What are the characteristics of the buyers of flood insurance in Florida?

As shown in Table 4.2, the majority of flood policies in Florida (over 80 percent) are for single-family residential properties. The remaining policies are either multiple family homes or other residential coverage (e.g., mobile homes). About four percent of policies-in-force are non-residential (e.g., commercial). For that reason, most of the analyses in the rest of the chapter focus on single-family residential properties. They represented over 1.15 million policies in Florida in 2005.

TABLE 4.2. PERCENT OF POLICIES-IN-FORCE IN FLORIDA BY OCCUPANCY TYPE, 2000-2005

OCCUPANCY TYPE	PERCENT IN 2005	PERCENT IN 2004	PERCENT IN 2003	PERCENT IN 2002	PERCENT IN 2001	PERCENT IN 2000
Single-Family	83.50	83.09	82.82	82.51	82.01	81.27
2-4 Family	4.45	4.58	4.66	4.69	4.81	4.94
Other Residential	7.82	8.03	8.27	8.56	9.01	9.69
Non-Residential	4.22	4.29	4.26	4.24	4.18	4.11

The highest absolute numbers of single-family policies-in-force in Florida in 2005 are in Broward (254,497 policies), Miami-Dade (197,078 policies), Palm Beach (82,408 policies), Lee (79,330 policies), and Pinellas (68,048 policies) Counties. These five counties account for nearly two-thirds of all single-family policies-in-force in the state in 2005. The five counties with the fewest absolute numbers of policies-in-force are: Liberty (23 policies), Union (38 policies), Hamilton (56 policies), Jefferson (60 policies), and Madison (73 policies) Counties. Not surprisingly, given the hurricane risk in Florida, the counties with more policies-in-force are on the coast, while those with fewer policies tend to be inland.

If instead of absolute numbers, the number of policies-in-force per household is examined (using an estimate of number of households from the 2000 Census), it provides a measure of market penetration. The counties with the highest percentage of policies-in-force per household in 2005 are Franklin (67 percent), Monroe (66 percent), Charlotte (41 percent), Lee (39 percent) and Broward (39 percent) Counties (see Figure 4.5). The counties with the fewest policies per household are Gadsden (0.005 percent), Liberty (0.005 percent), Jackson (0.006 percent), Madison (0.01 percent) and Washington (0.01 percent). Again, the counties with the highest percentages are, not surprisingly, located on the coast.

One can also examine the rankings of counties using the total value at risk for the NFIP rather than the number of policies-in-force. The counties with the highest total amount of coverage-in-force (building plus contents; i.e., NFIP's exposure) for single-family policies in 2005 are: Broward (\$53.6 billion), Miami-Dade (\$36.6 billion), Palm Beach (\$18.5 billion), Lee (\$14.7 billion), and Pinellas (\$11.6 billion). The counties with the highest number of policies-in-force are the same counties with the highest amount of total coverage. They are not, however, the counties with the highest market penetration. The five counties with the lowest amounts of total coverage are: Liberty (\$962,900), Union (\$3.38 million), Hamilton (\$4.51 million), Jefferson (\$5.14 million), and Madison (\$7.26 million).

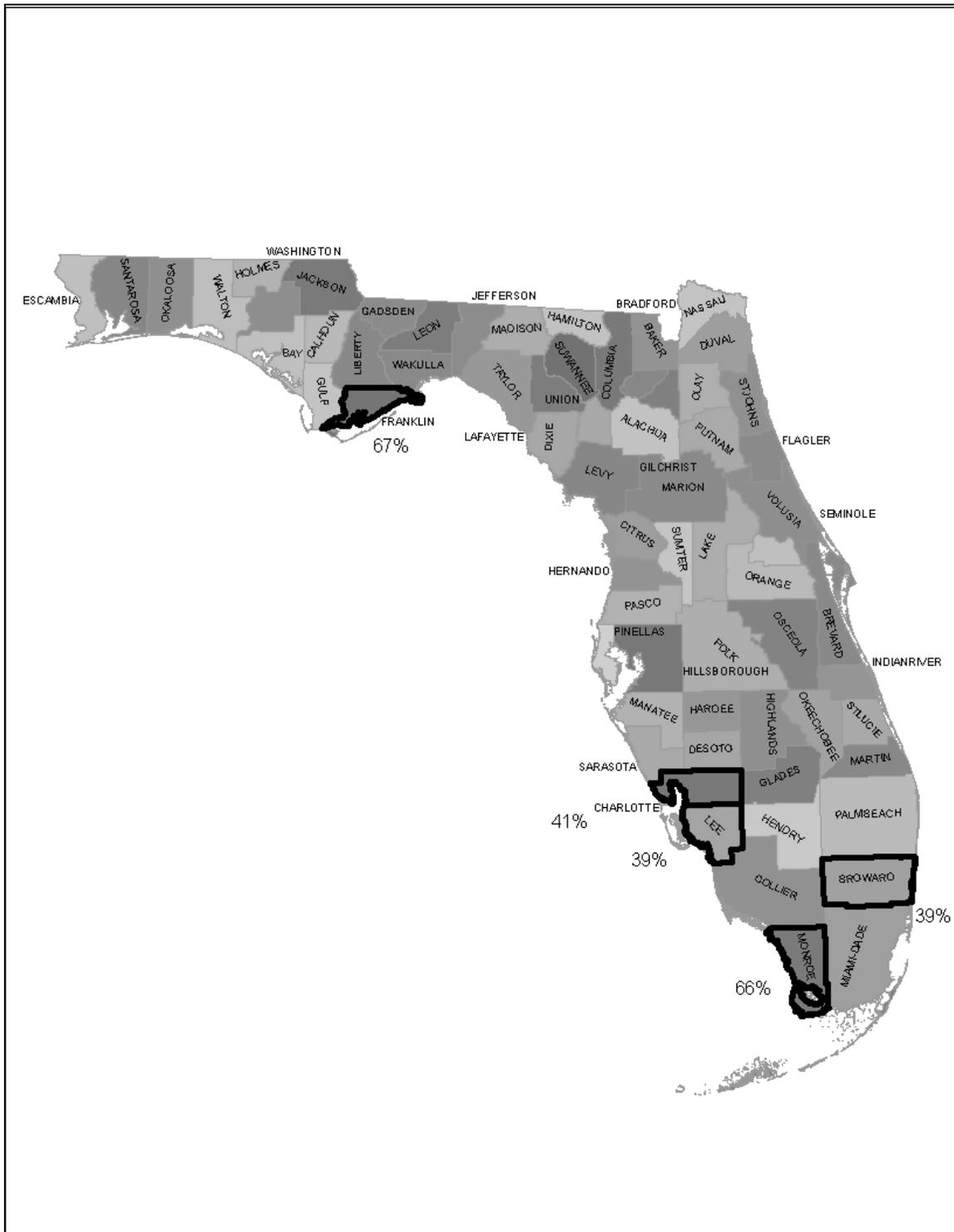


FIGURE 4.5. TOP FIVE FLORIDIAN COUNTIES IN TERMS OF MARKET PENETRATION IN 2005

It is also important to consider how the number of policies-in-force varies by risk level (at least as defined by FEMA). As mentioned earlier, FEMA has mapped the flood risk of communities participating in the NFIP. The risk is differentiated by flood zones. In reporting on flood zones here, we are not making any judgment on the quality of this risk assessment.¹¹⁸ Ideally, we would like to be able to look at take-up rate by flood zone. Unfortunately, there is no comprehensive dataset of the number of households in each flood zone by county for the state of Florida. From our data, however, we do have the number of policies-in-force in each flood zone. A summary is presented in Table 4.3. Definitions of NFIP flood zones are detailed in Appendix 4-A.

TABLE 4.3. PERCENT OF SINGLE-FAMILY RESIDENTIAL POLICIES-IN-FORCE IN FLORIDA BY FLOOD ZONE, 2000-2005

Flood Zone	Percent in 2005	Percent in 2004	Percent in 2003	Percent in 2002	Percent in 2001	Percent in 2000
X	17.90	15.15	14.89	15.31	15.62	15.39
A-A99	17.36	18.74	19.64	20.30	20.89	21.71
AE	32.22	32.80	32.30	31.77	31.56	31.78
AHB	22.17	22.99	18.34	20.13	20.07	19.77
AO, AOB, AH	2.26	2.55	6.81	4.3	3.52	2.64
V-VE	.94	1.04	1.09	1.12	1.16	1.23
B, C, D	7.15	6.73	6.93	7.05	7.17	7.44

Flood zone X is comprised of those areas that are determined to be outside the 100-year and 500-year floodplains, thus designating minimal flood risk.¹¹⁹ Flood insurance is not required for this zone. Interestingly, despite no insurance requirement and minimal risk, about 15 percent of all residential, single-family policies-in-force since 2000 have been in this zone, increasing to about 18 percent in 2005.

Zone B designates moderate flood risk and zone C designates minimal flood risk. Both areas are outside the 100-year floodplain. Zone D are areas with possible flood risks, but no analysis has been completed on these areas. These three zones represent only a small percentage of policies in Florida.

The A zones are FEMA-designated 100-year floodplains and NFIP insurance is **mandatory**. The subcategories within the A designations (A-A99; AE; AHB; AO, AOB, AH) refer to whether a detailed hydraulic analysis has been done, and if so, the particular nature of the flooding. Not surprisingly, about 75 percent of all single-family policies in Florida are located in these 100-year floodplains.

Finally, there are the V and VE zones which correspond to coastal 100-year floodplains that have associated with them risk of storm surges. Quite surprisingly to us, given that Florida is highly exposed to hurricane risk, very few policies are in the V and VE zones.

¹¹⁸ As discussed earlier, there has been an important controversy on the quality of these maps, especially in the aftermath of Hurricane Katrina and the breach of the levees in New Orleans.

¹¹⁹ We provide the full definition of each zone in Appendix 4-A.

The NFIP also maintains a Community Rating System (CRS), which is a voluntary program that rewards communities that undertake mitigating activities by lowering their premiums (to reflect the now lower risk). The deduction in premiums can range from 0 to 45 percent of the full “actuarial rate” (as defined by FEMA), depending on the actions taken. Table 4.4 shows how policies-in-force break down by CRS class. In 2005, about a quarter of residential policies-in-force were in communities with no CRS discount. The remaining three quarters of policies benefit from some type of price discount, ranging from 5 to 25 percent. Virtually no policies receive a discount higher than 25 percent.

TABLE 4.4. PERCENT OF RESIDENTIAL POLICIES-IN-FORCE IN FLORIDA BY CRS CLASS

CRS Discount	Percent in 2005	Percent in 2004	Percent in 2003	Percent in 2002	Percent in 2001	Percent in 2000
0%	26.36	23.15	22.97	23.03	23.08	22.20
5%	5.09	6.83	7.67	10.01	13.84	17.50
10%	25.24	27.57	28.15	31.62	33.10	35.81
15%	21.68	20.52	19.68	17.41	25.64	23.90
20%	8.22	8.64	18.30	17.21	3.79	.09
25%	13.41	13.29	3.23	.72	.55	.50
More than 25%¹²⁰	0	0	0	0	0	0

Table 4.4 also shows how these percentages varied between 2000 and 2005. Over the time period, there are an increasing percentage of policies receiving no discount, but a higher number receiving the discount of 25 percent. For instance, from 2000 to 2003 less than 1 percent of the policies were located in communities that received a 25 percent discount on the actuarially based price (as defined by FEMA). That proportion significantly increased in the following two years; more than 13 percent of the policies had such a discount in 2005. Since we cannot follow one specific policy over time, it is not possible to draw any conclusions from our dataset as to whether these changes are due to new policies or to existing policies located in communities that have become much more active in mitigating flood risk.

In conclusion, a more granular analysis of the state reveals important differences among counties. Like the country overall, the NFIP market in Florida is highly concentrated with just a few counties responsible for the majority of policies and coverage. Most of these policies are for single-family homes and naturally, most of the coverage-in-force is located along the coasts and in SFHAs. That said, almost 20 percent of homeowners are buying insurance outside of the mandatory purchase areas.

¹²⁰ Only a few policies in the dataset are in CRS classes that provide a discount higher than 25 percent. There was one policy (with a 50 percent discount) in 2004, one in 2002 (with a 30 percent discount), 35 policies in 2000 (with a 75 percent discount) and no policies with over a 25 percent discount in 2005, 2003, and 2001.

Second Question: How much coverage do Floridians buy?

We now turn to our second question that focuses more specifically on the design of the flood insurance contract Floridians purchase. Here, we analyze the demand side of flood insurance by determining policyholders' choice on the contract: what deductible and what limit they select.

Limit on coverage. The amount of insurance homeowners can purchase from the program has evolved over time. The NFIP has always had a maximum coverage limit (a policy has, in fact, two maximum limits: one for the structure and one for the contents). This maximum has increased over time but has remained the same since 1994 (see Table 4.5).¹²¹ A minimum amount was established with the enactment of the mandatory purchase requirements for those properties affected by the requirements. This minimum is the principal remaining on the outstanding mortgage (unless this amount is above the maximum coverage limit) with purchase being required for the life of the loan.

**TABLE 4.5. NFIP SINGLE-FAMILY, RESIDENTIAL COVERAGE LIMITS BY POLICY
(NOMINAL DOLLARS)**

Year	Structure Limit	Contents Limit
1994	\$250,000	\$100,000
1977 ¹²²	\$150,000	\$50,000
1973	\$35,000	\$10,000
1968	\$17,500	\$5,000

Source: 42 U.S.C. 4013 (as amended)

In order to compare the evolution of the real value of this maximum, we compiled data by indexing this limit to 2008 prices (total maximum limit of \$350,000 in 2008). Figure 4.6 depicts this 2008-index total policy limit over the period 1968-2008 using the official U.S. inflation rate for each year over this 40-year period. This index was computed on January 1, 2008. In real price, the maximum limit on a flood policy today is about the same as it was 20 years ago, despite a significant inflation over this period (not to mention that in many places real estate price has actually increased at a much higher rate than just the inflation).

¹²¹ Commercial (non-residential) buildings are eligible for up to \$500,000 in building coverage and up to \$500,000 on personal property. According to FEMA, as of June 2007, nearly 2 million of the 5.4 million policies-in-force had building coverage only, 3.4 million had both building and contents coverage, and 100,000 had contents coverage only.

¹²² Since 1977, limits are the same for single-family dwelling and multi-family dwellings.

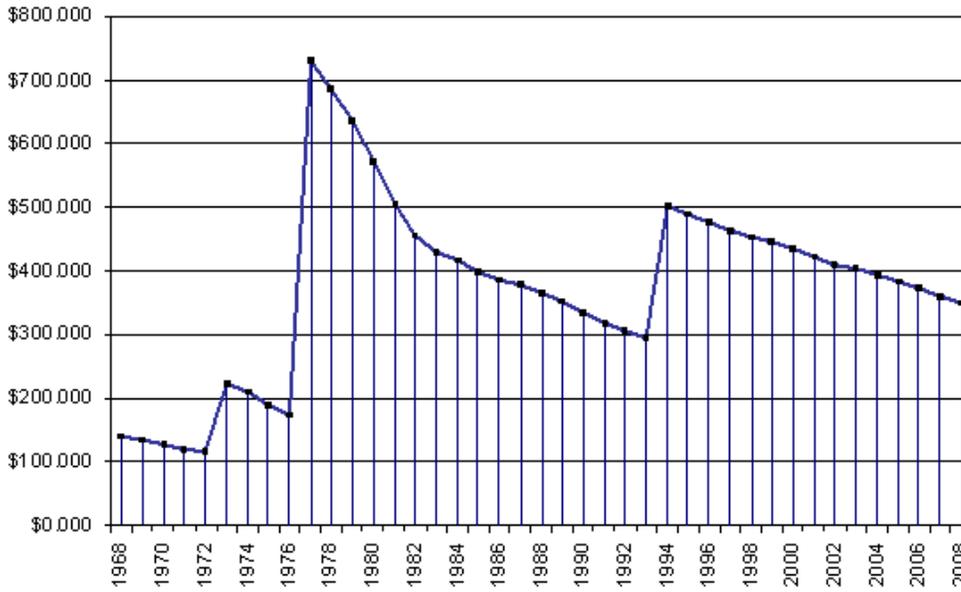


FIGURE 4.6. EVOLUTION OF FLOOD TOTAL COVERAGE LIMITS BY YEAR (1968-2008)

INDEXED TO JANUARY 1, 2008 DOLLARS

Source: Authors' calculation

Over the years, many have argued that the \$250,000 coverage limit is a problem for many homeowners. This concern was raised again following Hurricane Katrina. Given our data on the over seven million flood insurance policies issued in Florida between 2000 and 2005, it is possible for us to measure whether or not that \$250,000 threshold really constitutes a limitation on the demand side.

Our conclusion, looking at all policies-in-force in the state of Florida in 2005, is that this limit is **not** binding for the majority of homeowners. More specifically, we find that about 73 percent of single-family homes had building coverage below the \$250,000 limit in 2005. Given that the median value of owner-occupied housing units in the state of Florida reported in the 2000 Census was only \$105,000, this result should not be surprising. While much media attention has been paid to the multi-million dollar houses located on the beach, the large majority of residences in Florida are valued less than the NFIP building coverage limit for residential properties.

Figure 4.7 depicts the percentage of the 1.14 million flood policyholders in 2005 that selected a given limit for building and contents coverage. As seen in the figure, about 27 percent of homeowners purchased building coverage at the insurance limit. Presumably, many of these policyholders would welcome the option of choosing a higher limit.¹²³

¹²³ Not surprisingly, several private insurers, including AIG and Chubb, offer private insurance in excess of the NFIP policy limits. However, the same problems of insurability that the NFIP was established to address affect private programs. To our knowledge, AIG offers its coverage in a only handful of states, including California, Colorado, Connecticut, Illinois, and Massachusetts: Silverman, R. (2005), "Insurers Introduce Flood Coverage Aimed at Costly Homes," *Wall Street Journal*, September 1. The Chubb Group is offering its policies only in Arizona, Colorado, Illinois, Idaho, Indiana, Michigan and Utah: *Best's Review*, (2006) "High Water Mark: Privatizing Flood," July 1. Therefore, private flood insurance is not available in the areas where homeowners need it the most. We are not aware, however, of any exhaustive dataset that contains this information for the state of Florida that we could access.

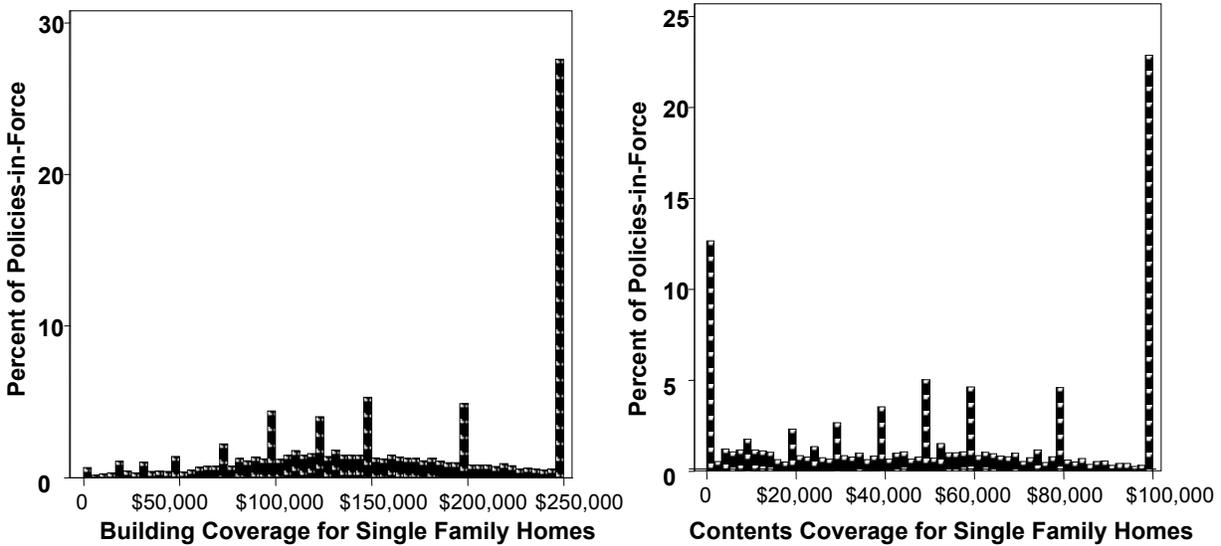


FIGURE 4.7. BUILDING AND CONTENTS COVERAGE FOR SINGLE-FAMILY HOMES IN THE STATE OF FLORIDA FOR 2005

The pattern for contents coverage is also shown in Figure 4.7. About 23 percent of single-family policies in the state of Florida in 2005 are at the \$100,000 limit for contents coverage – very close to the 27 percent at the building coverage limit. Of the 1.14 million single-family policies-in-force in 2005, however, roughly 12.5 percent have zero contents coverage. The number with zero contents coverage has been declining slowly since 2000, however, while the number at the coverage limit has risen substantially over this time from 7.5 percent in 2000 to almost 23 percent in 2005.

Similarly, the number and proportion of policyholders who have purchased the \$250,000 limit has been growing steadily. In 2000, only around 10 percent of single-family policyholders were at the coverage maximum limit. In 2003, there were 17 percent, and 27 percent in 2005, as discussed. In part, this reflects the growth of Florida’s population over this time period and the increased value of the real estate.

As expected, those with higher building coverage tend to have higher contents coverage. Our analysis of the data shows that on average over the entire state, there is approximately a 70 percent chance a policyholder will buy the maximum limit of contents coverage if she has bought the maximum limit of building coverage.

These state averages mask considerable county-level variability in whether policyholders are up against the maximum coverage limit. In 2005, there were some counties with virtually no policyholders at the limit, such as Liberty and Lafayette Counties, and some counties with half or more policyholders at the limit, such as Walton, Nassau, Collier, and Martin Counties. As mentioned, over time, more counties are finding more policyholders at the coverage limit. In 2000, the counties with the highest percentages of policies at the limit had only about 25 percent at the limit (these were Indian River, Walton, and Martin Counties) whereas in 2005, the highest percentages were over 50 percent.

As expected, the percent of policyholders at the limit is positively correlated with income measures from the 2000 Census, such as the median value of owner-occupied housing and median income. We calculated that the correlation coefficient is approximately .6 for both measures. The higher the value of the home and/or the higher income of the policyholder, the more likely they are to be at the coverage limit. Both the median value of owner-occupied housing and median income are significant predictors in county-level regressions with the percent of policies at the coverage limit as the dependent variable (not provided here due to space limitations). Also, as expected, as the cost of insurance increases, the amount of coverage purchased declines.

Deductible. The second element of the contract we analyze is the choice of the deductible. The NFIP offers policyholders a choice of six deductibles for building coverage under which policyholders retain the full loss: \$500, \$1,000, \$2,000, \$3,000, \$4,000, and \$5,000.

We find that the majority of homeowners prefer a lower deductible. Our findings reinforce results previously published in the literature on decision making and insurance. Eldred (1980)¹²⁴ examined decisions with respect to homeowners and automobile insurance in South Carolina. He found that 20 percent of the 657 respondents who were interviewed had chosen the lowest possible deductible for automobile insurance and 57 percent for homeowners insurance. More recently, Sydnor (2006)¹²⁵ studied deductible choices by 50,000 homeowners using a dataset provided by an insurance company, and finds that that 83 percent of customers chose a deductible lower than the maximum available one. Cutler and Zeckhauser (2004)¹²⁶ examined decisions with respect to auto insurance (in Boston and Miami) and homeowners insurance (in Philadelphia and Orlando). They found that 60 to 90 percent of the individuals in each of these cities selected the minimal \$500 deductible.

Also, in an earlier study, Schoemaker and Kunreuther (1979)¹²⁷ reported that 36 percent of subjects sampled from a population of insurance-agency clients would rather pay a \$90 premium for a zero deductible insurance policy than \$20 for a policy with a \$500 deductible to protect themselves from a .01 probability of losing an amount between \$10,000 and \$30,000. For rational economists, this finding is somewhat counterintuitive. Indeed, it means that more than one-third of these people were apparently willing to pay \$70 more (the difference between the \$90 premium with no deductible and the \$20 premium with a \$500 deductible) to protect themselves against a loss of \$5 (expected loss: .01 probability of losing \$500).¹²⁸

Our results, based on a very large sample of policies, are even more pronounced than the findings of these previous studies. We find that of the 1.14 million flood insurance policies-in-force in 2005, 98.3 percent of customers chose a deductible lower than the maximum available one. We also find that almost 80 percent of policyholders chose the lowest possible

¹²⁴ Eldred, G.W. (1980), "How Wisely Do Consumers Select Their Property and Liability Insurance Coverages?" *Journal of Consumer Affairs*, 14 (Winter), 288-306.

¹²⁵ Sydnor, J. (2006), "Abundant Aversion to Moderate Risk: Evidence from Homeowners Insurance." University of California, Berkeley.

¹²⁶ Cutler, D.M. and R.J. Zeckhauser (2004), "Extending the Theory to Meet the Practice of Insurance," *Brookings-Wharton Papers on Financial Services* 2004, 1-53. The Brookings Institute, Washington, DC.

¹²⁷ Schoemaker, P. and H. Kunreuther (1979), "An Experimental Study of Insurance Decisions" *The Journal of Risk and Insurance*, 46(4): 603-618.

¹²⁸ The findings are more consistent with the goal-based model of insurance decision making discussed in Chapter 5.

\$500 building deductible, and around 18 percent chose the second-lowest deductible available, \$1,000. These percentages are largely constant over the time period we studied (2000-2005).

There might be several explanations for the choice of a low deductible and unfortunately, in the absence of interviews of buyers of flood coverage, we are unable to tease apart these competing explanations. First, consumers might want to cover as much as possible whatever happens (risk aversion). They do not act on a rational basis by evaluating expected loss, but rather assess risk in a binary way: “I suffer a loss or I don’t; but if I do, I want to be sure my investment in insurance protection gets me as much as possible back.” Second, some homeowners might not be aware of the existence of the different levels of deductible insurance. Third, for some customers who are forced to buy flood insurance by law or by lenders, a low deductible means that the insurer will indeed make payments to customers more often. Even though such payments may not be a valid indication of a company’s reliability, they may at least increase confidence in the company’s promise of protection against unlikely large losses. Small claims might help make the payment of required insurance more tangible. Fourth, some individuals see insurance more as an investment and they want to collect something back from their policy. The lowest possible deductible guarantees that in the case of a loss, they will collect as much as possible (Kunreuther, 1978).¹²⁹

One hypothesis we wanted to test was that people with the highest limit would tend to also have a higher deductible on their policy.¹³⁰ This would be consistent with individuals choosing to insure against catastrophic losses but not small losses. The analysis reveals, however, that is **not** the case. To the contrary, we find that proportionally, more people who bought the highest limit on their coverage are likely to take the lowest possible deductible: nearly 81 percent of policyholders with the maximum \$250,000 limit also have the lowest possible deductible, versus nearly 73 percent for policy with a limit lower than \$100,000 for building coverage. Table 4.6 presents the number of policyholders choosing a given deductible stratified by the amount of building coverage purchased in 2005 (results for previous years are very similar). This suggests that individuals are trying to receive the maximum payout from their insurance or cover both small losses and catastrophic ones.

TABLE 4.6. PERCENTAGE OF POLICYHOLDERS CHOOSING THE GIVEN DEDUCTIBLE FOR VARYING AMOUNTS OF BUILDING COVERAGE IN 2005

Building Coverage Deductible	0 – \$50,000	\$50,000 – \$99,999	\$100,000– \$149,999	\$150,000– \$199,999	\$200,000– \$249,999	\$250,000	Total Policies
\$500	72.5%	72.8%	79.9%	80.9%	82.1%	81.2%	909,077
\$1,000	25.6%	24.3%	17.9%	16.5%	15.1%	14.8%	202,714
\$5,000	1.2%	1.9%	1.4%	1.5%	1.6%	2.4%	20,417
Number of Policies	58,099	153,036	270,668	209,988	138,796	313,257	1,143,844

¹²⁹ Kunreuther et al. (1978), *Disaster Insurance Protection: Public Policy Lessons*, New York: John Wiley & Sons.

¹³⁰ Results previously published show that policyholders would choose a lower deductible but also a lower limit on the policy, focusing mainly on non-catastrophic loss. For instance, in his survey of insurance buyers, Eldred (1980) found that 68 percent of the automobile policies and 69 percent of the homeowner’s policies that had a the lowest deductible also had liability limits of \$25,000 or less, even though insurance professionals and consumer publications agreed that a \$100,000 personal liability limit was necessary to afford reasonable protection.

For contents coverage (full results not provided here), the deductibles were similar, with about 83 percent of single family policies having a deductible of \$500 and 15 percent having a deductible of \$1,000. Again, these percentages are fairly consistent from 2000 to 2005 and the number and proportion choosing the \$500 deductible increased with higher amounts of contents coverage.

Impact of Catastrophes on Consumers' Choice. It is also interesting to contrast our analysis for 2005 with the distribution of choices (deductible; limit) in 2000. Keeping in mind that Florida went through several flooding episodes in 2004, one would expect more people to buy flood insurance as a reaction to these catastrophes, and that people who were already insured would want to be more fully covered if the differential in price is not too high. As we will discuss below, the NFIP does not react to any specific local episode by increasing its rates there to reflect an updated view of the risk exposure, but rather, defines its rates at a national level. As a result, cost of flood insurance has remained virtually the same in Florida between 2000 and 2005 (see our analysis of the fourth question).

In that context, our results are not surprising. First, there were 973,444 flood insurance policies in place for single-family homes versus 1,143,844 in 2005 (a 17 percent increase). Second, in most building coverage limit brackets, many more insureds have selected the lowest possible deductible in 2005 than they had in 2000. For instance, taking into account all single-family flood insurance policies in Florida, in the lowest limit bracket ([0; \$50,000]) 58 percent of the insureds had selected the \$500 deductible in 2000; this increased to 72.5 percent in 2005. In the two counties that suffered significantly from the 2004 hurricane season in Florida (Santa Rosa and Escambia Counties), 73 and 76 percent of the insureds in this low bracket had selected the \$500 deductible in 2000; the year following the floods, this proportion had increased to 87 percent and 92 percent, respectively. We noticed that effect even for those who had selected the highest possible limit on their policy (\$250,000). In Santa Rosa County for instance, 85 percent of them had selected the \$500 deductible in 2000; this number increased to 92 percent in 2005.

Third, the distribution of limit choice has evolved as well. While, 70 percent of the flood policies in Florida in 2000 had a limit lower or equal to \$150,000, only 40 percent of the increased number of total policies in the state had a limit below that threshold in 2005. Also, 10 percent of the 973,444 flood insurance policies-in-force for single-family homes had a \$250,000 limit in their contract in 2000; in 2005, more than 27 percent of the 1,143,844 flood insurance policies had selected that maximum limit.

There might be several explanations for these changes: people living in devastated areas and who had coverage wished they had purchased the largest possible coverage before being flooded (regret); the floods were a vivid experience not only for those affected but also their neighbors and family and they revised their beliefs that a flood is actually more likely to happen to them than they had thought before; the decision to buy more insurance also becomes more appealing because it is viewed as a sound financial investment.

Third Question: What factors determine claims payments?

As discussed above, the NFIP does not cover wind damage (this coverage is provided by private insurers through homeowners policies), but major hurricanes in coastal states typically induce significant flood losses due to storm surge pushing water inland, which is covered by the NFIP. In addition, as hurricanes move inland, the torrential rains can lead to substantial inland flood damage. For these reasons hurricanes are responsible for the majority of claims in Florida.

For example, in 2004, 15 percent of NFIP claims in Florida were attributable to Hurricane Charlie, 17 percent to Hurricane Frances, 36 percent to Hurricane Ivan, and 18 percent to Hurricane Jeanne—a total of 86 percent of flood claims. In 2005, over 50 percent of all claims payments for covered households in Florida were associated with Hurricane Wilma and just under a quarter were associated with Hurricane Katrina.¹³¹ Another 13 percent of claims were due to Hurricane Dennis¹³²—a total of 88 percent of the claims for that year. This likely explains the fact that the mean claim payment in Florida is significantly higher for V flood zones – floodplains associated with wave action – than for other flood zones.

It is also interesting to take a closer look at what counties have generated the largest amount of flood insurance claims over the 6 year period we studied (2000-2005). Santa Rosa and Escambia Counties, located in the far northwest of Florida (see Figure 4.5), both suffered severe losses from the 2004 hurricane season. Flood claims for Santa Rosa were about \$350 million, or about 30 percent of the total flood coverage in the county; Escambia claims were \$260 million, or 25 percent of its entire coverage.

Rather than looking at the total value of these reimbursements (a county with many more policies will receive more payments, all thing being equal), we use the average insurance claims per policy in each county as a measure of quantity. For certain counties, this figure is quite high indeed: \$44,017 for Santa Rosa County, \$34,954 for Escambia, and \$10,259 for Monroe County.¹³³ The other eight counties in the top 10 are as follows: Wakulla (\$8,868), Okaloosa (\$7,366), Franklin (\$5,481), Baker (\$3,499), Gilchrist (\$3,083), De Soto (\$3,035), and Walton (\$2,640).¹³⁴ This raises the question of what the main drivers of these claims are.

Determinants of Claims Payments. As mentioned earlier, to examine claim payments in Florida, we received a dataset from the NFIP that contained all claims for the state through August 31, 2006. Although identifying information was removed, it still allows us to examine general patterns. In order to determine the main drivers of flood claims in Florida, we ran a simple ordinary-least square (OLS) regression for residential properties.¹³⁵ The dependent variable is the log of the total claims paid (building plus contents). The explanatory variables we include are dummy variables as to whether the property is in a Special Flood Hazard Areas (SFHA),¹³⁶ if the property is elevated, and if it is the owner's principal residence. Variables are also included for

¹³¹ Hurricane Katrina made its first landfall in Florida as a Category 1 hurricane on August 25, before moving to the Gulf of Mexico and becoming a Category 3 hurricane when it hit landfall again three days later in Louisiana.

¹³² Hurricane Dennis made landfall in Florida on July 11, 2005 as a Category 3 hurricane.

¹³³ In 2005, the average premium in Santa Rosa County was \$411; in Escambia, it was \$423. These floods then correspond more or less to a 15-to-20-year event if NFIP rate are actuarially based (this is a conservative assumption since rates are also supposed to cover management costs).

¹³⁴ Miami was ranked 23rd with an average \$929 in claims per policy over this period of time; Palm Beach was 59th with \$148.

¹³⁵ OLS linear regression technique minimizes the sum of the squared differences between the predicted and observed values.

¹³⁶ See Appendix 4-B for the percentage of properties located in an SFHA for each county in Florida.

the value of the building and the contents before damage, the number of floors in the house, and a code for the type of basement (if there is a basement, if it is finished, etc.), as well as county fixed effects, the date of the loss, and fixed effects for each catastrophe.

The specification is given by:

$$\ln(\text{total claims paid}) = \beta_0 + \beta_1(\text{SFHA dummy}) + \beta_2(\text{Elevated dummy}) + \beta_3(\text{value of building}) + \beta_4(\text{value of contents}) + \beta_5(\text{number of floors}) + \beta_6(\text{basement code}) + \beta_7(\text{date}) + \beta_8(\text{principal residence dummy}) + \lambda_1(\text{county FE}) + \lambda_2(\text{catastrophe FE}) + \varepsilon$$

Results of this regression are presented in Table 4.7. While the R-squared is somewhat small, the regression does confirm some intuitive notions about what drives claim amounts. Properties in the 100-year floodplain – SFHAs – have higher claims paid (coefficient +0.12453). This makes sense since the risk for these properties is higher. If a building is elevated, paid claims are less (the coefficient is -0.77518)¹³⁷ which is expected, since the risk of being flooded should be lower. If the building is a principal residence, claims paid are higher. This may be because second homes are less valuable, they contain less valuable contents, and/or they have lower levels of coverage.

TABLE 4.7. RESULTS OF THE OLS REGRESSION EXPLAINING TOTAL PAID CLAIMS TO FLOODED NFIP-COVERED RESIDENTIAL PROPERTIES IN FLORIDA

Variable	Coefficient Estimate
Constant	4.6655*** (.43181)
Dummy equal to 1 if property is in a SFHA	.12453*** (.02070)
Dummy equal to 1 if building is elevated	-.77518*** (.01953)
Value of building	-1.05e-06 (8.21e-07)
Value of contents	.00001*** (2.53e-06)
Number of floors	-.10349*** (.00634)
Basement code	-.08490*** (.01591)
Date of loss	.00030*** (.00002)
Dummy equal to one if building is principal residence of owners	.14372*** (.01709)
County Fixed Effects	Y
Catastrophe Fixed Effects	Y
R-squared	0.2832
N (number of claims studied)	45,374

*Dependent variable is natural log of total amount paid (building plus contents) for a given claim. Robust standard errors are given in parentheses. Coefficients significant at the 10 percent level are marked with *, those significant at the 5 percent level are marked with **, and those significant at the 1 percent level are designated by ***.*

¹³⁷ Having a basement also slightly reduces the claims; the coefficient is -0.08490.

The coefficients on the value of the building and value of the contents are essentially zero, implying that flood damage does not disproportionately impact high- or low-valued homes. That result is somewhat puzzling, as one might expect a house with higher contents and building values to suffer a larger loss (all things being equal). One possible explanation is that these more costly houses are also more protected against flooding (for instance, because the owners are wealthier and willing to invest more in mitigation). This conjecture is consistent with our findings that owners at the coverage limit are also more anxious to buy the largest available protection of their assets (by choosing the lowest possible deductible).

Fourth Question: How much does flood insurance cost in Florida? How has that cost evolved over the period 2000-2005?

We now turn to our last question to determine the cost of flood insurance in different parts of the state. We also discuss how flood insurance pricing has evolved in the aftermath of the major flooding that occurred during the time period of our analysis to conclude that while the average premium per policy has slightly increased, the cost of insurance (measured as premium per \$1,000 of coverage) has significantly decreased.

Cost of Flood Coverage in Florida Counties. As we discussed in Section 4.2, among the top nine states that make up the largest portion of the NFIP's portfolio, Florida has, on average, the lowest cost of flood insurance per \$1,000 of coverage. Table 4.8 depicts for each of the 67 Florida counties the *average premium* paid per \$1,000 of flood coverage, the *average premium per policy*, and the percent of policies in Special Flood Hazard Areas (SFHAs) in 2000 and 2005.

Looking at the first measure of insurance cost, among the 67 counties we analyze, in 2005 cost ranges from \$1.30 in Flagler County to \$7.50 in Dixie County, with an average of \$2.80 and a mean of \$2.50. While data confirm that the proportion of policies in a 100-year flood zone is an indicator of the average cost of flood insurance in the county, we notice that the relationship is not always clear. For instance, the counties in which the cost of insurance is the most expensive are not necessarily those with the highest proportion of policies in SFHAs: Palm Beach, Broward and Santa Rosa Counties all have over 50 percent of their policies in these high-risk zones but are among the counties with the lowest average cost of flood insurance. At the extreme, over 90 percent of flood policies in Miami-Dade County are located in SFHAs, where the probability of a flood is expected to be at least 1-in-100, but the cost there is less than \$2 per \$1,000 of coverage – an implicit probability of a flood occurring only once every 500 years. Only the monitoring of flood claims over a much longer period of time than given by our dataset would allow for some evaluation of this rating (e.g., 50 years).

Another way to measure the cost of insurance is to determine the average premium per policy. We find that in 2005, premiums ranged from \$300 in Okeechobee County to \$985 in Franklin County, with an average of \$450 and a mean of \$395.

TABLE 4.8. FLOOD INSURANCE RATES PER \$1,000 AND PER POLICY BY COUNTY IN FLORIDA FOR SINGLE-FAMILY, RESIDENTIAL POLICIES ONLY AND PERCENT OF POLICIES IN SFHAs (2000/2005)

County	Average Premium per \$1,000 of Coverage		Average Premium per Policy		Percent of Policies in SFHAs	
	2005	2000	2005	2000	2005	2000
ALACHUA	\$2.02 (-26%)	\$2.75	\$339	\$337	45%	31%
BAKER	\$2.50 (-28%)	\$3.48	\$353	\$337	47%	43%
BAY	\$1.72 (-19%)	\$2.13	\$382	\$326	34%	36%
BRADFORD	\$3.07 (-21%)	\$3.90	\$406	\$346	74%	74%
BREVARD	\$1.46 (-25%)	\$1.95	\$322	\$294	37%	35%
BROWARD	\$1.62 (-16%)	\$1.94	\$372	\$328	95%	96%
CALHOUN	\$4.73 (-14%)	\$5.49	\$478	\$328	81%	82%
CHARLOTTE	\$2.62 (-30%)	\$3.76	\$523	\$499	94%	88%
CITRUS	\$3.64 (-27%)	\$4.97	\$527	\$487	91%	87%
CLAY	\$1.64 (-22%)	\$2.09	\$369	\$338	46%	38%
COLLIER	\$2.35 (-15%)	\$2.75	\$590	\$528	78%	73%
COLUMBIA	\$2.99 (-35%)	\$4.62	\$401	\$385	79%	55%
DESOTO	\$2.71 (-15%)	\$3.20	\$417	\$328	55%	56%
DIXIE	\$7.46 (-11%)	\$8.38	\$734	\$506	88%	88%
DUVAL	\$1.38 (-22%)	\$1.76	\$334	\$305	23%	23%
ESCAMBIA	\$1.91(-33%)	\$2.85	\$443	\$478	64%	40%
FLAGLER	\$1.30 (-28%)	\$1.80	\$317	\$288	20%	17%
FRANKLIN	\$4.50 (+2%)	\$4.40	\$985	\$702	93%	92%
GADSDEN	\$2.29 (-23%)	\$2.97	\$356	\$277	41%	49%
GILCHRIST	\$3.65 (-35%)	\$5.61	\$451	\$428	82%	72%
GLADES	\$3.34 (-16%)	\$3.98	\$363	\$300	91%	92%
GULF	\$3.01 (-4%)	\$3.15	\$557	\$398	61%	62%
HAMILTON	\$3.72 (-15%)	\$4.39	\$405	\$323	77%	75%
HARDEE	\$3.01 (-9%)	\$3.29	\$396	\$295	43%	52%
HENDRY	\$3.73 (-12%)	\$4.23	\$388	\$337	72%	83%
HERNANDO	\$3.99 (-35%)	\$4.57	\$683	\$517	74%	63%
HIGHLANDS	\$1.93 (-21%)	\$2.45	\$318	\$266	55%	58%
HILLSBOROUGH	\$2.58 (-21%)	\$3.28	\$517	\$475	80%	69%
HOLMES	\$3.02 (-39%)	\$4.94	\$358	\$329	71%	63%
INDIAN RIVER	\$1.80 (-18%)	\$2.21	\$440	\$433	58%	66%
JACKSON	\$2.46 (-25%)	\$3.28	\$331	\$386	50%	44%
JEFFERSON	\$3.17 (-16%)	\$3.76	\$360	\$308	72%	77%
LAFAYETTE	\$5.08 (-18%)	\$6.19	\$494	\$377	91%	95%
LAKE	\$1.94 (-24%)	\$2.57	\$340	\$308	63%	58%
LEE	\$2.53 (-18%)	\$3.08	\$548	\$478	85%	84%
LEON	\$2.26 (-20%)	\$2.82	\$384	\$319	69%	57%
LEVY	\$6.10 (-7%)	\$6.53	\$808	\$573	92%	88%
LIBERTY	\$5.97 (+1%)	\$5.90	\$440	\$275	87%	70%
MADISON	\$3.19 (-29%)	\$4.48	\$391	\$452	60%	58%
MANATEE	\$2.75 (-22%)	\$3.52	\$569	\$501	75%	70%
MARION	\$1.95 (-29%)	\$2.76	\$314	\$289	37%	31%
MARTIN	\$1.70 (-22%)	\$2.19	\$447	\$441	43%	43%

County	Average Premium per \$1,000 of Coverage		Average Premium per Policy		Percent of Policies in SFHAs	
	2005	2000	2005	2000	2005	2000
MIAMI-DADE	\$1.89 (-19%)	\$2.33	\$395	\$355	93%	93%
MONROE	\$3.72 (-7%)	\$3.99	\$760	\$594	93%	94%
NASSAU	\$1.48 (-19%)	\$1.82	\$396	\$361	35%	33%
OKALOOSA	\$1.66 (-20%)	\$2.08	\$415	\$375	30%	28%
OKEECHOBEE	\$2.3 (-20%)	\$2.87	\$299	\$273	75%	77%
ORANGE	\$1.73 (-21%)	\$2.18	\$342	\$301	50%	53%
OSCEOLA	\$1.78 (-25%)	\$2.39	\$325	\$276	65%	68%
PALM BEACH	\$1.42 (-22%)	\$1.82	\$368	\$364	51%	48%
PASCO	\$3.59 (-24%)	\$4.70	\$549	\$477	82%	76%
PINELLAS	\$3.49 (-10%)	\$3.89	\$686	\$560	78%	76%
POLK	\$2.10 (-25%)	\$2.80	\$335	\$298	62%	60%
PUTNAM	\$2.88 (-25%)	\$3.81	\$396	\$366	82%	79%
SANTA ROSA	\$1.60 (-29%)	\$2.27	\$411	\$406	53%	35%
SARASOTA	\$2.41 (-22%)	\$3.10	\$524	\$480	62%	58%
SEMINOLE	\$1.52 (-21%)	\$1.93	\$335	\$299	40%	39%
ST. JOHNS	\$1.62 (-19%)	\$2.01	\$417	\$395	53%	54%
ST. LUCIE	\$1.72 (-32%)	\$2.54	\$339	\$303	61%	52%
SUMTER	\$1.95 (-38%)	\$3.14	\$326	\$283	58%	39%
SUWANNEE	\$3.24 (-33%)	\$4.87	\$355	\$352	76%	75%
TAYLOR	\$6.36 (-3%)	\$6.54	\$759	\$517	89%	87%
UNION	\$3.30 (-27%)	\$4.51	\$354	\$377	59%	53%
VOLUSIA	\$1.83 (-22%)	\$2.36	\$358	\$308	41%	46%
WAKULLA	\$6.23 (-2%)	\$6.38	\$961	\$628	94%	89%
WALTON	\$1.76 (-22%)	\$2.25	\$476	\$444	29%	40%
WASHINGTON	\$2.63 (-48%)	\$5.12	\$330	\$276	70%	45%

Source: Authors' calculation

Private versus Public Insurance: Difference in Price Adjustment. It appears that the 2004 hurricane information was not incorporated into rate changes. In Table 4.8 we generate for each county the evolution of the cost of insurance (using the same two measures) between 2000 and 2005. We find that not only has the cost of insurance not increased, but it has significantly decreased in *all* but two of the 67 counties in Florida (Franklin and Liberty). The irony is even more severe when one considers Santa Rosa and Escambia Counties. As we discussed above, these two counties suffered the most in 2004. Furthermore, these two counties also saw a significant increase in the proportion of flood policies located in high-risk areas (SFHAs). Despite these facts, the average cost of flood insurance in Santa Rosa decreased from \$2.27 per \$1,000 of flood coverage in 2000 to \$1.60 in 2005 (a 29 percent decrease); in Escambia County, the cost decreased from \$2.85 per \$1,000 of flood coverage in 2000 to \$1.91 in 2005 (a 33 percent decrease).¹³⁸

¹³⁸ Looking at changes in average premium per policy, we see from Table 4.8 that the policy premiums have not seen the same decrease between 2000 and 2005. This is the case because over time, more people have selected a lower deductible and increased the maximum limit on their policy (as we discussed earlier); in other words, the premiums remained about the same but the quantity of insurance purchased increased significantly, which diminished the cost, measured as premium per thousand dollars of coverage.

As already discussed, there is some concern that FEMA's flood zone designations are not updated frequently enough and are not at a fine enough resolution. Further, as mentioned, the operation of the NFIP is such that rates are set nationally by zone and are not typically modified locally as the result of a flood episode. Our discussion with NFIP representatives confirms that rates are revised once a year in May. By law, any yearly increase in premiums cannot exceed 10 percent overall. Still, some might have expected in the aftermath of the 2004 and 2005 flood claims that the NFIP would have revised its cost of flood insurance. The 2004 Actuarial Rate Review, however, recommended no change in premiums for V zones – those associated with wave action – and only a 1.4 percent total increase in premiums across other zones. The federal view is that the ultimate goal of the program is to guarantee a financial balance over time at a national level rather than being accurate everywhere at a micro level (then compensating negative results in certain areas with positive ones in others). Our analysis of the financial balance of the program in the next section reveals that such a goal had been more or less reached over the nearly forty years of operation of the NFIP (until Hurricane Katrina, at least).

4.4. Financial Performance of the NFIP over the Years

The remainder of the chapter returns to the operation of the NFIP nationwide. In the aftermath of Hurricane Katrina and the flooding of New Orleans, the program has been under severe criticism because its reserve was far below its claims payments, and so it was forced to borrow over \$20 billion from the federal government. We first analyze the balance of the system since its creation in 1968 and determine the main sources of spending beyond the payment of flood claims. The concluding section discusses the future of the NFIP.

Premiums collected from NFIP policies, plus as a small policy fee, are deposited in the National Flood Insurance Fund, from which losses and administrative costs are paid. The NFIP also has borrowing authority from the Treasury. Borrowing authority started at \$1 billion and was increased to \$1.5 billion in 1996. Due to the catastrophic nature of flooding and the desire to keep premiums affordable, as well as the subsidization of many properties, the Fund was not large enough to make payouts for the 2005 hurricane season. In the aftermath of Hurricane Katrina and the levee breaches in New Orleans, borrowing authority was increased to over \$20 billion to pay claims from 2005 (Council of Economic Advisors, 2007).¹³⁹ While this obviously raises major issues regarding the long term financial stability of the program, it is worthwhile to look at previous years to judge how the program has performed over time.

¹³⁹ Council of Economic Advisors (2007), *The Economic Report of the President*, Washington, DC.

Premiums versus Claims

Figure 4.8 shows total premiums collected by the NFIP minus total claims paid by the NFIP for each year (not cumulative) from 1978 to 2006.

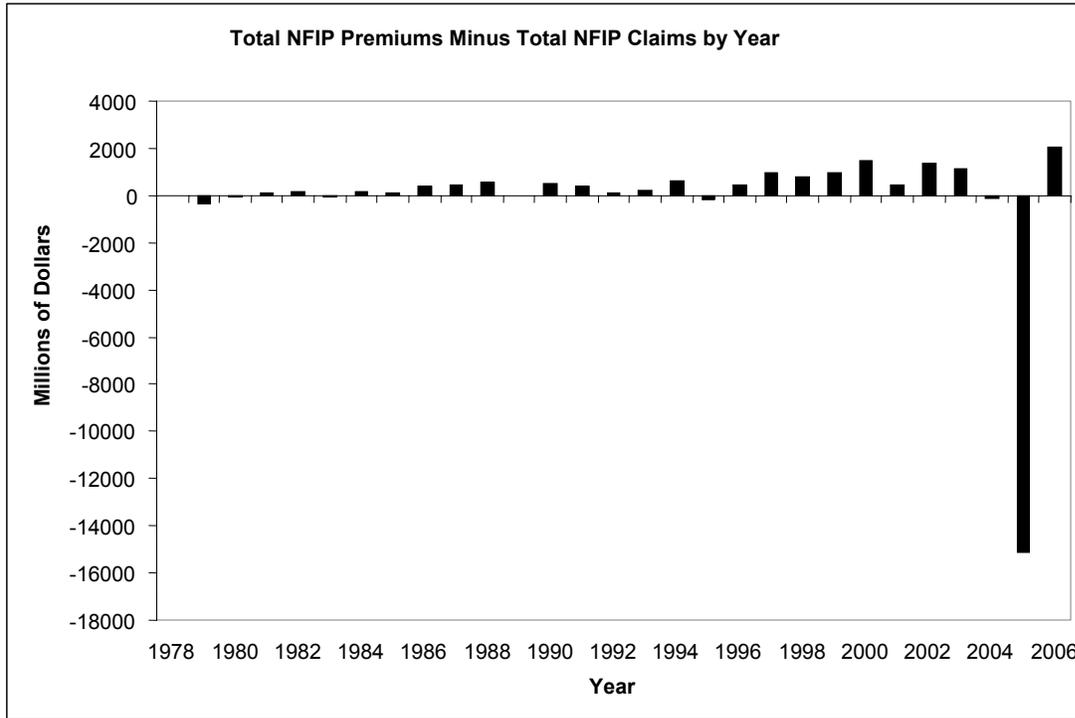


FIGURE 4.8. NFIP PREMIUMS MINUS CLAIMS BY YEAR: 1978 -2006
 Sources: Authors’ calculation, Data from FEMA, Department of Homeland Security

As this figure shows, until the hurricanes in 2004 and 2005, the program had generally been collecting enough premiums each year to cover policyholders’ claims.¹⁴⁰ Note that Figure 4.8 does not include management costs or payments NFIP makes to WYO insurers. It is thus an overly optimistic depiction of the financial situation of the program in each year. In order to provide a more realistic description of the balance sheet of the program over time, we must look at the financial records of the NFIP since its inception in 1968 up to the most recent information available (year closing September 30, 2006).¹⁴¹ While there are typically many elements to integrate into the calculation of the NFIP’s financial performance, several budget lines are particularly critical.

¹⁴⁰ Indeed, the NFIP borrowed from the Treasury only three times prior to 2005 and repaid all three loans with interest: Jenkins, W.O. (2005), “Federal Emergency Management Agency: Challenges Facing the National Flood Insurance Program,” GAO-06-174T. U.S. Government Accountability Office, Washington, DC. (Under current law, FEMA is required to repay all funds for the NFIP borrowed from the Treasury). The 2005 hurricanes, however, have taxed the NFIP’s financial soundness, as shown in Figure 4.8. FEMA had about \$23 billion in claims from Hurricanes Katrina, Rita, and Wilma – close to double the amount paid over the program’s lifetime: King, R.O. (2006), “National Flood Insurance Program: Treasury Borrowing in the Aftermath of Hurricane Katrina (Order Code RS22394),” Congressional Research Service, Washington, DC.

¹⁴¹ We are grateful to Ed Pasterick from the NFIP for providing us with these data.

On the earning side, the main income outside of the earned premiums is provided by the \$30 policy fee levied against all NFIP flood policyholders, which typically accounts for an additional 6 or 7 percent of the earned premiums. The NFIP also had some investment revenue. Overall, for the period 1968 to September 2005 (before Hurricane Katrina and the flooding of New Orleans), the NFIP collected a total of \$22.15 billion in premiums, \$1.16 billion in federal policy fees and \$0.258 billion in investment revenue. It also received federal appropriations of \$1.2 billion in the early 1980s to repay borrowed funds from the early years of the program, as no funds had been given to initially capitalize the program (Pasterick, 1998).¹⁴²

On the expense side, the major source of spending, after the payment of claims, is the payment to the insurers and agents participating in the WYO program on behalf of the federal government. The program pays them an expense load based on the average costs for underwriting, policy writing and advertising, as well as taxes and general expenses. On average, that represents about 15.6 percent of earned premiums. In addition, insurers receive a 15 percent commission allowance, paid to them regardless of whether an agent or broker receives a commission. Another 1 percent “addition” is paid by the NFIP (2 percent if the WYO insurer meets “production” goals).

In addition, following a flooding episode, FEMA pays WYO insurance companies for claims adjustment expenses (e.g., attorney fees and adjuster fees) and an allowance of 3.3 percent of each claim settlement amount to pay for their processing expenses. For example, the amount FEMA paid WYO insurance companies for Katrina’s claims processing expenses was more than ten-fold from \$30 million in fiscal year 2004 to about \$385 million in fiscal year 2005. (GAO, 2007).¹⁴³ Figure 4.9 provides an overview of this spending as a percentage of the premiums collected by the program over time.

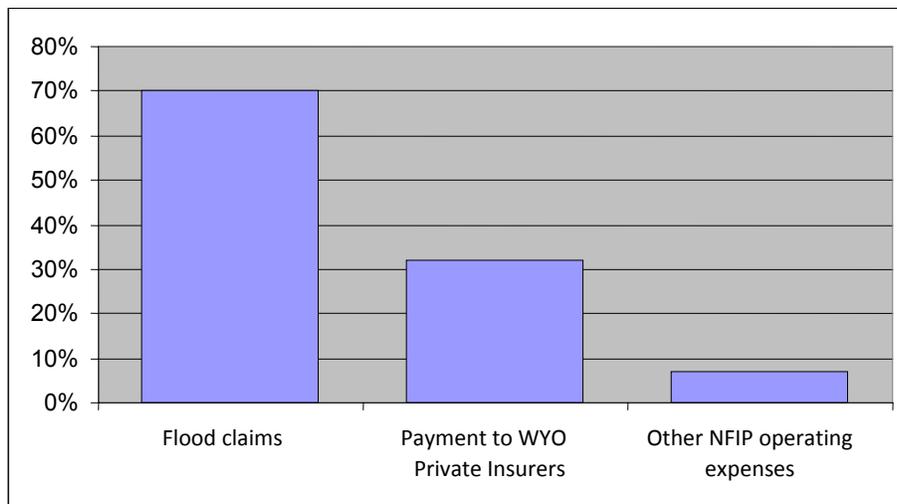


FIGURE 4.9. NFIP MAIN EXPENDITURES (AS A PERCENTAGE OF PREMIUMS COLLECTED) 1968 TO SEPTEMBER 2005

Note: Percentages add up to more than 100 percent since the program runs a deficit

¹⁴² Pasterick, E.T. (1998). “The National Flood Insurance Program,” in *Paying the Price: The Status and Role of Insurance Against Natural Disasters in the United States*. H. Kunreuther and R.J. Roth, Sr. Washington, DC, Joseph Henry Press.

¹⁴³ See GAO (2007) for a detailed description of FEMA’s payments to participating insurers. U.S. Government Accountability Office (2007), “National Flood Insurance Program: FEMA’s Management and Oversight of Payments for Insurance Company Services Should Be Improved,” GAO-07-1078, Washington, DC, September.

Overall, more than **30 percent of the total earned premiums go to WYO participating companies**, which do not bear any of the risk.¹⁴⁴ In 2006, that proportion was higher due to additional costs incurred to process an historic number of claims due to Katrina, Rita and Wilma. Over the period 1968-2005, participating insurers collected over \$7.4 billion (excluding the loss adjustment expenses for which we do not have data). Other expenses include NFIP operating expenses and floodplain management costs (flood studies and surveys, mitigation grants, community rating system operation costs).¹⁴⁵ That represents about **7 percent of the earned premiums**. Over the period 1968-2005, these other expenses of the program accounted for \$2.2 billion.¹⁴⁶

The findings of our analysis, undertaken during the summer of 2007, are very much aligned with those of the U.S. Government Accountability Office, published in September 2007. In its report to Congressional Committees, GAO specifically points out that aspect of the program and recommends that “FEMA take steps to ensure that it has a reasonable estimate of actual expenses WYO companies incur to help determine payments for services and that financial audits are performed. The Department of Homeland Security reviewed a draft of this report and generally agreed with our recommendations.” (GAO, 2007).¹⁴⁷

To summarize, over the period 1968-2005, NFIP’s revenue was \$23.6 billion, its total insurance expenses were \$24.3 billion (including \$16.5 billion of claims paid to insured victims of flood and \$7.4 billion paid to companies participating in the WYO program). In addition, the program spent \$2.2 billion for administrative expenses. After 37 years of operation, the cumulative operating result was a deficit of about \$3 billion.

NFIP could have balanced its current deficit by doing two simple things, or a combination of the two: (1) increasing the federal policy fee from \$25 to \$100; and (2) increasing the premium charged against policyholders by 15 percent. A certain combination of changes would have certainly ended up being a smoother decision: if the federal policy fee had been \$50 instead of \$25, the premiums had been increased by 5 percent, and payments to insured reduced by 10 percent (if financial audits reveal the current levels were too high given the real spending of the insurers), the NFIP would have had a balanced budget before being hit by the most devastating natural disaster in the history of the country.

¹⁴⁴ This estimation is in the range of loading factors used by insurers when selling their own policy to reflect administrative costs beyond their estimates of actuarial cost of the coverage. In fiscal years 2005 and 2006, payments to WYO insurers were even larger because the WYO insurance companies received payments in these years for settling an unprecedented number and dollar amount of claims for the major 2004 and 2005 hurricanes.

¹⁴⁵ Until 1986, the salaries, program expenses, and mapping costs were paid by an annual appropriation from Congress. From 1987 to 1990, these costs were paid out of premiums collected. Starting in 1991, a federal policy fee of \$25 was added to every policy (increased to \$30 in 1995) to cover salaries and administrative costs.

¹⁴⁶ We have not included in that description the \$400 million spent for interest expenses by the program over this 1968-2005 period.

¹⁴⁷ U.S. Government Accountability Office (2007), "National Flood Insurance Program: FEMA’s Management and Oversight of Payments for Insurance Company Services Should Be Improved," GAO-07-1078, Washington, DC, September.

It becomes clear from this analysis that right before the tragedy of Katrina, the program had been relatively balanced (or could have been, by slightly modifying the terms of the flood premiums and/or payments to insurers participating into the program), even though millions of new policies were added to its national coverage over the years.

The Impact of Truly Extreme Events

The 2005 hurricane season radically changed the balance sheet of the NFIP. This raises at least two important questions: (1) how did the program manage the very large number of claims it received from flood victims? and (2) should the NFIP build up enough reserve to face such a truly large-scale catastrophe, or is it better to finance truly exceptional losses through *ex post* federal funding?

On the claim management side, despite the scale of the catastrophe, collaboration between participating insurers and FEMA enabled a large portion of the loss to be settled in the months following Hurricane Katrina. As of May 2006, with over 95 percent of the claims reported by FEMA settled, the NFIP had paid claims for about 162,000 losses for flood damage from Hurricane Katrina in Alabama, Florida, Louisiana, and Mississippi. As a point of comparison, the program processed about 30,000 claims in each of the two largest single flood events prior to Hurricane Katrina (the 1995 Louisiana flood and Tropical Storm Allison in 2001). The average amount paid per claim for Hurricane Katrina flood damages, \$94,800, was about three times the average paid per claim in the previous record year, 2004 (GAO, 2006).¹⁴⁸

On the financial side, the magnitude and severity of losses from Hurricane Katrina and other 2004 and 2005 hurricanes required the NFIP to obtain borrowing authority of \$20.8 billion from the Treasury. Many believe that this is a level of deficit that the program is unlikely to be able to repay with its current premium income of about \$2.8 billion annually (GAO, 2006).¹⁴⁹ This calls into question the structure of the program and whether it can and should be designed to handle catastrophes of this magnitude.

The policy question is whether the program should be in a position to build up a significant reserve to be able to face a Katrina-like disaster, or whether such extreme events should be financed by the U.S. Treasury – essentially, the general taxpayer. If one relies solely on the resources of the NFIP, then residents in flood-prone areas would have to pay much more to insure their homes against water damage from flooding. After several years without a major loss, many are likely to question FEMA, which would then be sitting on a multi-billion dollar reserve. It was known since the NFIP's inception that it would not be able to handle very large catastrophes even if the premiums that are subsidized (25 percent of all flood policies) were charged the full actuarial rate. A private insurance representative is reported to have said during early discussions of the NFIP: *"It will be a damage-reimbursement program that will hit the Treasury whenever you have a serious disaster"* (Overman, 1957).¹⁵⁰

¹⁴⁸ U.S. Government Accountability Office (2006), "National Flood Insurance Program: New Processes Aided Hurricane Katrina Claims Handling, but FEMA's Oversight Should Be Improved," GAO-07-169, Washington, DC, December.

¹⁴⁹ Op. Cit.

¹⁵⁰ Overman, E.S. (1957), "The Flood Peril and the Federal Flood Insurance Act of 1956," *Annals of the American Academy of Political and Social Science*, 309 (January): 98-106.

The question of whether the NFIP should be able to cover the costs of catastrophes must be addressed in the context of the program's goals. These are to decrease the risk of future flood losses, reduce the costs of flooding, reduce the demand for disaster assistance after floods, and preserve and restore the natural value of floodplains (Wetmore, Bernstein et al., 2006).¹⁵¹ Another implicit goal is political feasibility. For instance, the decision was made at the NFIP's inception to subsidize existing structures to improve political feasibility and to maintain property values,¹⁵² although at the expense of developing a financially independent insurance program. In 1981, a goal was set to make the program self-supporting for the average loss year; Pasterick (1998)¹⁵³ points out that this is not the same as being actuarially sound. A current question is whether the NFIP should be actuarially sound and what time horizon policymakers should consider.

There are many steps that could be taken both to reduce costs and increase revenue for the NFIP. As already discussed, after almost forty years in existence, the subsidies for pre-FIRM properties could be reduced or eliminated. More efforts could be made to enforce the mandatory purchase requirement.¹⁵⁴ Currently, properties located behind levees can petition to be removed from SFHAs and thus made exempt from the mandatory purchase requirement. As seen in New Orleans, properties behind levees are not safe and perhaps should not be given this exemption. The tragedy of New Orleans was that the levee system gave inhabitants the feeling they were fully protected when they were not. In addition, if a property is elevated above the base-flood level, either due to topography or fill, the owners can request to be exempted from insurance requirements through a Letter of Map Change (LOMC). The use of these has been increasing from around 2,800 in 1993 to over 11,000 in 1997 (Pasterick, 1998).¹⁵⁵ It is possible that this process could be exempting properties that are still at risk. Finally, the NFIP could work on improving the connection between insurance and mitigation and land use regulation. While at least 6,000 acres of previously developed floodplain have been returned to open space, most areas at risk from flooding are still subject to development (Wetmore, Bernstein et al., 2006).¹⁵⁶

¹⁵¹ Wetmore, F., G. Bernstein, D. Conrad, L. Larson, D. Plasencia, R. Riggs, J. Monday, M.F. Robinson and M. Shapiro (2006), *An Evaluation of the National Flood Insurance Program: Final Report*. American Institutes for Research. Washington, DC.

¹⁵² On the property value aspect, see Kunreuther, H. (1968), "The Case for Comprehensive Disaster Insurance," *Journal of Law and Economics*, 11(1): 133-163.

¹⁵³ Pasterick, E.T. (1998), "The National Flood Insurance Program," in *Paying the Price: The Status and Role of Insurance Against Natural Disasters in the United States*. Kunreuther, H. and R. J. Roth, Sr. (eds.), Washington, DC., Joseph Henry Press.

¹⁵⁴ These questions are being discussed in Congress as this report goes to press. For instance, the marked-up version of House bill *Multiple Peril Insurance Act of 2007* (H.R. 3121) states that beginning in 2011, subsidized rates would not be continued for properties with pre-1974 construction starts. The bill would also increase penalties – from \$350 to \$2,000 per violation – for federally insured lenders that do not enforce mandatory flood insurance policies for homeowners living in a 100-year flood zone and who hold a federally-backed mortgage.

¹⁵⁵ Pasterick, Op. Cit.

¹⁵⁶ Wetmore, Bernstein et al., Op. Cit.

4.5. The Future of the NFIP

We conclude this chapter by discussing bills that have been introduced in Congress in the past 2 years to reform the NFIP. Two bills were introduced in 2006 and two others in 2007. The House bill (H.R. 4973) was passed by the House on June 27, 2006 by a nearly unanimous vote (416-4). When the House bill was passed, the President issued a Statement of Administration Policy that was largely positive. The Senate bill (S. 3589) was referred to the full Senate by the Banking, Housing, and Urban Affairs Committee on June 28, 2006, but the Senate took no further action on this bill before recessing.

The major difference between the House and the Senate bills deals with the size of the program and its funded status going forward. Generally, the House bill is expansive while the Senate bill is not. The House bill would increase the flood insurance limits for residential property from \$350,000 to \$470,000, and increase the nonresidential (small business) limit from \$500,000 to \$670,000. The House bill also includes a payment of "...\$1,000 per dwelling in additional living expenses following a flood loss when the residence is unfit to live in." The Senate bill contains neither of these provisions.

With respect to funding, the Senate bill "...requires the Secretary of the Treasury to completely eliminate any obligations owed to the Treasury by the NFIP for the 2005 hurricane season. Debt forgiveness for over \$20 billion takes effect only after the Director of FEMA certifies to the Treasury that all financial resources have been obligated to pay claims." The Senate bill combines this debt relief with a reduction in the NFIP's borrowing limit to the pre-Katrina level (\$1.5 billion), and gives the NFIP the ability to establish a loss reserve fund for the first time. The House bill has no debt forgiveness feature, dealing with the funded status issue by raising the borrowing limit to \$25 billion. Both bills seek to put the NFIP on a sounder footing by raising the maximum annual premium increase from 10 percent to 15 percent, as well as introducing steps to move towards actuarially fair rates (although the two bills take different approaches to this issue).

While it is not clear what reforms will be enacted by Congress, the sustainability of the program – especially with regards to its funding status – is uncertain. David Maurstad, the Director of FEMA's Mitigation Division and Federal Insurance Administrator, testified before the Senate Committee on Banking, Housing, and Urban Affairs that the NFIP cannot handle its debt load. Annual interest on borrowing for the 2005 hurricanes (expected to exceed \$23 billion) will exceed \$1 billion. This amount could easily swamp premiums, currently on the order of \$2.8 billion, which is enough to cover average annual losses and administration costs. Given this problem, it was clear in December 2006 that the 110th Congress would be forced to deal with the NFIP by reforming it in some way.

On March 26, 2007, Chairman Barney Frank and Rep. Judy Biggert introduced the *Flood Insurance Reform and Modernization Act of 2007* (H.R. 1682) that aims to offer a comprehensive reform of the NFIP. H.R. 1682, as introduced, was similar to H.R. 4973 described above, and most notably seeks to reform the program by increasing its borrowing authority to \$21.5 billion from \$20.775 billion.

As discussed in Chapter 2, the wind/water controversy has been at the forefront of the political and legal debates regarding insurance against hurricane risk. On February 8, 2007, Rep. Gene Taylor introduced H.R. 920 that would make multi-peril coverage available under NFIP (homeowners who buy flood insurance would also be offered coverage against wind; a multi-peril policy that would be administrated by the NFIP). Based on the analyses provided in this chapter and the rest of the report, it is not clear to us the economic grounds of such a decision. In particular, it is not clear whether there has been any attempt to measure the potential impacts of such inclusion on hurricane risk insurance markets.

On July 19, 2007 Chairwoman Maxine Waters of the House Financial Services Subcommittee on Housing and Community Opportunity introduced the *Flood Insurance Reform and Modernization Act of 2007* (H.R. 3121) which combines H.R. 1682 and H.R. 920. H.R. 3121 reauthorizes the NFIP for five years. On the market penetration and mitigation sides, the bill would increase the maximum insurance coverage limits for residential and nonresidential properties, increase penalties for lenders that do not enforce mandatory flood insurance policies for homeowners living in a 100-year flood zone and who hold a federally-backed mortgage where insurance is supposedly mandatory, and also increase funding for mitigation programs and mapping updates. The bill would also reinforce information campaigns to encourage homeowners to purchase flood insurance. Additionally, and most controversially, H.R. 3121 adds a section including multi-peril language from H.R. 920. The House Financial Services Committee held a mark-up of H.R. 3121 in July 2007 and reported the bill out favorably by a vote of 38-29. The bill was then passed by the House on September 27, 2007. The Senate Banking Committee has not acted on the flood insurance issue in the 110th Congress as yet.

There is a need for legislation to be enacted, since the National Flood Insurance Program expires in 2008. We hope that the analyses provided in this chapter will help decisions to be made by Congress in the near future. (Pending legislation is discussed in Chapter 14.)

SUMMARY OF CHAPTER 4

This chapter describes the evolution of the program over the past 30 years by focusing on three key elements: number of policies in place, premiums collected and value at risk at a state and national level. We also specifically discuss these variables, along with several measures of price, for the top 10 states (ranked by proportion of the NFIP portfolio).

Florida alone represents nearly 40 percent of the entire NFIP portfolio; the second part of this chapter provides a detailed analysis of flood insurance in Florida. We ask and answer four questions using the entire NFIP dataset for Florida over the period 2000-2005, as well as U.S. Census data.

- (1) *What are the characteristics of the buyers of flood insurance in Florida?*
- (2) *How much coverage do Floridians buy?*
- (3) *What factors determine claims payments?*
- (4) *How much does flood insurance cost in Florida? How has that cost evolved over the period 2000-2005?*

The chapter then analyzes the financial stability of the NFIP since its inception in 1968 and how flood insurance premiums are spent. We find that private insurers collect on average one-third of the total flood insurance premiums just to administer the program on behalf of the federal government, even though they don't bear any risk.

The chapter concludes with a brief overview of pending legislation concerned with the future of flood insurance. The National Flood Insurance Program (NFIP) is scheduled for renewal in 2008, and the political and legislative debate surrounding the wind/water controversy described in Chapter 2 makes the future of flood insurance a sensitive issue.

**APPENDIX 4-A.
DEFINITION OF THE NFIP FLOOD ZONES**

Flood Zone	Definition
Zone A	Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the Flood Insurance Study by approximate methods of analysis. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.
Zone AE and A1-A30	Zones AE and A1-A30 are the flood insurance rate zones that correspond to the 1-percent annual chance floodplains that are determined in the Flood Insurance Study by detailed methods of analysis. In most instances, Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.
Zone AH	Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding with a constant water-surface elevation (usually areas of ponding) where average depths are between 1 and 3 feet. The Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.
Zone AO	Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average flood depths derived from the detailed hydraulic analyses are shown within this zone. In addition, alluvial fan flood hazards are shown as Zone AO on the Flood Insurance Rate Map. Mandatory flood insurance purchase requirements apply.
Zone AR	<p>Zone AR is the flood insurance rate zone used to depict areas protected from flood hazards by flood control structures, such as a levee, that are being restored. FEMA will consider using the Zone AR designation for a community if the flood protection system has been deemed restorable by a Federal agency in consultation with a local project sponsor; a minimum level of flood protection is still provided to the community by the system; and restoration of the flood protection system is scheduled to begin within a designated time period and in accordance with a progress plan negotiated between the community and FEMA. Mandatory purchase requirements for flood insurance will apply in Zone AR, but the rate will not exceed the rate for an unnumbered Zone A if the structure is built in compliance with Zone AR floodplain management regulations.</p> <p>For floodplain management in Zone AR areas, the property owner is not required to elevate an existing structure when making improvements to the structure. However, for new construction, the structure must be elevated (or floodproofed for non-residential structures) so that the lowest floor, including basement, is a minimum of 3 feet above the highest adjacent existing grade, if the depth of the Base Flood Elevation (BFE) does not exceed 5 feet at the proposed development site. For infill sites, rehabilitation of existing structures, or redevelopment of previously developed areas, there is a 3-foot elevation requirement regardless of the depth of the BFE at the project site.</p> <p>The Zone AR designation will be removed and the restored flood control system will be shown as providing protection from the 1-percent annual chance flood on the National Flood Insurance Program map upon completion of the restoration project and submittal of all the necessary data to FEMA.</p>
Zone A99	Zone A99 is the flood insurance rate zone that corresponds to areas within the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No Base Flood Elevations or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.
Zone D	The Zone D designation is used for areas where there are possible but undetermined flood hazards. In areas designated as Zone D, no analysis of flood hazards has been conducted. Mandatory flood insurance purchase requirements do not apply, but coverage is available. The flood insurance rates for properties in Zone D are commensurate with the uncertainty of the flood risk.
Zone V	Zone V is the flood insurance rate zone that corresponds to areas within the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no Base Flood Elevations are shown within this zone. Mandatory flood insurance purchase requirements apply.
Zone VE	Zone VE is the flood insurance rate zone that corresponds to areas within the 1-percent annual chance coastal floodplain that have additional hazards associated with storm waves. Base Flood Elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.
Zone B, C, and X	Zones B, C, and X are the flood insurance rate zones that correspond to areas outside the 1-percent annual chance floodplain, areas of 1-percent annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1-percent annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1-percent annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone. Insurance purchase is not required in these zones.

Source: FEMA, U.S. Department of Homeland Security

APPENDIX 4-B.

PERCENTAGE OF ALL RESIDENTIAL POLICIES-IN-FORCE (INCLUDING SINGLE-FAMILY RESIDENCES) LOCATED IN SFHAS IN EACH FLORIDA COUNTY IN 2005 (100-YEAR FLOODPLAIN, MANDATORY INSURANCE)

County Name	%		
		POLK COUNTY	59.63%
FLAGLER COUNTY	17.42%	GULF COUNTY	61.54%
DUVAL COUNTY	23.25%	HOLMES COUNTY	63.16%
OKALOOSA COUNTY	27.59%	HERNANDO COUNTY	63.19%
MARION COUNTY	31.18%	INDIAN RIVER COUNTY	65.65%
ALACHUA COUNTY	31.19%	OSCEOLA COUNTY	67.68%
NASSAU COUNTY	33.30%	HILLSBOROUGH COUNTY	68.56%
SANTA ROSA COUNTY	34.82%	LIBERTY COUNTY	69.57%
BREVARD COUNTY	35.44%	MANATEE COUNTY	70.18%
BAY COUNTY	36.04%	GILCHRIST COUNTY	72.20%
CLAY COUNTY	37.96%	COLLIER COUNTY	73.40%
SUMTER COUNTY	39.43%	BRADFORD COUNTY	74.43%
SEMINOLE COUNTY	39.49%	SUWANNEE COUNTY	74.81%
WALTON COUNTY	39.54%	HAMILTON COUNTY	75.00%
ESCAMBIA COUNTY	39.80%	PINELLAS COUNTY	75.92%
MARTIN COUNTY	42.69%	PASCO COUNTY	76.49%
BAKER COUNTY	43.43%	JEFFERSON COUNTY	76.67%
JACKSON COUNTY	44.44%	OKEECHOBEE COUNTY	77.24%
WASHINGTON COUNTY	45.00%	PUTNAM COUNTY	78.79%
VOLUSIA COUNTY	46.35%	CALHOUN COUNTY	81.94%
PALM BEACH COUNTY	48.12%	HENDRY COUNTY	82.72%
GADSDEN COUNTY	49.38%	LEE COUNTY	83.81%
HARDEE COUNTY	51.69%	TAYLOR COUNTY	87.26%
ST. LUCIE COUNTY	52.07%	CITRUS COUNTY	87.34%
UNION COUNTY	52.63%	DIXIE COUNTY	88.07%
ORANGE COUNTY	53.09%	LEVY COUNTY	88.15%
ST. JOHNS COUNTY	54.41%	CHARLOTTE COUNTY	88.35%
COLUMBIA COUNTY	55.45%	WAKULLA COUNTY	89.21%
DESOTO COUNTY	55.53%	GLADES COUNTY	91.55%
LEON COUNTY	56.81%	FRANKLIN COUNTY	92.29%
MADISON COUNTY	57.53%	MIAMI-DADE COUNTY	93.43%
HIGHLANDS COUNTY	57.63%	MONROE COUNTY	93.67%
LAKE COUNTY	57.88%	LAFAYETTE COUNTY	94.81%
SARASOTA COUNTY	58.49%	BROWARD COUNTY	96.15%

Part II

UNDERSTANDING THE DEMAND AND SUPPLY OF DISASTER INSURANCE

CHAPTER 5

INSURANCE PURCHASE DECISION MAKING BY HOMEOWNERS

KEY FINDINGS

Empirical evidence reveals that most individuals do not make cost-benefit tradeoffs in their insurance purchase decisions. Many people may correctly think about risk and have adequate insurance coverage, but others do not. A key factor that explains their decisions not to purchase insurance or not to buy adequate levels of coverage is *underestimation of the risk*. In fact, some homeowners in hazard-prone areas believe that the disaster will **not** happen to them. Some families also face budget constraints which limit their interest and/or ability to voluntarily purchase adequate insurance to cover replacement costs should they suffer a major loss. This behavior is especially likely in areas where property values have increased rapidly.

The number of Presidential disaster declarations has dramatically increased over the past 50 years. There were 162 Presidential disaster declarations during the period 1955-1965, and 545 declarations during the years 1996-2005, with notable spikes during election years. Despite this upward trend, there is no empirical evidence indicating that individuals are uninsured or underinsured because they expect to receive federal disaster relief following a disaster.

Homeowners' decisions related to the purchase of insurance are driven by a variety of goals other than only financial protection. These may include reduction of anxiety (i.e., obtaining peace of mind), satisfying mortgage requirements, and satisfying social norms (e.g., purchasing insurance because one's friends and neighbors have coverage).

CHAPTER 5

INSURANCE PURCHASE DECISION MAKING BY HOMEOWNERS¹⁵⁷

This chapter contrasts a normative theory of decision making for purchasing insurance with a descriptive model of choice. We provide an illustrative example as to how a typical homeowner would determine how much insurance (if any) to purchase against losses from a natural disaster, by trying to maximize expected utility.

While this model does have some predictive power, there are further subtleties to actual decision making that need to be addressed. People do not have access to perfect data and, even if they did, they may process information in somewhat different ways. We will review empirical evidence on how these behavioral and informational factors are likely to impact insurance buying.

5.1. Normative Model of Choice: Expected Utility Theory

The Waterman family, a hypothetical family in New Orleans, owns their house outright and has wealth (W). They are considering how much insurance coverage (I) to purchase next year against water damage to their house from a future hurricane. To keep the analysis simple and without loss of generality, we assume only two states of nature – flood or no flood – with annual probabilities p and $1-p$ respectively. If a flood occurs, the damage to the Waterman house will be L dollars. The cost of insurance per dollar coverage is c .

We assume that there are no moral hazard problems so that the Waterman family will not take advantage of purchasing insurance by either being more careless or putting objects in harm's way (e.g., moving unwanted furniture to the basement). Furthermore, we assume that the insurer has the same information about risk as the Waterman family, and charges premiums that reflect risk so that it will not lose money in the long run.

The optimal amount of insurance will be determined by maximizing the Watermans' expected utility $[E[U(I)]]$ where:

$$E[U(I)] = p \cdot U[W - L + I(1-c)] + (1-p) U(W - cI)$$

$$\text{where } 0 \leq I \leq L$$

According to this model, the Watermans should determine the amount of insurance to purchase based on the premium per dollar (c). If c equals the likelihood of a flood (p), the family should buy full insurance (i.e., covering all losses up to the value of their property with no deductible). This premium is unrealistic. With a more realistic premium loading built in, the family should scale down its coverage by taking a deductible.

¹⁵⁷ The first two sections of this chapter are based on Kunreuther, H. and M. Pauly (2006), "Rules Rather Than Discretion: Lessons from Hurricane Katrina," *Journal of Risk and Uncertainty*, 33: 101-116.

Government intervention can further reshape insurance buying patterns. According to federal income tax laws, any uninsured loss from a natural disaster can be *mostly* written off the family's federal income taxes at the marginal tax rate t , based on the Waterman's current income. $D(I, L)$ is the amount of disaster assistance the family will receive should they have I dollars of insurance coverage and L dollars of losses.¹⁵⁸ The new utility function would now look as follows:

$$E[U(I)] = p \cdot U[W - L + I(1-c) + t(L-I) + D(I, L)] + (1-p) U(W-cI)$$

The combined effect of a tax write-off and expectation of disaster relief may further dampen the demand for insurance – perhaps to the point where some homeowners decide not purchase any coverage.

5.2. Factors Influencing Insurance Purchasing Decisions

Misperception of the Risk

Individuals normally purchase insurance on an annual basis and thus must decide each year whether to renew or cancel their policy, assuming they have this discretion to do so. In the case of residents of hazard-prone areas, the annual probability of a disaster damaging their structure is not high; it is within the range of 1-in-50 to 1-in-500. So, while the financial losses could be significant, should such an event occur, the great majority of people will not have observed an event close at hand recently. The evidence on decision making under uncertainty in these low probability cases suggests that many individuals do not use an expected utility model such as the one characterized above to determine how much insurance coverage to purchase.

For one thing, people have difficulty dealing with probabilistic information for small likelihood events because they need a context in which to evaluate the data. In one study, individuals were presented with either a probability or an actuarially fair insurance premium characterizing the risks associated with the discharge of a hypothetical toxic chemical, Syntox.¹⁵⁹ The chemical had the potential for causing fatalities to individuals living near the fictitious ABC chemical plant located on the outskirts of an urban center in New Jersey. To give some reference points, respondents were also provided with the probability of death from a car accident. Finally, the participants were asked a set of questions regarding how risky they perceived the facility to be.

People were not able to distinguish between probabilities which ranged from 1 in 10,000 to 1 in 1 million in judging the riskiness of the facility. Surprisingly, the study also found that subjects did not respond to insurance premiums as a signal of risk. While individuals may not be able to think meaningfully about what a 1-in-100,000 chance of death implies, they should understand what a \$15 premium means. Yet individuals distinguished no difference between the perceived risks of the ABC chemical plant, whether the annual premiums paid for coverage against fatalities from the release of Syntox were \$15.00, \$1.50 or 15 cents.

¹⁵⁸ The amount of disaster assistance is assumed to have no impact on the uninsured losses that a person can write off for tax purposes.

¹⁵⁹ Kunreuther, H., N. Novemsky and D. Kahneman (2001), "Making Low Probabilities Useful," *Journal of Risk and Uncertainty*, 23: 103-120.

With respect to obtaining such data on their own, many potential victims of disaster perceive the costs of getting information about the hazard and costs of protection to be so high relative to the expected benefits that they do not even consider purchasing insurance.¹⁶⁰ Research shows that decision makers use *threshold models*: if the probability of a disaster is below some prespecified level they do not think about the event.¹⁶¹ In a laboratory experiment on purchasing insurance, many individuals bid zero for coverage, apparently viewing the probability of a loss as sufficiently small that they were not interested in protecting themselves against it (McClelland et al., 1993).¹⁶²

Budget Constraints

This reluctance to invest in protection voluntarily is compounded by budget constraints. For some homeowners with relatively low incomes, disaster insurance is considered a discretionary expense that should only be incurred if residual funds are available after taking care of what individuals or families consider to be the necessities of life. In focus groups on the topic, a typical response of a homeowner living in a hazard-prone area to the question, “Why don’t you have flood or earthquake insurance?” is, “I live from payday to payday.”¹⁶³ This response implies that an increase in premiums will cause people to buy less insurance because of budget constraints. In contrast to the expected utility model where the demand for insurance depends on the premium relative to the expected loss, demand under this scenario depends only on the premium for a given amount of coverage.

Role of Disaster Relief

One of the arguments that has been advanced as to why individuals do not adopt protective measures prior to a disaster is that they assume that liberal aid from the government will be forthcoming should they suffer losses from an earthquake, hurricane or flood. Federal disaster assistance may create a type of Samaritan’s dilemma: providing assistance *ex post* (after a disaster) reduces parties’ incentives to undertaking loss reduction measures *ex ante* (prior to a disaster) (Buchanan, 1975).¹⁶⁴ In the context of insurance purchases, if a family expects to receive government assistance after a loss, it will have less economic incentive to purchase coverage prior to a disaster. The increased loss due to the lack of protection by residents in hazard-prone areas then amplifies the pressure on government to provide assistance to disaster victims.

The empirical evidence on the role of disaster relief suggests, however, that individuals or communities have *not* based their protective decisions in advance of a disaster by focusing on

¹⁶⁰ Kunreuther, H. and M. Pauly (2004), “Neglecting Disaster: Why Don’t People Insure against Large Losses?” *Journal of Risk and Uncertainty*, 28: 5-21.

¹⁶¹ For empirical evidence on the use of threshold models of choice in protective decisions see Camerer, C. and H. Kunreuther (1989), “Decision Processes for Low Probability Events: Policy Implications,” *Journal of Policy Analysis and Management*, 8: 565-592.

¹⁶² McClelland, G., W. Schulze and D. Coursey (1993), “Insurance for Low-Probability Hazards: A Bimodal Response to Unlikely Events,” *Journal of Risk and Uncertainty*, 7: 95-116.

¹⁶³ Kunreuther, H. et al. (1978), *Disaster Insurance Protection: Public Policy Lessons*. New York: John Wiley & Sons.

¹⁶⁴ Buchanan, J. (1975), “The Samaritan’s Dilemma,” in Phelps, E. (ed.), *Altruism, Morality and Economic Theory*, New York: Russell Sage Foundation, 71-85.

the expectation of government assistance. Kunreuther et al. (1978)¹⁶⁵ found that most homeowners in earthquake- and hurricane-prone areas did not expect to receive aid from the federal government following a disaster. Burby et al. (1991)¹⁶⁶ found that local governments that received disaster relief undertook more efforts to reduce losses from future disasters than those that did not. This behavior seems counter-intuitive and the reasons for it are not fully understood. It will be important to see whether Hurricane Katrina changes this view given the highly publicized commitment by the Bush administration to provide billions of dollars in disaster relief to victims. In fact, one concern would be that homeowners in hazard-prone areas expect to receive more assistance from a disaster than they will actually obtain should they suffer losses.

Whether or not individuals incorporate an expectation of government relief in their pre-disaster planning process, the driving force in the provision of government assistance is the occurrence of large-scale losses (Moss 2002).¹⁶⁷ Under the current system of disaster assistance, the governor of the state(s) can request that the President declare a "major disaster" and offer special assistance if the damage is severe enough. Although the President does not specify the amount of aid (the House and Senate determine this, he is responsible for a crucial step in the process. This obviously raises questions as to what are the key drivers of such a decision and whether some states are more likely to benefit from such situation than others, and if so, when does this occur.

Recent research has shown that disaster assistance is more prevalent in Presidential election years, all other things being equal. Three salient examples are the Alaska earthquake of March 1964, Tropical Storm Agnes in June 1972, and Hurricane Andrew in September 1992. These three disasters each occurred during Presidential election years and led to special legislation by the U.S. Congress in the form of liberal disaster assistance. For example, following the Alaska earthquake in 1964 where relatively few homes and businesses had insurance protection, the U.S. Small Business Administration provided 1 percent loans for rebuilding structures and refinancing mortgages through its disaster loan program. In fact, the uninsured victims in Alaska were financially better off after the earthquake than their insured counterparts (Dacy and Kunreuther, 1968).¹⁶⁸ More recently, a battleground state with 20 electoral votes received more than twice as many Presidential disaster declarations as a state with only three electoral votes (Reeves, 2004, 2005).¹⁶⁹

¹⁶⁵ Kunreuther, H. et al. (1978), *Disaster Insurance Protection: Public Policy Lessons*. New York: John Wiley & Sons.

¹⁶⁶ Burby, R.J. with B.A. Cigler, S.P. French, E.J. Kaiser, J. Kartez, D. Roenigk, D. Weist, and D. Whittington (1991), *Sharing Environmental Risks: How to Control Governments' Losses in Natural Disasters*, Boulder, CO: Westview.

¹⁶⁷ Moss, D. (2002), *When All Else Fails: Government as the Ultimate Risk Manager*, Cambridge, MA: Harvard University Press.

¹⁶⁸ Dacy, D. and H. Kunreuther (1968), *The Economics of Natural Disasters*. New York: The Free Press.

¹⁶⁹ Reeves, A. (2004), "Plucking Votes from Disasters," *Los Angeles Times*, May 12; Reeves, A. (2005), "Political Disaster? Electoral Politics and Presidential Disaster Declarations," Kennedy School of Government, Harvard University, Cambridge, MA.

Overall, the number of Presidential declarations has dramatically increased over the past 50 years: there were 162 during the period 1955-1965, 282 during the period 1966-1975, 319 during the period 1986-1995 and 545 during the period 1996-2005 (Michel-Kerjan, in press).¹⁷⁰ Figure 5.1 depicts the evolution of the number of these declarations between 1955 and 2005. It also highlights the peak years, which often correspond to presidential election years.

In the case of Hurricane Katrina, Governor Kathleen Blanco declared a State of Emergency on August 26, 2005, and requested disaster relief from the federal government on August 28. President Bush declared a State of Emergency on the 28th, an action that freed federal government funds but caps them at \$5 million and puts emergency response activities, debris removal, and individual assistance and housing programs under federal control (CRS 2005).¹⁷¹

On August 29 in response to Governor Blanco’s request, the President declared a “major disaster,” allotting more federal funds to aid in rescue and recovery. By September 8, Congress had approved \$52 billion in aid to victims of Hurricane Katrina. Two years after the catastrophe, the total federal relief allocated by Congress for the reconstruction of the areas devastated by the 2005 hurricane season was nearly \$125 billion.

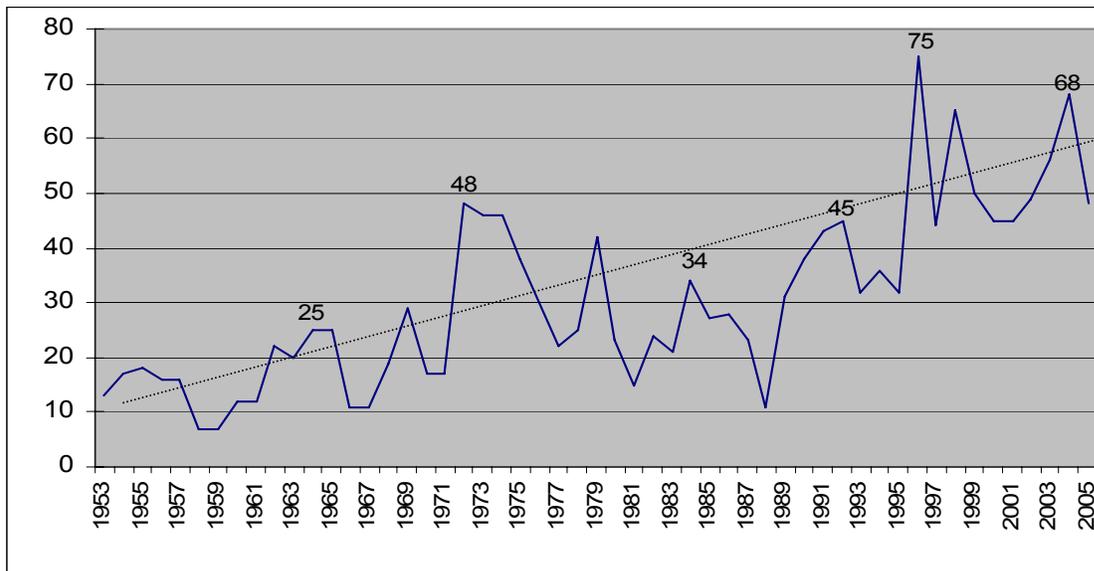


FIGURE 5.1. U.S. PRESIDENTIAL DISASTER DECLARATIONS PER YEAR
 (PEAK VALUES ON THE GRAPH CORRESPOND TO SOME PRESIDENTIAL ELECTION YEARS)
 Source: Michel-Kerjan (in press)¹⁷²

¹⁷⁰ Michel-Kerjan, E. (in press), “Disasters and Public Policy: Can Market Lessons Help Address Government Failures?” proceedings of the 99th National Tax Association Conference, Boston, MA, *National Tax Journal*.

¹⁷¹ Congressional Research Service (2005), “Federal Stafford Act Disaster Assistance: Presidential Declarations, Eligible Activities, and Funding,” Washington, DC: Congressional Research Service, Library of Congress.

¹⁷² Michel-Kerjan, Op. Cit.

5.3. Role of Goals and Plans in Insurance Decision Making¹⁷³

The expected utility model assumes that financial considerations determine one's decision on whether or not to purchase insurance. In practice, individuals make their insurance decisions by constructing or selecting plans designed to achieve multiple goals. For example, a plan to purchase homeowners insurance may satisfy as many as seven goals simultaneously: (1) reducing the chances of a catastrophic loss; (2) reducing anxiety about risks of fire and theft; (3) avoiding regret and/or providing consolation in case a loss occurs; (4) satisfying conditions required by a bank; (5) presenting the appearance of prudence to others who will learn about the insurance purchase; (6) maintaining one's relationship with an insurance agent; and (7) avoiding highly burdensome insurance premium payments.

The importance of these goals obviously varies with the decision maker, but may also be affected by contextual variables that change over time. When reflecting on paying monthly bills, an insurance purchaser may focus primarily on the goals of satisfying the requirements of the bank that holds the mortgage loan (goal 4), and minimizing the cost of insurance (goal 7). When that same person reflects on her valuable works of art, she may think about reducing anxiety (goal 2) and avoiding regret (goal 3).

The plan/goal representation appears to capture the insurance decision making process, as illustrated by the following example based on empirical data. People often purchase flood insurance only after suffering damage in a flood, but then many cancel their policies when several consecutive years pass with no flood (Kunreuther, Sanderson and Vetschera, 1985).¹⁷⁴ In the case of flood insurance, this finding is particularly striking since the National Flood Insurance Program (NFIP) requires that homes located in Special Flood Hazard Areas (SFHAs) purchase insurance as a condition for federally-backed mortgages. To determine the extent to which residents in hazard-prone areas adhere to the law, FEMA examined applications for disaster assistance from 1549 victims of a flood in August 1998 in northern Vermont, and found that 84 percent of residents in SFHAs did *not* have insurance, 45 percent of whom were required to purchase it.¹⁷⁵ A simple explanation is that avoiding anxiety and feeling justified when buying coverage are both important goals. Following flood damage, anxiety is high, and reducing it is a salient goal; it is also easy to justify buying the insurance, since a flood has just occurred.

Thus, insurance is purchased based strongly on the desire to feel justified and avoid anxiety. After several years, many people may find that the prospect of a flood no longer troubles their "peace of mind," so anxiety avoidance (goal 2) now has low value. Meanwhile, insured individuals do not feel justified in continuing to pay premiums and not collecting on their policy; the goal of feeling justified is unfulfilled and becomes more salient. The differential weighting of these two goals can lead one to decide not to purchase insurance (i.e., cancel their existing policy).

¹⁷³ This section is based on Krantz, D.H. and H. Kunreuther (2007), "Goals and plans in decision making," *Judgment and Decision Making*, 2(3): 137-168.

¹⁷⁴ Kunreuther, H., W. Sanderson and R. Vetschera (1985), "A Behavioral Model of the Adoption of Protective Activities," *Journal of Economic Behavior and Organization*, 6: 1-15.

¹⁷⁵ Tobin, R. and C. Calfee (2005), *The National Flood Insurance Program's Mandatory Purchase Requirement: Policies, Processes, and Stakeholders*. Washington, DC: American Institute for Research.

Note that this theory predicts that a decision maker who puts heavy weight on the goals of avoiding catastrophic loss and avoiding regret will likely continue to purchase flood insurance year after year, if the cost is modest. A decision advisor confronting such a view, might well ask the individual about the importance of having good justification for purchasing insurance, and whether protection against catastrophic losses might justify paying the premium.

Taxonomy of Insurance-Related Goals

We now discuss five of the main goal categories for purchasing insurance: *sharing financial risk*, *emotion-related goals (either worry or regret)*, *satisfying legal or other official requirements*, and *satisfying social and/or cognitive norms*. (*Maintaining a relationship with a trusted agent/advisor and affording premiums are self-explanatory.*)

Financial Protection. Individuals can purchase insurance at relatively low cost and be financially protected against a catastrophic loss if the negative event in question has a low probability of occurrence, if there are many at risk, and if occurrences of the event are statistically independent. For low-probability, high-impact events, one benefit of purchasing insurance is being protected against the risk of a large financial loss.

Emotion-Related Goals. There is a growing literature on how affect and emotional goals impact individuals' decision making under risk (Loewenstein et al., 2001; Finucane et al., 2001).¹⁷⁶ Three goals in this category with respect to insurance are *reduction of anxiety* (i.e., peace of mind), *avoidance of anticipated regret* (Bell, 1982;¹⁷⁷ Loomes and Sugden, 1982;¹⁷⁸ Braun and Muermann, 2004)¹⁷⁹ and *disappointment* (Bell, 1985).¹⁸⁰ One might also expect individuals to pay more for insurance if they feared a specific event (e.g., their car or painting being stolen; their house being damaged by a hurricane) than if they were not very concerned about the event occurring. With respect to negative feelings about a situation, experimental findings of Rottenstreich and Hsee (2001)¹⁸¹ and Sunstein (2003)¹⁸² indicate that people focus on the unpleasantness of the outcome rather than on its probability when they have strong emotional feelings attached to the event.

Individuals may also purchase insurance as a form of consolation should they suffer a loss. In particular, if one has special affection for an item, such as a piece of art, then the knowledge that one can make a claim should the item be destroyed or stolen may give special

¹⁷⁶ Loewenstein, G.F., E.U. Weber, C.K. Hsee, and N. Welch, (2001), "Risk as Feelings." *Psychological Bulletin*, 127(2) 267-86; Finucane, M.L., A. Alhakami, P. Slovic and S.M. Johnson (2001), "The affect heuristic in judgments of risks and benefits," *Journal of Behavioral Decision Making*, 13(1): 1-17.

¹⁷⁷ Bell, D. (1982), "Regret in Decision Making Under Uncertainty," *Operations Research*, 30: 961-981.

¹⁷⁸ Loomes, G. and R. Sugden (1982), "Regret Theory: An Alternative Theory of Rational Choice Under Uncertainty," *The Economic Journal*, 92(368): 805-824.

¹⁷⁹ Braun, M. and A. Muermann (2004), "The Impact of Regret on the Demand for Insurance," *The Journal of Risk and Insurance*, 71(4): 737-767.

¹⁸⁰ Bell, D. (1985), "Disappointment in Decision Making Under Uncertainty," *Operations Research*, 33: 1-27.

¹⁸¹ Rottenstreich, Y. and C.K. Hsee (2001), "Money, kisses, and electric shocks: On the affective psychology of risk." *Psychological Science*, 12: 185-190.

¹⁸² Sunstein, C. (2003), "Terrorism and Probability Neglect," *Journal of Risk and Uncertainty*, 26: 121-136.

comfort to the person. Hsee and Kunreuther (2000)¹⁸³ attribute the need for consolation as the reason why individuals are willing to pay higher premiums for the same amount of coverage for objects they love than for those where they don't have special feeling. This behavior is consistent with Adam Smith's observation about human nature in *The Theory of Moral Sentiments*. Smith writes:

“A man grows fond of a snuff-box, of a pen-knife, of a staff which he has long made use of, and conceives something like real love and affection for them. If he breaks or loses them, he is vexed all out of proportion to the value of the damage. The house which we have long lived in, the tree whose verdure and shade we have long enjoyed, are both looked upon with a sort of respect that seems due to such benefactors. The decay of the one, or the ruin of the other, affects us with a kind of melancholy though we should sustain no loss by it.” (Smith, 1966, pp. 136-137)

Satisfying Requirements. Insurance coverage is often mandatory. Homeowners' insurance is normally required by mortgage lenders, and flood insurance must be purchased as a condition for a federally insured mortgage in Special Flood Hazard Areas. In these cases, the purchase of insurance may be viewed as a subgoal for meeting endgoals such as owning a car or a home, or practicing one's profession.

Satisfying Social and/or Cognitive Norms. Many insurance decisions are based on what other people are doing, or think is an appropriate action to take. There is also empirical evidence that the purchase of insurance, like adoption of new products, is based on knowledge of what friends and neighbors have done. An illustration of this behavior came from a pretest interview of an earthquake questionnaire when a homeowner, hearing that his neighbor had purchased earthquake insurance, indicated that he would want to buy such coverage himself without changing his beliefs about the risk he was facing or knowing about the actual cost of coverage (Kunreuther et al., 1978).¹⁸⁴

In our discussion of flood insurance above, we introduced feeling justified as one of several important goals. Someone who purchases flood insurance soon after suffering damage from such a disaster may do so in part because it is easy to justify the expenditure by pointing to the flood that just occurred. Cancelling insurance after some years of coverage may result from the social norm that it is hard to justify an expenditure that has not paid off. In fact, people are concerned with justifying their decisions to themselves and others (Shafir, Simonson and Tversky, 1993).¹⁸⁵ In the process, people often use arguments that have little to do with the tradeoffs between the cost of insurance and the expected loss that forms the basis of economic analyses of insurance or warranty transactions (Hogarth and Kunreuther, 1995).¹⁸⁶

¹⁸³ Hsee, C.K and H. Kunreuther (2000), "The Affection Effect in Insurance Decisions," *Journal of Risk and Uncertainty*, 20(2): 149-59.

¹⁸⁴ Kunreuther H. et al. (1978), *Disaster Insurance Protection: Public Policy Lessons*, New York: John Wiley & Sons.

¹⁸⁵ Shafir, E., I. Simonson and A. Tversky (1993), "Reason-Based Choice," *Cognition*, 49(1-2): 11-36.

¹⁸⁶ Hogarth, R. and H. Kunreuther (1995), "Decision Making Under Ignorance: Arguing with Yourself," *Journal of Risk and Uncertainty*, 10: 15-36.

5.4. Conclusions

The empirical evidence suggests that individuals do not make tradeoffs regarding the expected benefits and costs of purchasing insurance. In fact, many of the individuals who do not buy coverage voluntarily decline to do so because they underestimate the risk and face budget constraints. Those who do buy homeowners coverage are normally required to have this insurance as a condition for a mortgage. Others may buy protection to reduce their anxiety and sleep better at night. One question that will be explored in Chapter 14 will be the design of alternative programs for better providing insurance coverage for those residing in hazard-prone areas so as to avoid the liberal governmental disaster relief that normally is provided following a large-scale disaster.

SUMMARY OF CHAPTER 5

Expected utility theory is the normative model of choice for characterizing how homeowners should make insurance purchase decisions. This model does *not* characterize the behavior of most individuals, as they do not engage in cost-benefit analysis in the way that the theory suggests they should.

In reality, many individuals misperceive risks, and believe that the disaster will not happen to them until after the hurricane, flood or earthquake occurs. Only then do they consider purchasing insurance coverage. A significant number will cancel their coverage if a disaster does not occur within the coming few years. Some homeowners are likely to face budget constraints which limit their interest and/or ability to voluntarily purchase coverage.

Individuals seem to make their insurance decisions by focusing on how well they satisfy a set of goals. These include financial protection, emotion-related goals (either worry or regret), satisfying legal or other official requirements and satisfying social and/or cognitive norms (friends, family, neighbors).

CHAPTER 6

PRIVATE INSURERS' DECISION MAKING FOR SUPPLYING COVERAGE

KEY FINDINGS

Impacts of uncertainty and conflict between experts. Insurers are likely to charge higher premiums if there is ambiguity associated with estimating the likelihood and consequences of a risk. A recent survey of actuaries and underwriters undertaken by the Wharton Risk Center as part of this project revealed that the premiums for ambiguous risks are 25 percent higher than when risks are unambiguous.

Due to the unpredictability and sizable losses associated with catastrophes, insurers need to allocate more capital to cover the losses in the tail of the probability distribution. The need to secure an adequate rate of return on capital is not sufficiently understood. In particular, the prices charged for catastrophe insurance must be sufficiently high not only to cover the expected claims costs and other expenses, but also the costs of allocating capital to underwrite this risk. For truly extreme risks, the resulting premium can be as much as 5 to 10 times higher than the *expected* loss (probability multiplied by consequence), to provide investors with a fair return on equity and also maintain the insurer's credit rating. Following the 2004-2005 hurricanes, rating agencies instituted more stringent criteria for providing protection against catastrophic risk. This led insurers to allocate even more capital than they had previously to cover the tail of the distribution.

While catastrophes are often characterized as low-probability/high-consequence events, the data suggest that they are expected to occur with a much higher frequency than in the past. Catastrophe models and exceedance probability (EP) curves have been used in recent years by insurers to estimate their risks from natural disasters and manage their portfolios. Working with the risk modeling firm Risk Management Solutions (RMS) we determined aggregate residential losses associated with a series of hurricane scenarios for our four focus states. Using Florida as an illustrative example, we specified an EP curve that revealed a 15 percent annual probability of an insured loss in the state of at least \$10 billion, and a 5 percent annual probability that insured losses will exceed \$25 billion.

We also compared the insured losses from hurricanes in the postal zones within Miami-Dade County with 46 counties in the northern part of Florida. Taken together, these 46 counties have the same expected annual insured losses as Miami-Dade County; however, the standard deviation of losses for Miami-Dade is \$4.2 billion, and for the 46 northern counties is \$2.8 billion. The cost of capital in Miami-Dade County to cover losses should then lead to higher premiums than in portions of northern Florida that have the same expected loss but a much lower standard deviation, if insurers had the freedom to charge premiums reflecting risk.

CHAPTER 6

PRIVATE INSURERS' DECISION MAKING FOR SUPPLYING COVERAGE

6.1. The Concept of Insurability

Today, insurers and reinsurers are reexamining their ability to provide protection against wind damage from hurricanes and are asking whether these events are insurable, and at what price.

To understand the concept of insurability, consider a standard policy whereby premiums are paid at the start of a given time period to cover losses during this interval (usually a year). Two conditions must be met before insurance providers are willing to offer coverage against an uncertain event. The first is the ability to identify and quantify, or estimate at least partially, the chances of the event occurring and the extent of losses likely to be incurred. The second condition is the ability to set premiums for each potential customer or class of customers at prices that provide a competitive return at the assumed level of risk.

If both conditions are satisfied, a risk is considered to be insurable. But it still may not be profitable. In other words, it may be impossible to specify a premium for which there is sufficient demand and incoming revenue to cover the development, marketing, operating, cost of holding capital, and claims processing costs of the insurer and yield a net positive profit over a pre-specified time horizon. In such cases, the insurer will not want to offer coverage against this risk.

6.2. Determining Whether to Provide Coverage

Based on their knowledge of likelihood and outcome, insurers must make a decision as to whether to cover the risk (unless they are required to do so by law). In his study on insurers' decision making as to when they would market coverage for a specific risk, Stone (1973)¹⁸⁷ develops a model whereby firms maximize expected profits subject to satisfying a constraint related to the survival of the firm.¹⁸⁸ An insurer satisfies its survival constraint by choosing a portfolio of risks that has a likelihood of experiencing total claim payments greater than some predetermined amount (L^*) that is less than some threshold probability p_1 .

The value of L^* is determined by an insurer's concern with insolvency and/or a sufficiently large loss in surplus that will lead a rating agency to downgrade its credit rating. The threshold probability reflects the tradeoff between the expected benefits of issuing another insurance policy and the costs to the firm of a catastrophic loss that reduces the insurer's surplus by L^* or more. This threshold probability does not necessarily correspond to what would be efficient for society.

¹⁸⁷ Stone, J. (1973), "A Theory of Capacity and the Insurance of Catastrophic Risks: Part I and Part II," *Journal of Risk and Insurance*, 40: 231-243 (Part I) and 40: 339-355 (Part II).

¹⁸⁸ Stone also introduces a constraint regarding the stability of the insurer's operation. Insurers have traditionally not focused on this constraint in dealing with catastrophic risks but reinsurers have, as discussed in the next chapter.

A simple example illustrates how an insurer would utilize its survival constraint to determine whether a particular portfolio of risks is insurable with respect to hurricanes. Assume that all homes in a hurricane-prone area are identical and equally resistant to damage such that the total insurance premium, P , is the same for each structure. Furthermore, assume that an insurer has S dollars in current surplus and wants to determine the number of policies it can write and still satisfy its survival constraint. Then, the maximum number of policies, n , satisfying the survival constraint is given by equation (6.1):

$$\text{Probability [Total Claims Payments } (L^*) > (n \cdot P + S)] < p_1 \quad (6.1)$$

The insurer will use the survival constraint to determine the maximum number of policies it is willing to offer. Naturally, it can issue more policies by reducing the amount of coverage per policy and/or transferring of some of its risk to others in the private sector (e.g., reinsurers or capital markets). It may also rely on state or federal programs to cover its catastrophic losses.

Following the series of natural disasters that occurred at the end of the 1980s and in the 1990s, insurers focused on the survival constraint to determine the amount of catastrophe coverage they were willing to provide because they were concerned that their aggregate exposure to a particular risk must not exceed a certain level. Rating agencies, such as A.M. Best, focused on insurers' exposure to catastrophic losses as one element in determining credit ratings, so insurers paid attention to this risk.

6.3. Setting Premiums

If the insurer decides to offer coverage, it needs to determine a premium rate that yields a profit and satisfies its survival constraint given by equation (6.1). As discussed in Chapter 2, state regulations often limit insurers in their premium-setting process. Competition can play a role as well, in determining what premium can be charged in a given marketplace. Even in the absence of these influences, an insurer must consider problems associated with the *ambiguity of the risk*, asymmetry of information (*adverse selection* and *moral hazard*), and degree of *correlation of the risk* in determining what premium to charge. We briefly examine each of these factors below.

Ambiguity of the Risk

Figure 6.1 illustrates the total number of loss events from 1950 to 2000 in the United States for three types of natural disasters: earthquakes, floods and hurricanes. Events were selected that had at least \$1 billion of economic damage and/or over 50 deaths (American Re, 2002).¹⁸⁹ Looking across all the disasters of a particular type (earthquake, hurricane, or flood), for this 50-year period, the median loss is low while the maximum loss is very high. Given this wide variation in loss distribution, it is not surprising that insurers are concerned about the uncertainty of the loss in estimating premiums, or even providing any coverage in certain hazard-prone areas.

¹⁸⁹ American Re (2002), *Topics: Annual Review of North American Natural Catastrophes 2001*.

The 2004 and 2005 seasons have already dramatically changed the upper limits in Figure 6.1. Hurricane Katrina is estimated to have caused between \$150 billion and \$170 billion in economic losses, more than four times than the most costly hurricane between 1950 and 2000. On the other hand, despite predictions which indicated higher-than-normal activity seasons in 2006 and 2007, the only hurricane to make landfall in the U.S. since 2005 was a Category 1 hurricane.

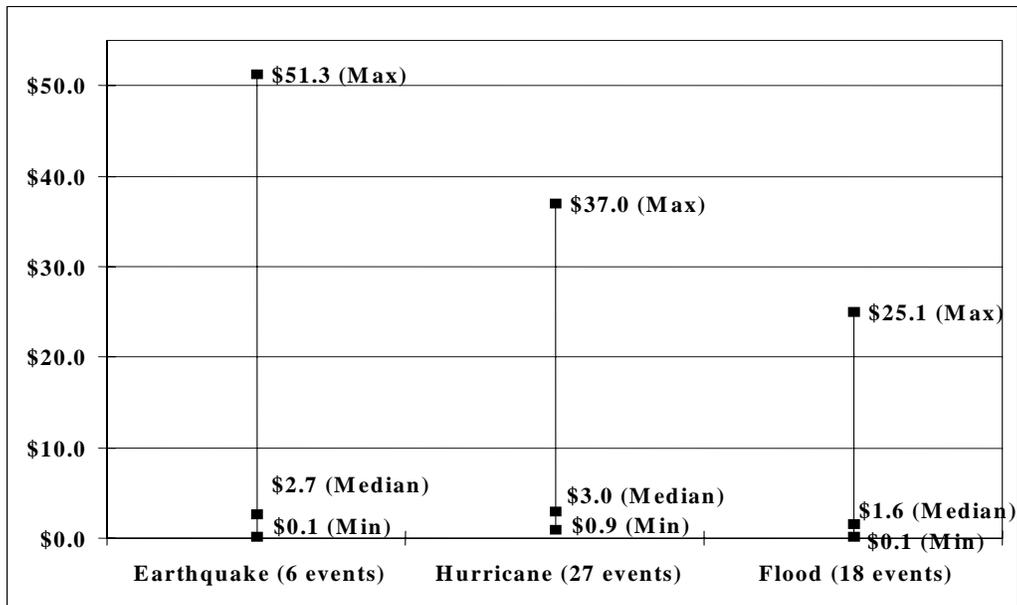


FIGURE 6.1. HISTORICAL ECONOMIC LOSSES IN \$ BILLION VERSUS TYPE OF SIGNIFICANT U.S. NATURAL DISASTERS FOR THE 50 YEAR PERIOD FROM 1950 TO 2000
 Source: American Re (now Munich Re)

The infrequency of major catastrophes in a single location implies that the loss distribution is not well specified. The ambiguities associated both with the probability of an extreme event occurring and with the outcomes of such an event raise a number of challenges for insurers with respect to pricing their policies. As shown by a series of empirical studies, actuaries and underwriters are averse to ambiguity and want to charge much higher premiums when the likelihood and/or consequences of a risk are highly uncertain than if these components of risk are well specified (Kunreuther et al., 1995).¹⁹⁰

Because of our limited scientific knowledge of most catastrophic risks, insurers are therefore left with imprecise estimates of the probability of a specific risk, such as a range of probabilities (i.e., $p \in [p_{low}; p_{high}]$). In some cases, the probability of the risk is so controversial that experts strongly disagree on the estimate of the probability. For instance, one group of experts confidently estimates that the probability of the risk is p_{low} , and the other confidently estimates it is p_{high} .

¹⁹⁰ Kunreuther, H., J. Meszaros, R. Hogarth, and M. Spranca (1995), "Ambiguity and underwriter decision processes," *Journal of Economic Behaviour and Organization*, 26: 337-352.

Fueled with such estimates, how would insurers react? How do they aggregate the probability estimates which the risk modeling firms have provided them with? In the case of conflicting estimates, would they take the arithmetic mean of the two estimates or some other linear combination? What is the effect of controversies on the estimate of the probability of a risk on insurance premiums?

Recent research shows that insurers are also sensitive to the type of ambiguity. In a survey of 78 actuaries in France, Cabantous (2007)¹⁹¹ showed that actuaries would charge a much higher premium when ambiguity came from conflict and disagreement regarding the probability of a loss than when the ambiguity came from an imprecise forecast. On average, the annual mean premium was 32 percent higher when the ambiguity came from an imprecise forecast than when the risk was well-known, and it was 40 percent higher when ambiguity came from conflict. The survey also showed that the source of ambiguity matters. (See Table 6.1 for details of the scenarios.)

For this study, the Wharton Risk Center launched a web-based survey of U.S. actuaries and underwriters' decision making under risk, uncertainty without conflict, and uncertainty with conflicting information on risk estimates. We invited underwriters and actuaries from Sponsor companies to complete a 15-minute survey that has the support of the Casualty Actuarial Association. Survey data is still being collected, but the first set of results on 78 responses are worth mentioning here.

In this survey, nine different scenarios were developed by crossing three different types of natural hazards (fire, flood and hurricane) with three types of information about the probability of a disaster (precise probability, imprecise probability and conflicting probability) with a loss of \$100,000, using the same type of questions as in the survey of actuaries in France, as described in Table 6.1. Participants were asked to determine the annual premium they would charge to cover a homeowner against a risk, assuming a 1-year contract. We are also interested in how insurers would behave if they had the opportunity to offer a long-term insurance contract (e.g., 20 years) tied to the homeowner's mortgage (see Chapter 14 for a detailed discussion of this concept).

When there was no ambiguity, the probability of the loss was 1 in 100, so the expected loss is \$1,000. In the two ambiguous cases, we specified 1 in 200 and 1 in 50 as the minimum and maximum estimates of the probability of the loss, so the expected loss for these two situations was \$500 and \$2,000 respectively.

¹⁹¹ Cabantous, L. (2007), "Ambiguity Aversion in the Field of Insurance: Insurers' Attitude to Imprecise and Conflicting Probability Estimates," *Theory and Decision*, 62: 219-235.

TABLE 6.1. SCENARIOS OF THREE RISKY SITUATIONS

No Ambiguity	Source of the Ambiguity	Source of the Ambiguity
Precise Probability	Imprecise Probability	Conflicting Probability
Both modeling firms estimate that there is 1 in a 100 chance that a flood will severely damage homes in this area this year (i.e., the annual probability is 1 percent). They both are confident of their estimate.	Both modeling firms recognize that it is difficult to provide a precise probability estimate. The two modeling firms agree that the probability that a hurricane will severely damage homes in this area this year ranges somewhere between a 1 in 200 chance and 1 in 50 chance.	One modeling firm confidently estimates that there is 1 in a 200 chance that a fire will severely damage homes in this area this year (i.e., the annual probability is 0.5 percent). The other modeling firm however, confidently estimates that the chance that a fire will severely damage homes in this area this year is much higher: 1 in 50 chance (i.e. the annual probability is 2 percent).

The preliminary results shown in Figure 6.2 reveal that the type of hazard does not have a significant effect on mean premiums. However, the quality of the probabilistic information can change the premium significantly.

Under a 1-year contract, mean annual premiums when the probability is ambiguous are 25 percent higher than when it is given precisely. The source of uncertainty, however, does not affect insurers, and premiums under conflict are not significantly different from premiums under imprecision. Contrary to results by Cabantous (2007),¹⁹² in this population of U.S. insurers, imprecision is of only slightly greater concern than conflict. The mean premium under imprecision is 5 percent higher than the mean premium under conflict.

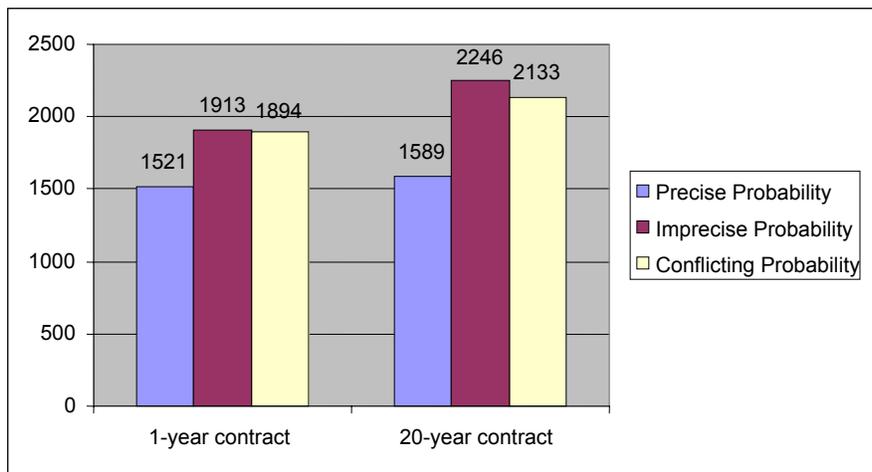


FIGURE 6.2. ANNUAL MEAN PREMIUMS IN DOLLARS, ACROSS NATURAL HAZARDS (N=78)

Under the 20-year contract, aversion to ambiguity is even stronger. Depending on whether the probability is imprecise or there are conflicting probability estimates, mean annual premiums are 34 percent and 41 percent higher respectively than when there is no ambiguity. When probabilities are precise, the premium charged for the 20-year contract is slightly higher than for a 1-year contract.

¹⁹² Ibid.

Adverse Selection

If the insurer cannot differentiate the risks facing two groups of potential insurance buyers and all buyers knows their own risk, then the insurer is likely to suffer losses if it sets the same premium for both groups by using the entire population as a basis for this estimate. If only the highest risk group is likely to purchase coverage for that hazard and the premium is below its expected loss, the insurer will have a portfolio of “bad” risks. This situation, referred to as *adverse selection*, can be rectified by the insurer charging a high enough premium to cover the losses from the bad risks. In so doing, the good risks might purchase only partial protection or no insurance at all, because they consider the price of coverage to be too expensive relative to their risk.¹⁹³

This was the argument made by private insurers regarding the non-insurability of flood risk that led to the creation of the National Flood Insurance Program (NFIP) in 1968 (see Chapter 4). Indeed, insurers thought that families who had lived in a specific flood-prone area for many years had a much better knowledge of the risk than any insurer would have gained unless it undertook costly risk assessments.

In the context of hurricane, however, it is not clear whether there is any adverse selection. Indeed, there is no evidence that those at risk have an informational advantage over the insurer. In fact, the opposite might be true: if insurance companies spend a lot of resources estimating the risk (which they do today) they might gain an informational advantage over their policyholders who cannot afford or do not want to do so. In recent years, there has been a growing literature on the impact of insurers being more knowledgeable about the risks than the insureds themselves. Research in this field reveals that insurers might want to exploit this *reverse information asymmetry*, which results in low-risk agents being optimally covered, while high risks are not (Henriet and Michel-Kerjan, 2008).¹⁹⁴

Moral Hazard

Moral hazard refers to an increase in the expected loss (probability or amount of loss conditional on an event occurring) as a result of purchasing insurance (i.e., behaving more carelessly). Providing insurance protection may lead the policyholder to alter his or her behavior in ways that increase the expected loss relative to what it would have been without coverage. If the insurer cannot predict this behavior and relies on past loss data from uninsured individuals to estimate the distribution of claim payments, the resulting premium is likely to be too low to cover expected losses. The introduction of deductibles, coinsurance or upper limits on coverage can be useful tools in reducing moral hazard, by encouraging insureds to engage in less risky behavior, as they know they will incur part of the losses from an adverse event.

Correlated Risks

¹⁹³ For a survey of adverse selection issues, see Dionne, G., N. Doherty and N. Fombaron (2000), “Adverse Selection in Insurance Markets,” Chapter 7 in Dionne, G. (ed.) *Handbook of Insurance*. Boston: Kluwer.

¹⁹⁴ Henriet D. and E. Michel-Kerjan (2008), “Looking at Optimal Risk-Sharing in a Kaleidoscope: The (Market Power, Information) Rotational Symmetry.” Working Paper, Wharton Risk Management and Decision Processes Center, Philadelphia, PA.

For extreme events, the potential for high correlation between the risks will have an impact on the tail of the distribution. In other words, at a predefined probability p_i , the region below the EP curve is likely to expand for higher correlated risks covered by insurers. This requires additional capital for the insurer to protect itself against large losses. Insurers normally face spatially correlated losses from large-scale natural disasters. State Farm and Allstate paid \$3.6 billion and \$2.3 billion in claims respectively in the wake of Hurricane Andrew in 1992 due to their high concentration of homeowners policies in the Miami-Dade County area of Florida. Given this unexpectedly high loss, both companies began to reassess their strategies of providing coverage against wind damage in hurricane-prone areas (Lecomte and Gahagan, 1998).¹⁹⁵

Hurricanes Katrina and Rita, which devastated the U.S. Gulf Coast in August and September 2005, had dramatic impacts on several lines of insurance, notably property damage and business interruption. Edward Liddy, chairman of Allstate, which provided insurance coverage to 350,000 homeowners in Louisiana, Mississippi and Alabama, shortly after Katrina declared that:

“... extensive flooding has complicated disaster planning ... and the higher water has essentially altered efforts to assess damage. We now have 1,100 adjusters on the ground. We have another 500 who are ready to go as soon as we can get into some of the most-devastated areas. It will be many weeks, probably months, before there is anything approaching reliable estimates.” (Francis, 2005).¹⁹⁶

6.4. Importance of the Cost of Capital

The importance of capital as a requisite to secure an adequate rate of return is often not sufficiently understood. In particular, the prices charged for catastrophe insurance must be sufficiently high to cover the expected claims costs and other expenses, but also must cover the costs of allocating risk capital to underwrite this risk. Moreover, because large amounts of risk capital are needed to underwrite catastrophe risk relative to the expected liability, the resulting premium is high relative to its loss expenses, simply to earn a fair rate of return on equity and thereby maintain the insurer’s credit rating.

There is indeed a temptation for parties to imbue the notion of a fair premium to serve their own interests. For example, the term *actuarially fair premiums* has a precise definition: the premium is equal to the expected loss. Much of the public debate surrounding a fair price of catastrophe insurance implicitly uses the concept of actuarially fair premium because it is simple and results in a low cost to the policyholder. However, while *actuarially fair* is a useful statistical concept, the implied premiums are not economically sustainable; insurers must cover all their costs (not only expected claims) in order to survive and attract capital.

¹⁹⁵ Lecomte, E. and K. Gahagan (1998), “Hurricane Insurance Protection in Florida,” in Kunreuther, H. and R. Roth, Sr., (eds.), *Paying the Price: The Status and Role of Insurance Against Natural Disasters in the United States*, Washington, DC: Joseph Henry Press: pp. 97-124.

¹⁹⁶ Francis, T. (2005), “CEO Says Allstate Adjusts Storm Plan. Interview of Edward Liddy,” *The Wall Street Journal*, pp. C1-C3, September 5.

An expanded notion of fair premiums derives from the notion of a *fair rate of return on capital*. A fair return is one that offers the investor a competitive return on capital so that the investor will want to place her funds with the insurer rather than elsewhere. A fair premium would then be one that just offered the investor a fair rate of return. To offer a fair return, the premium would have to cover all costs (expected claims, expenses of various sorts and taxes), and then produce an expected return to the investor which was equal to the cost of capital or fair return. The premium would yield some profit, but only the normal level of profit necessary to attract and maintain the insurer's capital base.

While a sustainable premium must offer a return consistent with the cost of capital, we need also to pay attention to how much capital the insurer will want to have so that it can promise to pay claims with an acceptably low probability of default. The amount of capital necessary to do so will depend on the risk characteristics of its liability portfolio, its asset portfolio and the effectiveness of its risk management strategy. What is an acceptably low risk will be interpreted differently by prospective policyholders, by regulators and by rating agencies who impose standards ostensibly on behalf of such policyholders. For current purposes, we can think of the economic capital as that required to maintain the insurer's credit rating or the capital needed to satisfy regulatory requirements if this is higher than the rating agency's requirements.

Each policy the insurer sells imposes its own capital burden. If an additional policy were sold without adding to the insurer's overall capital, there would normally be a small increase in the likelihood that the insurer would default. Just how much of a change would depend on the riskiness of the policy and its covariance with other policies and assets held by the insurer. The appropriate allocation of capital to a policy would be that amount required to maintain the insurer's credit status; i.e., the addition of the policy and the accompanying capital would leave the insurer with the same credit status as before.

We thus define a fair price for insurance as a premium that provides a fair rate of return on invested equity. To illustrate, we construct a somewhat conservative hypothetical example that ignores taxes and regulatory constraints. Consider a portfolio that has \$1,000 in expected losses, $E(L)$. Let k be the ratio of capital to expected losses for the insurer to maintain its credit rating. For this example $k=1$, a value utilized by many property liability insurers for their combined book of business (Doherty 2000).¹⁹⁷

In addition to paying claims, the insurer is assumed to set aside capital for covering additional expenses (X) in the form of commissions to agents and brokers, and underwriting and claims assessment expenses. For this example, $X = \$200$. Given the risk characteristics of the portfolio, investors require a return on equity (ROE) of 15 percent to compensate for risk. The insurer invests its funds in lower-risk vehicles that yield an expected return, r , of 5 percent. What premium π would the insurer have to charge its policyholders to cover them against natural disasters and to secure a return of 15 percent for its investors?

¹⁹⁷ Doherty, N. (2000), *Integrated Risk Management*, New York; McGraw-Hill.

The formula is given by:

$$\pi = \frac{E(L) + X(1+r)}{(1+r) - k(ROE - r)}$$

which yields a value of $\pi = \$1,274$ for this hypothetical example. We can think of this premium now as the expected loss of \$1,000 plus a proportionate loading, λ , of 0.274. Thus, the premium is

$$(1 + \lambda)E(L) = (1 + 0.274)\$1,000 = \$1,274$$

This calculation is very sensitive to the ratio of capital to expected liability, k , needed to preserve credit. In the above example, the ratio was one dollar of capital for one dollar of expected liability. This ratio is in the ballpark for the combined books of business of many property liability insurers. However, for catastrophic risk, with its very large tail risk (which severely affects the insurer's credit risk), the capital to liability ratio needs to be higher. Indeed, the capital to liability ratio depends on volatility of the catastrophe liability and its correlation with the insurer's remaining portfolio. For the catastrophe risk premium for individual homeowners, this may translate into a loading, λ , perhaps approximating 0.5. Thus the premium would be 150 percent of the expected loss. This does not reflect undue profitability, but simply that insurers need considerable capital to supply this insurance and the cost of that capital is included in the premium.

When it comes to reinsurance of catastrophic risk, the relative capital cost is much higher. For higher layers of catastrophe reinsurance, the expected loss is often quite low and the volatility very high. At these layers, the required capital/liability ratio can be considerably greater than the one-to-one used in the above example. An increase in the capital/liability ratio will increase the premium required to generate a fair return on equity.

A second issue with respect to catastrophic risk is that it can be expensive to underwrite since it requires extensive modeling. Many companies buy commercial models and/or use their own in-house modeling capability. We recalculate the premium formula with $X = \$600$ and $k = 5$. The required premium is now \$2,964, more than twice the value of π computed above and now nearly three times the expected loss. Notice this translates into a loading, λ , of 1.965, so the premium is

$$(1 + \lambda)E(L) = (1 + 1.965)\$1,000 = \$2,965$$

There are other considerations that can dramatically increase the capital cost, notably the impact of double taxation. Harrington and Niehaus (2001)¹⁹⁸ have simulated the tax burden over many parameters and show that tax costs alone can reasonably be as much as the claim cost and lead to further increases in premiums. When we account for all these factors (i.e., high capital inputs, transaction costs and taxes), catastrophe insurance premiums often are several multiples of expected claims costs.

¹⁹⁸ Harrington, S.E., and G. Niehaus (2001), "Government Insurance, Tax Policy, and the Affordability and Availability of Catastrophe Insurance," *Journal of Insurance Regulation*, 19(4): 591-612.

6.5. The Role of Rating Agencies

During the past few years, rating agencies have paid increasing attention to the impact that catastrophic risks will have on the financial stability of insurers and reinsurers. The rating given to a company will affect its ability to attract business and hence, its pricing and coverage decisions.

To illustrate how ratings are determined, consider the rating agency, A.M. Best, which undertakes a quantitative analysis of an insurer's balance sheet strength, operating performance and business profile. Evaluation of catastrophe exposure plays a significant role in the determination of ratings, as these are events that could threaten the solvency of a company. Projected losses from disasters occurring at specified return periods (a 100-year windstorm/hurricane or a 250-year earthquake) and the associated reinsurance programs to cover them are two important components of the rating questionnaires that insurers are required to complete.

For several years now, A.M. Best has been requesting such information for natural disasters. Their approach has been an important step forward in the incorporation of catastrophic risk into an insurer's capital adequacy requirements. Until recently, the rating agency has been including probable maximum loss (PML) for only *one* of these severe events (100-year windstorm/250-year earthquake, depending on the nature of the risk the insurer was mainly exposed to) in its calculation of a company's risk-adjusted capitalization. In 2006, A.M. Best introduced a second event as an additional stress test. The PML used for the second event is the same as the first event in the case of hurricane (a 1-in-100 year event; the occurrence of one hurricane is considered to be independent of the other one). If the main exposure facing the insurer is an earthquake, the second event is reduced from a 1-in-250 year event to a 1-in-100 year event (A.M. Best, 2006).¹⁹⁹ These new requirements have increased the amount of risk capital that insurers have been forced to allocate to underwrite this risk and have made them more reluctant to provide this coverage unless they are able to increase premiums sufficiently to reflect these additional costs.

Standard and Poor's, another rating agency, has also revised criteria for measuring catastrophic risk which traditionally has been based on premium charges. But the new criteria measure catastrophic risk based on exposure of the insurer. In the past, only reinsurers received a specific "catastrophe" charge. This includes an exposure-based capital charge for insurers similar to what it does for reinsurers based on net expected annual aggregate property losses for all perils at 1 in 250 year return period.²⁰⁰ And Moody's has adjusted the industry loss exceedance curves used in its risk adjusted capital model for U.S. companies to reflect the recent storm activity (Fleckenstein, 2006).²⁰¹ Appendix 6 provides a summary table of recent changes in rating agencies' requirements.

¹⁹⁹ A.M. Best (2006), *Methodology: Catastrophe Analysis in A.M. Best Ratings*, April.

²⁰⁰ *Insurance Journal* (2006), "S&P to Implement New Way to Assess Insurer Cat Risk," March 31.

²⁰¹ Fleckenstein, M. (2006), "Rating Agency Recalibrations," Chapter 6 in *The Review Cedant's Guide to Renewals 2006*.

The changes in risk estimates and the new requirements by rating agencies have significantly affected the way insurers are managing their exposure. As a graphic example, Figure 6.3 depicts two hypothetical distributions of probability. The first one corresponds to Insurer A’s portfolio prior to the 2004 and 2005 hurricane season and before rating agencies asked for more stringent stress tests for extreme events. *On average* the insurer needs to collect 30 in premiums a year to cover its claims and other administrative cost (half of the integral below the curve). But the insurer also realizes that there is a possibility that it will suffer more claims. For that reason, the insurer needs to be in a position to access additional capital (either internal or external) to pay all its claims. In the figure, we show that it would need 120 to pay 99.5 percent of the claims in a very bad year.

Now, if there is a shift to the right in the probability distribution, two things occur. First, the insurer needs to charge much higher premiums to cover the higher average annual claims (65 in Figure 6.3). Second, since this new distribution has a much fatter tail than the previous one, the insurer need to access much more capital than before. In this example, the insurer needs 210 to pay 99.5 percent of its claims when there is a very bad year where it only required 120 to meet this criterion for the initial probability distribution of losses prior to the 2004-2005 hurricane season.

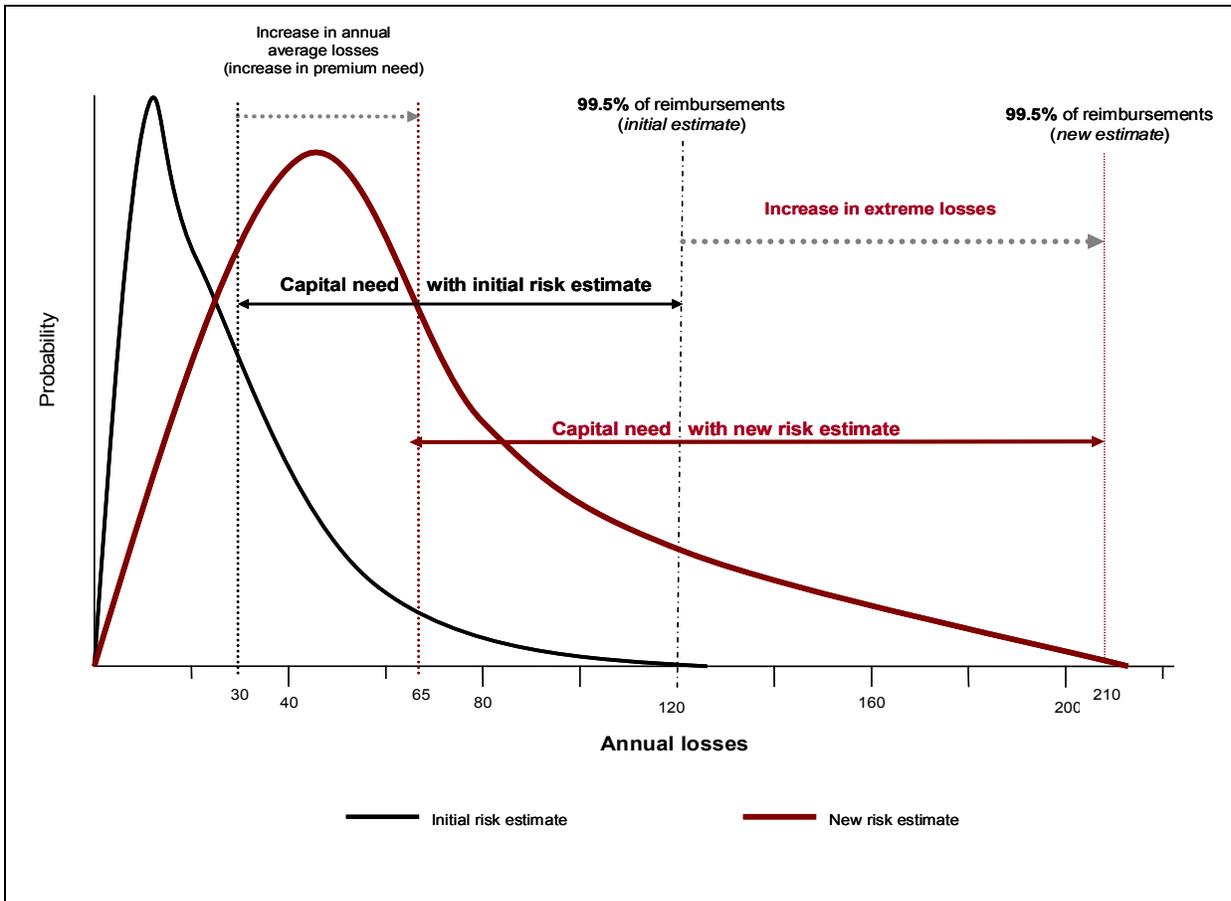


FIGURE 6.3. DEMAND FOR CAPITAL WHEN RISK ESTIMATE INCREASES

6.6. Measuring Exposure to Natural Disasters: The Role of Catastrophe Models²⁰²

In order to adequately manage their portfolios, it is necessary for insurers to undertake a systematic analysis of the damage that can be caused by hurricanes of different magnitudes and intensities and the likelihood that these events will occur in specific parts of the country.

History of Catastrophe Modeling

Catastrophe modeling is not rooted in one field or discipline. The science of assessing and managing catastrophic risk originates in the fields of property insurance and the science of natural hazards. In the 1800s, residential insurers managed their risk by “mapping” the structures that they covered. Instead of using the latest Geographic Information Systems (GIS) software, they used tacks on a wall map to indicate their concentration of exposure. This crude technique served insurers well and limited their risk. Widespread usage of “mapping” ended in the 1960s when it became too cumbersome and time-consuming to execute (Kozlowski and Mathewson, 1995).²⁰³

Measuring an earthquake’s magnitude and a hurricane’s intensity is one of the key elements in state-of-the-art catastrophe modeling. A standard set of metrics for a given hazard must be established so that risks can be assessed and managed. This measurement began in the 1800s, when the first modern seismograph (measuring earthquake ground motion) was invented and modern versions of the anemometer (measuring wind speed) gained widespread usage.

In the first part of the twentieth century, scientific measures of natural hazards advanced rapidly. Two separate developments – mapping risk and measuring hazard – came together in a definitive way in the late 1980s and early 1990s, through catastrophe modeling as shown in Figure 6.4. Computer-based models for measuring catastrophic loss potential were developed by linking scientific studies of natural hazards’ measures and historical occurrences with advances in information technology and geographic information systems (GIS). The models provided estimates of catastrophic losses by overlaying the properties at risk with the potential natural hazard(s) sources in the geographic area. With the ability to store and manage vast amounts of spatially referenced information, GIS became an ideal environment for conducting future hazard and loss studies more easily and cost-effectively.

Around the same time, several new companies developed computer software for analyzing the implications of natural hazard risk. Three major modeling firms emerged: AIR Worldwide Corporation was founded in 1987 in Boston; Risk Management Solutions (RMS) was formed in 1988 at Stanford University; and EQECAT began in San Francisco in 1994 as a subsidiary of EQE International. In 2001, EQE International became a part of ABS Consulting.

²⁰² This section is based on Grossi, P. and H. Kunreuther (eds.) (2005), *Catastrophe Modeling: A New Approach to Managing Risk*. New York: Springer, Chapter 2.

²⁰³ Kozlowski, R.T. and S.B. Mathewson (1995), “Measuring and Managing Catastrophe Risk,” 1995 Discussion Papers on Dynamic Financial Analysis, Casualty Actuarial Society, Arlington, Virginia.

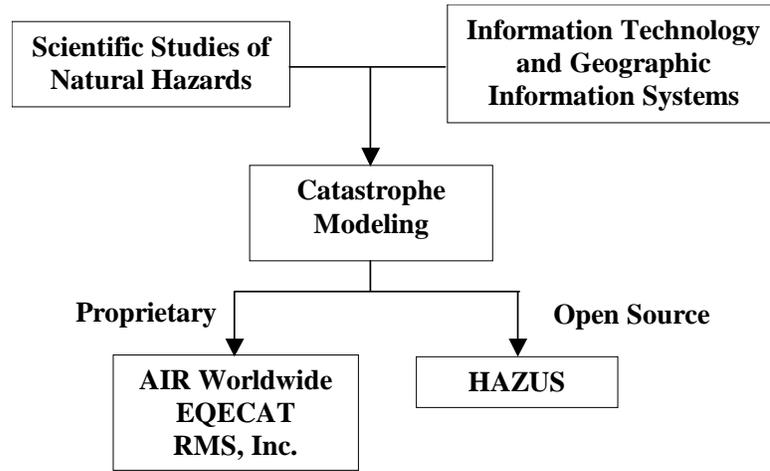


FIGURE 6.4. HISTORY OF CATASTROPHE MODELING

Nature of Catastrophe Models

Catastrophe risk assessment often relies on estimates based on past data (e.g., loss history in a specific region) coupled with data on what experts know about a particular risk through the use of catastrophe models. The four basic components of a catastrophe model are: hazard, inventory, vulnerability and loss, as depicted in Figure 6.5 and are illustrated for a natural hazard such as a hurricane. First, the model determines the risk of the *hazard* phenomenon, which in the case of a hurricane is characterized by its projected path and wind speed. Next, the model characterizes the *inventory* (or portfolio) of properties at risk as accurately as possible. This is done by first assigning geographic coordinates to a property and then determining how many structures in the insurer’s portfolio are at risk from hurricanes of different wind speeds and projected paths. For each property’s location in spatial terms, other factors that characterize the inventory at risk are the construction type, the number of stories in the structure, and its age.

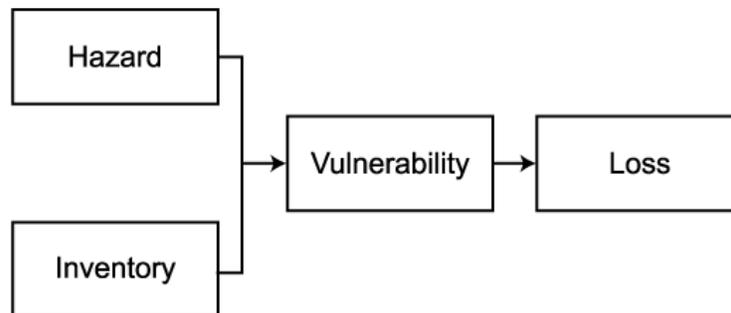


FIGURE 6.5. STRUCTURE OF CATASTROPHE MODELS

The hazard and inventory modules enable one to calculate the *vulnerability* or susceptibility to damage of the structures at risk. In essence, this step in the catastrophe model quantifies the physical impact of the natural hazard phenomenon on the property at risk. How this vulnerability is quantified differs from model to model. Based on this measure of vulnerability, the *loss* to the property inventory is evaluated. In a catastrophe model, loss is characterized as direct or indirect in nature. Direct losses include the cost to repair and/or replace a structure, which has to anticipate the increase in cost of material and workforce due to the demand surge in the aftermath of a major disaster. Indirect losses include business interruption impacts and relocation costs of residents forced to evacuate their homes.

Constructing Exceedance Probability Curves

Based on the outputs of a catastrophe model, the insurer can construct an exceedance probability (EP) curve that specifies the probabilities that a certain level of losses will be exceeded in a specific location (or its entire portfolio) over a specific period of time (e.g., one year, ten years, etc.). These losses can be measured in terms of dollars of damage, fatalities, illness or some other unit of analysis.

Suppose one were interested in constructing an EP curve for an insurer with a given portfolio of policies covering wind damage from hurricanes in Miami-Dade County, Florida. By combining the set of events that could produce a given dollar loss, one can determine the resulting probabilities of exceeding losses of different dollar magnitudes. In the hypothetical mean EP curve of Figure 6.6, the x-axis measures the loss to insurer in dollars and the y-axis depicts the probability that losses will exceed a particular level. Suppose the insurer focuses on a specific loss L_i . The likelihood that insured losses will exceed this L_i is given by p_i .

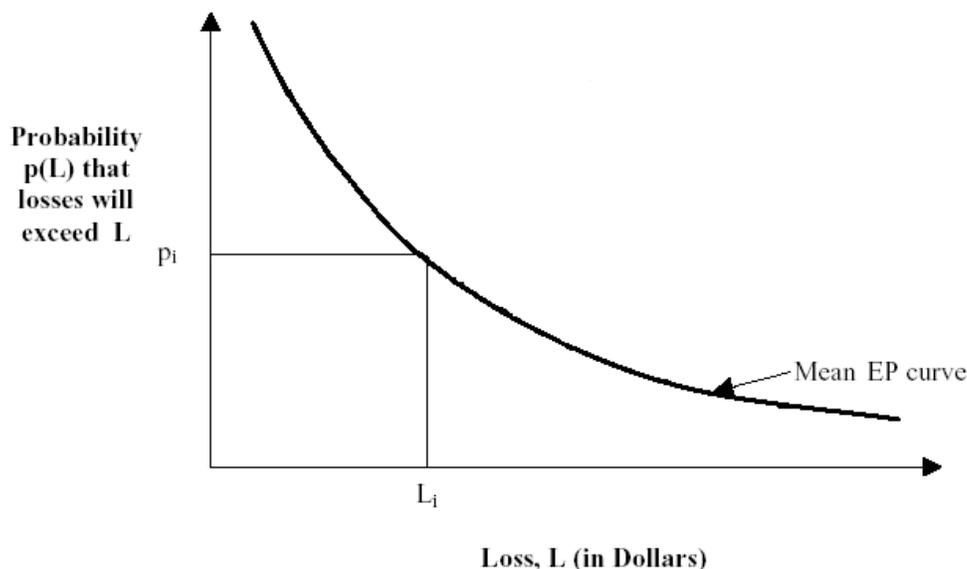


FIGURE 6.6. HYPOTHETICAL MEAN EXCEEDANCE PROBABILITY CURVE

An insurer utilizes its EP curve for determining how many structures it will want to include in its portfolio, given that there is some chance that there will be hurricanes causing damage to some subset of its policies during a given year. More specifically, if the insurer wanted to reduce the probability of a loss from hurricanes that exceeds L_i to be less than p_i , it could reduce the number of policies-in-force for these hazards, increase the premium or decide not to offer this type of coverage at all. The uncertainty associated with the probability of an event occurring and the magnitude of dollar losses of an EP curve can be reflected in confidence intervals surrounding the mean EP curve.

The EP curve serves as an important element for evaluating risk management tools. It puts pressure on experts to make explicit the assumptions on which they are basing their estimates of the likelihood of certain events occurring and the resulting consequences. A key question that needs to be addressed in constructing an EP curve is the degree of uncertainty regarding both probability and outcomes. There will be considerably more uncertainty facing an insurer if one constructs an EP curve reflecting losses to a specific region (e.g., Miami-Dade County) than for a wider area (e.g., Florida).

Application to Florida: Focus on Hurricane Risks²⁰⁴

Risk Management Solutions has provided us with an analysis of the data from the Florida Hurricane Catastrophe Fund (FHCF) book of business as of 2005. Since the FHCF is a state mandatory reinsurance program (see Chapter 2 for more details), it has every residential insurance policy written in the state by private insurers as well as the state-run insurer, Citizens Property Insurance Corporation. Data collected for this simulation include all lines of coverage of the FHCF. Total insured value (TIV) by the Fund at the end of 2005 was estimated to be \$1.7 trillion for the entire state of Florida. We focus on wind coverage only.²⁰⁵

Table 6.2 provides estimates of the annual probability that insured wind losses from hurricanes will equal or exceed different magnitudes for 18 thresholds ranging from \$1 billion to \$350 billion. Specifically, there is a 42.5 percent chance that there will be at least \$1 billion of insured residential losses in Florida next year. The probability that hurricanes will inflict at least \$10 billion of insured residential losses in Florida next year is 15 percent and there is a 0.81 percent chance that insured losses will be at least \$75 billion.

TABLE 6.2. EXCEEDANCE PROBABILITY OF INSURED RESIDENTIAL LOSSES IN FLORIDA (IN \$ BILLION)

\$1 bn	\$2 bn	\$5 bn	\$10 bn	\$15 bn	\$20 bn	\$25 bn	\$30 bn	\$40 bn
42.5%	35.9%	24.5%	15.0%	10.1%	6.9%	5.0%	3.9%	2.5%
\$50 bn	\$60 bn	\$75 bn	\$100 bn	\$125 bn	\$150 bn	\$200 bn	\$250 bn	\$350 bn
1.7%	1.3%	0.81%	0.41%	0.22%	0.11%	0.028%	0.005%	0.00012%

Sources: Wharton Risk Center - FHCF Data 2005; simulation by RMS

²⁰⁴ We thank Jack Nicholson of the Florida Hurricane Catastrophe Fund (FHCF) for providing us with the FHCF database and Patricia Grossi and Robert Muir-Wood of Risk Management Solutions (RMS) for their analyses of the FHCF data. They provided us with the relevant EP curves and tables presented in this section.

²⁰⁵ We use here the new generation of models developed by RMS in 2006.

As one can see from this table, the probability decreases significantly as the threshold level of losses increases. For very high levels of insured losses (\$100 billion and greater), the exceedance probability is less than 0.5 percent. This translates into a hurricane that occurs less than once in every 200 years. Of course, such an unlikely catastrophic event could occur during the next hurricane season. By undertaking this analysis for all possible levels of insured hurricane losses, one can generate the entire exceedance probability curve for the FHCF. Figure 6.7 provides this curve for losses up to \$100 billion.

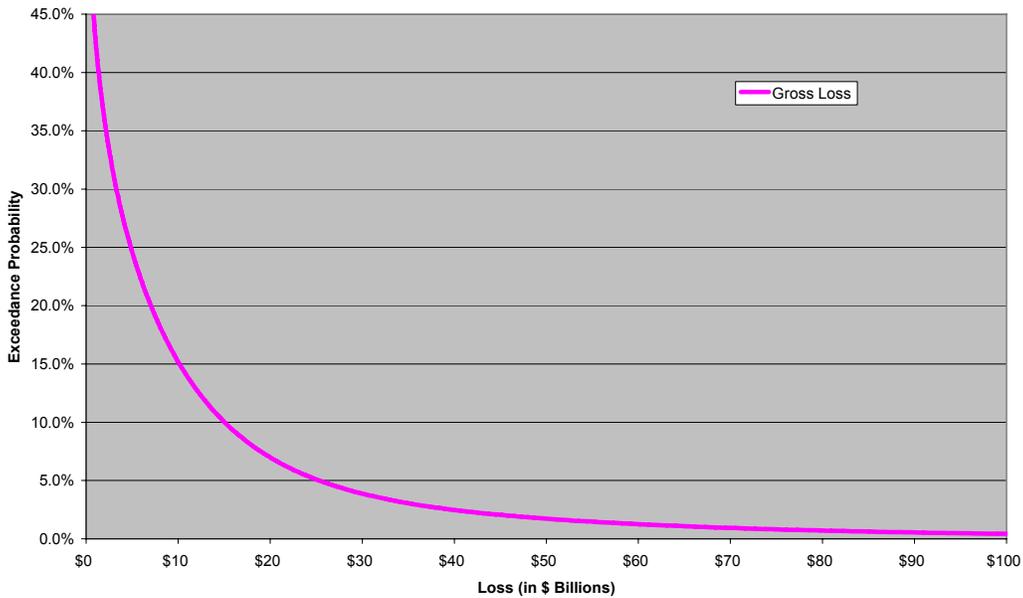


FIGURE 6.7. EXCEEDANCE PROBABILITY CURVE FOR FLORIDA (ENTIRE FHCF PORTFOLIO) FOR INSURED LOSSES FROM HURRICANES UP TO \$100 BILLION

Sources: Wharton Risk Center - FHCF Data 2005; simulation by RMS

In order to measure the uncertainty surrounding these estimates, one needs to utilize data on the average annual expected losses and the standard deviation for each postal zone in the state. For all postal zones combined, the average annual expected loss for Florida residential insurance is \$5.4 billion and the standard deviation is \$13.9 billion (a 2.55 coefficient of variation). Even if the average expected loss is identical in two regions, their standard deviations can differ significantly. To illustrate this point, we compared the insured losses from hurricanes in postal zones within Miami-Dade County with 46 counties in the northern part of Florida, depicted in Figure 6.8. The 46 counties taken together had the same expected annual insured losses as Miami-Dade County. Figure 6.9 depicts the two EP curves for these two regions. Although the EP curves between the two regions look similar, their standard deviations are quite different. For both Miami-Dade County and the 46 northern counties in Florida, the average annual expected loss is approximately \$900 million. The standard deviation of losses for Miami-Dade is \$4.2 billion (a coefficient of variation of nearly 5), and for the 46 northern counties it is \$2.8 billion (a coefficient of variation of nearly 3).²⁰⁶ This uncertainty in losses poses serious insurability problems for insurers as well as reinsurers.

²⁰⁶ The coefficient of variation is the ratio of the standard deviation of a given variable to its mean.

SUMMARY OF CHAPTER 6

Insurers are reexamining their ability to provide protection against wind damage from hurricanes and are asking whether these events are insurable. A risk is considered to be insurable if one has the ability to identify and quantify it and set premiums at a price that yields a competitive rate of return.

To determine whether to offer coverage against a specific risk, insurers look to maximize their expected profits subject to satisfying constraints related to the survival of the firm. The premium that the insurer would like to charge reflects not only the expected loss but how uncertain the risk is, whether there are potential problems of adverse selection and moral hazard, and how correlated the losses are likely to be in the event of a severe disaster. The prices charged for catastrophe insurance must be sufficiently high to cover not only the expected claims costs and other expenses, but also the costs of allocating capital so that investors obtain a fair rate of return. Because large amounts of capital are needed to underwrite catastrophe risk relative to the insurers' expected liability, the capital cost built into the premium is high.²⁰⁷

In recent years, rating agencies have put more emphasis on the impact that catastrophic risks will have on the financial stability of insurers. Insurers have thus focused their attention on the amount of coverage that they are willing to provide against wind losses from hurricanes and damage from earthquakes, given the need to allocate more capital to underwrite this risk.

The last part of the chapter shows how catastrophe models help insurers and reinsurers assess risk. Catastrophe models help measure the U.S. exposure to natural disasters. Using a complete dataset of residential coverage in the state of Florida provided by the Florida Hurricane Catastrophe Fund, Risk Management Solutions developed an exceedance probability curve for insured losses from hurricanes in Florida. Comparisons are then made between exceedance probability (EP) curves for Miami-Dade County and 46 counties in northern Florida with the same combined annual expected insured losses from hurricane damage. The coefficient of variation for Miami-Dade County area is about 5, compared to a coefficient of about 3 for the 46 counties. This implies that Miami-Dade is much more likely to suffer catastrophic losses from hurricanes in the future than are these 46 counties in northern Florida.

²⁰⁷ The next chapter discusses how reinsurers decide to cover risks, as this will have an impact on insurers' capacity to handle catastrophe risks.

APPENDIX 6.

TREATMENT OF NATURAL CATASTROPHIC RISK BY THE RATING AGENCIES			
Category	AM Best (11)(7)	Standard & Poor's (2)(3)(7)	Fitch (4)(5)(7)
Adjustment to Capital	Adjusted actual capital reduced for the higher of the 1/100 wind or the 1/250 earthquake net PML (occurrence basis)	Target capital increased for net 1/250 net PML (aggregate basis), net of one year's catastrophe premiums written less 30% for expenses	Target capital include an amount based on tail value at risk (TVaR) from the catastrophe aggregate loss exceedance curve. The TVaR thresholds have not yet been determined.
Catastrophe Model	5-year horizon (medium or near term depending on catastrophe modeller)	5-year horizon (medium or near term depending on catastrophe modeller)	5-year horizon (medium or near term depending on catastrophe modeller)
Assumptions	Property structure and contents, additional living expenses, business interruption, flood, auto/motor physical damage, workers compensation, energy, ocean marine, inland marine and crop	Global property	Property (including workers comp for earthquake)
Coverages	Property structure and contents, additional living expenses, business interruption, flood, auto/motor physical damage, workers compensation, energy, ocean marine, inland marine and crop	Global property	Property (including workers comp for earthquake)
Perils	Hurricane, earthquake, tornado, hail	All	Hurricane (wind) and earthquake
Components of Loss	Demand surge, storm surge, fire following earthquake, secondary uncertainty and loss adjustment expenses	Demand surge, storm surge, fire following earthquake, sprinkler leakage and secondary uncertainty	All switches are turned on (demand surge, storm surge, secondary uncertainty and fire following)
Reinsurance	Net of reinsurance, plus reinstatements and co-participations	Net of reinsurance, plus reinstatements and co-participations	Assumes 90% cession for losses between the 1/25 to 1/100 level
Tax	Post-tax	Pre-tax	Pre-tax
Credit Risk	Stress test adds credit risk charge by applying the credit factor to 80% of ceded reserves from first event and by assuming one level downgrade	Potential material increases in reinsurance recoverables added to reinsurance risk taken into account (analyst discretion)	Ceded losses are considered reinsurance recoverables and added to the reinsurance risk
2nd Event Stress Test	Calculate a stressed BCAR including a 2nd net catastrophe PML at the higher of the 1/100 wind or the 1/100 earthquake	Not applicable	Adds randomly generated catastrophes from the seven areas so this includes multiple events, but not necessarily second event in same region or peril

Sources:

- 1 AM Best, Catastrophe Analysis in AM Best Ratings, November 2005, Revised April 2006
- 2 Standard and Poor's, Insurance Criteria: Catastrophe-Specific Capital Charges To Be Extended to Primary Insurers, But Reinsurance Criteria Unchanged, November 7, 2005
- 3 Standard and Poor's, Reinsurer Criteria: Larger Losses And Better Modeling Prompt Changes To Property Catastrophe Criteria, June 27, 2005"
- 4 Fitch Ratings, Special Report: New Thinking on Catastrophic Risk and Capital Requirements, November 9, 2005
- 5 Fitch, Criteria Report, Exposure Draft: Capital Assessment Methodology and Model (Prism) – Executive Summary, June 2006
- 6 Moody's, Rating Methodology: Risk Adjusted Capital Model For Property & Casualty Insurers, September 2004"
- 7 Conversations with the Rating Agency

Source: The Review Pedant's Guide to Renewals 2006

CHAPTER 7

PRIVATE REINSURERS' DECISION MAKING FOR SUPPLYING COVERAGE

KEY FINDINGS

Determining reinsurance prices. Reinsurers consider both the expected loss and the variance of losses in their portfolio when pricing different layers of coverage. The prices will typically be much higher in a hard market than in a soft market, reflecting the different weights placed on the variance dimension to reflect the cost of capital. An analysis of different layers of reinsurance for a constructed portfolio of homeowners policies in Florida reveals that the average annual loss decreases with higher layers but the variance of the losses increases. Using that portfolio, we calculate that the average annual loss (in billions) for the [\$10 bn; \$20 bn] layer is \$1.35; for the [\$20 bn; \$40 bn] layer it is \$0.99; and for the [\$40 bn; \$80 bn] layer it is \$0.63; the standard deviation (in billions) for the first layer is \$4.52, \$5.37 for the second and \$5.65 for the third.

Market in 2005 and 2006. Due to the severe hurricanes in 2004 and 2005, the reinsurance market hardened in 2006 and premiums measured by rate on line (ROL) rose on average 76 percent between July 1, 2005 and June 30, 2006. The premium increase was much higher for Florida-only insurers. The large increase in premiums attracted new major entrants into the market and \$26-\$27 billion of new capital during this period.

Market in 2007 and 2008. Between July 1, 2006 and June 30, 2007, prices fell slightly but were still considerably higher than during 2005. Prices continued to fall at the January 2008 renewal, but are still considerably higher than they were at the beginning of 2005. Despite the slight decrease in price, retention and limits on reinsurance programs continued to increase in 2007, but at a much slower pace than in the previous year. After a 40 percent jump in 2006, retentions increased approximately 5.6 percent in 2007.

CHAPTER 7

PRIVATE REINSURERS' DECISION MAKING FOR SUPPLYING COVERAGE

7.1. Nature of Reinsurance

Reinsurers provide protection to private insurers in much the same way that insurers provide coverage to their policyholders. They offer coverage against the catastrophic portion of a loss for which insurers do not want to be financially responsible. In this type of arrangement, the reinsurer charges a premium to indemnify an insurance company against a layer of the catastrophic losses which the insurer would otherwise be responsible for covering.

There are two main types of reinsurance: *pro rata* (co-insurance or quota-share) reinsurance, in which premium and loss are shared on a proportional basis, and *excess of loss* reinsurance, for which a premium is paid to cover losses between two attachment points. For example, a contract that specifies \$200 million in excess of \$500 million for hurricane losses in Texas means that an insurer who purchased such a layer would cede its exposure for claims from Texas hurricanes in the \$500-\$700 million range. Figure 7.1 illustrates how these types of reinsurance contracts relate to the entire risk transfer process. While a certain amount of *pro rata* reinsurance is used for catastrophe protection, excess of loss reinsurance is the predominant form.

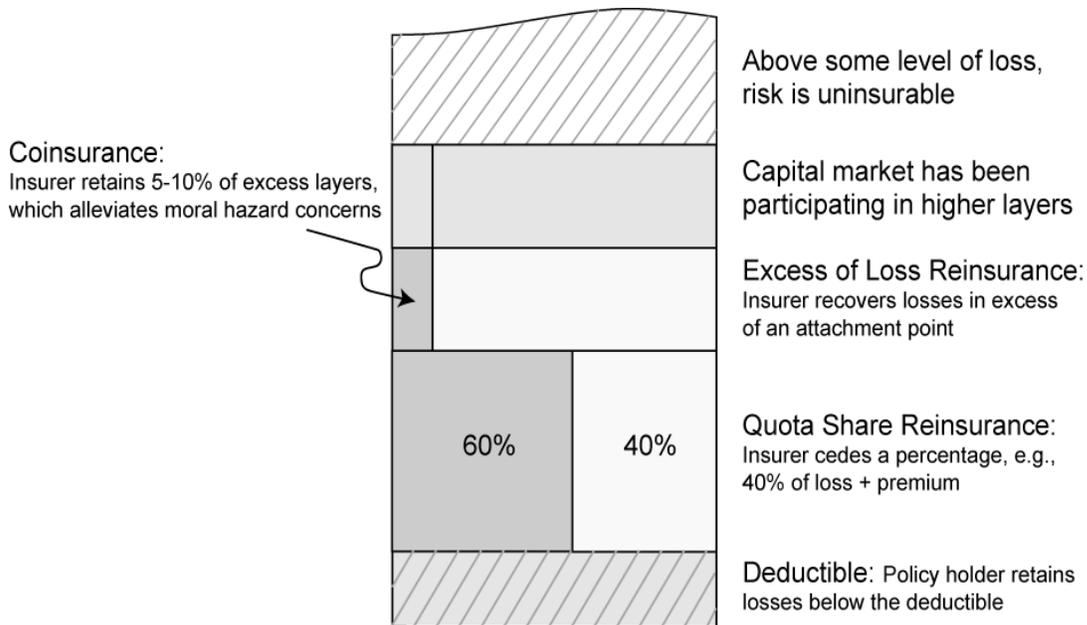


FIGURE 7.1. OVERVIEW OF TRANSFER RISK: POLICYHOLDER, INSURER, REINSURER, AND CAPITAL MARKET

Source: Lalonde, D., "Risk Financing" in Grossi, P. and H. Kunreuther (eds.) (2005), *Catastrophe Modeling: A New Approach to Managing Risk*, New York: Springer

7.2. How Reinsurers Determine Coverage and Set Premiums

Based on our discussions with brokers, reinsurers and insurers, we have a clearer understanding of how capital is allocated by the reinsurer for providing coverage against catastrophic risks and how prices are determined. Below, we characterize this process.

Determining Whether to Offer Coverage

Reinsurers are concerned about having a high concentration of risk in any region for the same reason that insurers limit their coverage; they want to avoid a large decrease in their surplus from a catastrophic loss. They thus restrict their exposure in hazard-prone areas so as to keep the chances of severe losses at an acceptable level.

Consider a reinsurer who has (S) dollars in current surplus that reflects the amount of its internal capital and the amount of capital it can raise from investors. The value of (S) includes premiums received by the reinsurer on the risks in its current portfolio. The insurer wants to determine whether to cede a layer of excess of loss coverage (Δ) to a reinsurer against hurricane-related losses in coastal regions of Texas. The reinsurer needs to determine whether it will take on this layer, and, if so, what price it should charge. The reinsurer will make this decision based on the following considerations:

- The likelihood (p) of having to pay claims for this layer.
- The distribution of the claim payments, (L), should this layer be affected by a hurricane.
- The expected loss associated with the layer $E(L)$.
- The incremental impact of the layer on the variance of the portfolio as $(\sigma_{\Delta})^2$
- The premium (P_{Δ}) it would want to charge to the insurer should it decide to offer coverage.
- The minimum return on equity required by investors (ROE^*) so they will provide capital to the reinsurer.

Based on the above considerations, the reinsurer will make his decision by first determining what his rate of return on equity (ROE_{Δ}) will be if he reinsures this layer Δ . If $ROE_{\Delta} > ROE^*$, then the reinsurer will want to provide this coverage as long as it has met a survival constraint similar to that faced by the insurer in determining whether it wants to offer additional coverage. More specifically, based on its current portfolio of risks, the reinsurer computes the distribution of total claim payments if he incorporates this layer in his book of business thus adding P_{Δ} to his current surplus (S) and determines whether:

$$\text{Probability [Total Claims Payments} > z(P_{\Delta} + S)] < p_1 \quad (7.1)$$

The value of z reflects the fraction of surplus that the reinsurer considers to be critical to its continued operation where $0 < z \leq 1$. If $z = 1$ then the critical value (i.e. $P_{\Delta} + S$) is where the reinsurer would become insolvent and equation (7.1) is equivalent to a survival constraint used by insurers in determining whether or not to offer coverage (see equation (6.1) in Chapter 6). The threshold probability, p_1 , plays a similar role for the reinsurer as it does for the insurer. It reflects the tradeoff between obtaining a ROE_{Δ} should the reinsurer add Δ to its portfolio and the costs to the firm of a catastrophic loss that reduces the insurer's surplus below a critical

level. Reinsurers' decisions on how much coverage to offer are also based on a stability constraint.²⁰⁸ They are concerned that, if their surplus falls below a critical level given by $z(P_{\Delta} + S)$, rating agencies are likely to downgrade them. Should this occur, the reinsurer will be forced to offer a higher return on investment to attract new capital. They will also have to charge a lower premium to insurers for the same layer of coverage.

It should be clear from the above simplified descriptive model that the composition of a reinsurer's existing book of business plays a key role in whether to accept a certain contract and what price to charge for it. A layer that is not highly correlated with the existing book of business will be viewed as much more attractive than a layer in a hazard-prone region where the reinsurer already has a large amount of surplus at risk.

In summary, the decision to offer coverage against catastrophic risk depends on the following three factors:

- Current portfolio and volatility of the layer (Δ) under consideration. Hurricane losses are more volatile than fire or wind. The higher the volatility of Δ , the less attractive it will be to the reinsurer at a given price.
- The minimum required rate of return (ROE*) for an investor to want to provide capital to the reinsurer.
- Price of coverage (P_{Δ}). The higher the price for providing Δ , the greater the ROE $_{\Delta}$ and the more likely the reinsurer will provide this layer of coverage.²⁰⁹
- The amount of capital available to the reinsurer from either internal or external sources.

Setting Premiums for a Given Layer²¹⁰

The pricing of a layer of reinsurance needs to cover the expected claims $[E(L)]$ as well as marketing, brokerage and claims processing expenses, while at the same time ensuring that the coverage earns a high enough expected return on equity (ROE) so that it is attractive to investors. The reinsurer is also concerned with the impact of the policy on the variance of its portfolio, since this has an impact on the stability constraint given by equation (7.1). Hence, it will charge a higher price for a given layer, the greater its variance as well as the more highly correlated this layer is with the reinsurer's existing book of business (Kreps, 1990).²¹¹ For a prespecified layer Δ we denote the incremental impact of the policy on the standard deviation of the portfolio as σ_{Δ} .

²⁰⁸ See Kreps, R. (1990), "Reinsurer Risk Loads from Marginal Surplus Requirements," *Proceedings of the Casualty Actuarial Society*, 77: 196-203 for a mathematical treatment as to how this constraint affects reinsurers' decisions on whether to offer coverage or not.

²⁰⁹ Reinsurers are not regulated by states as to what premiums they can charge.

²¹⁰ We thank Sean Mooney of Guy Carpenter who provided us with relevant material including an unpublished draft of his paper "Pricing" (1999) that helped us to better determine how reinsurers price different layers of coverage.

²¹¹ Kreps (1990), Op. Cit.

The model used by most reinsurers for determining the premium (P_Δ) for a specific layer of excess loss coverage (Δ) that captures these concerns is given by the following simple formula:

$$P_\Delta = E(L_\Delta)(1+\lambda) + c \cdot \sigma_\Delta \quad (7.2)$$

where λ = the loading costs
 c = the degree of conservatism of the reinsurer

The first term in (7.2) reflects the premium that a reinsurer would charge if it was unconcerned with the impact of a loss from layer Δ on its surplus. The second term in equation (7.2) represents the risk load and reflects the concern that the reinsurer has with its survival constraint given by equation (7.1). The higher the value of σ_Δ , the more the reinsurer will want to charge for providing Δ . A reinsurer who is highly conservative and specifies a very low value of p_1 in equation (7.1) will specify a higher value of c reflecting its concern with taking on any new book of business unless P_Δ is sufficiently high to cover the minimum return on equity (ROE*) required by investors so they will provide capital to the reinsurer. Hence, an insurer with $p_1 = 1/100$ will have a smaller value of c than if it chose $p_1 = 1/1000$.²¹²

7.3. The Use of Catastrophe Modeling to Price Reinsurance: Application to Florida²¹³

Risk Management Solutions (RMS) has provided us with an analysis of the data from the Florida Hurricane Catastrophe Fund (FHCF) book of business as of 2005 to determine the price of different layers of reinsurance for wind coverage. Here we assume that the FHCF is a single entity with a given portfolio concentrating exclusively on Florida that would like to determine how much it will have to pay for different amounts of reinsurance coverage.

Based on the characterization of reinsurance pricing detailed Section 7.1, we can analyze the prices of reinsurance under both soft market ($c = .4$) and a hard market ($c = .7$) where reinsurers are more conservative. Since higher reinsurance layers are more volatile than lower reinsurance layers, they will cost more for the same average annual loss (AAL). For two regions with the same AAL, the area that has a more concentrated level of coverage will be likely to have losses impact higher reinsurance layers. Our analysis will be conducted at a postal zone level for two regions of Florida so one can see how reinsurance pricing changes as a function of the exposure concentration. In reality, reinsurers provide coverage in many regions of the world, so they have to estimate the correlation between different types of risk such as a hurricane in Florida, a hurricane in New York, an earthquake in Japan and an earthquake in California in making their pricing decisions.

²¹² For more details on this model see Kreps, R. (1990), Op. Cit.; Feldblum, S. (1990), "Risk Loads for Insurers," *Proceedings of the Casualty Actuarial Society*, LXXVII, pp. 160-195.

²¹³ We thank Patricia Grossi and Robert Muir-Wood from Risk Management Solutions for undertaking these analyses which are based on the RMS 2006 models.

The following 7-step methodology can be utilized in determining reinsurance pricing:

- Step 1:* Create different reinsurance layers for the FHCF portfolio.
- Step 2:* Use a hurricane cat model to calculate for each layer (Δ) the expected average annual loss (AAL_{Δ}) and the uncertainty (σ_{Δ}) of this loss.
- Step 3:* For each layer (Δ) calculate the prices for a soft market ($AAL_{\Delta} + 0.4 \cdot \sigma_{\Delta}$) and for a hard market ($AAL_{\Delta} + 0.7 \cdot \sigma_{\Delta}$).
- Step 4:* Using the stochastic event set from the hurricane cat model, identify all those events with expected losses in the range of each layer and assign the average annual loss (AAL) for each event to the affected postal zones in order to map the areas that will be covered by that layer.
- Step 5:* Identify all events with expected losses above or below the reinsurance layers and assign the AAL from these events to each postal zone.
- Step 6:* Determine the price of reinsurance for each layer and each postal zone for the soft market and hard market conditions.
- Step 7:* Calculate the cost of insuring each postal zone by summing up the costs of insurance coverage, plus the additional cost to purchase reinsurance.

Using data from the FHCF, four layers of reinsurance were selected (Step 1). Results from Step 2 in the process are depicted in Figure 7.2. The first layer, which covers losses in the \$5-\$10 billion range (i.e., \$5 billion in excess of \$5 billion), has an attachment point of 1 in 4 years and an exhaustion point of 1 in 7 years. For that relatively likely \$5 billion layer, the AAL is \$1.53 billion and σ_{Δ} equals \$3.52 billion. The exercise is repeated for each layer. Layer 4, covering losses from \$40-\$80 billion (i.e., \$40 billion in excess of \$40 billion) has an attachment point with an annual probability of 1 in 40 and an exhaustion point of 1 in 145 years. Since it is much less likely that this layer is triggered annually than layer 1, the AAL is much lower (\$0.62 billion), but σ_{Δ} is higher (\$5.65 billion).

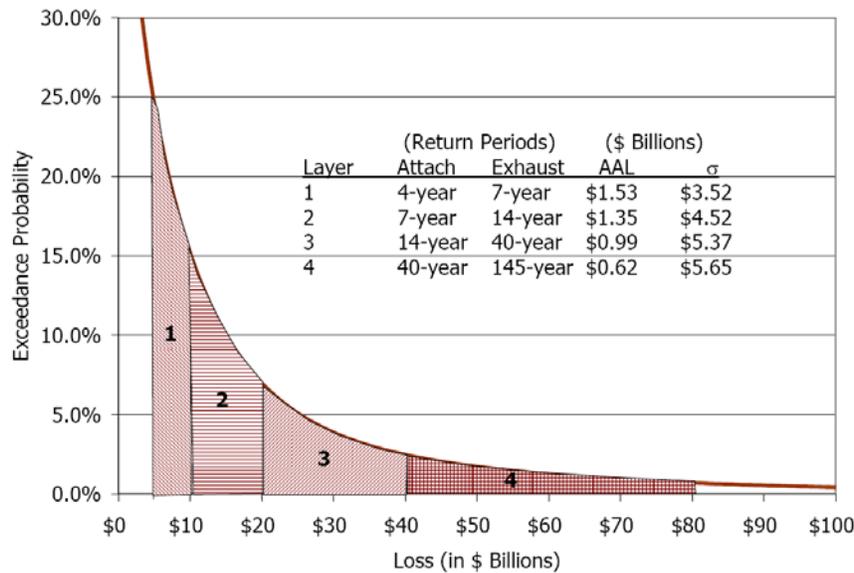


FIGURE 7.2. TECHNICAL RISK (AAL) AND UNCERTAINTY (σ_{Δ}) ASSOCIATED WITH EACH LAYER OF REINSURANCE
 Source: Simulation by RMS

We can now apply a pricing scheme for each of the 4 layers. We use $P_{\Delta} = E(L_{\Delta})(1+\lambda) + c \cdot \sigma_{\Delta}$ (Step 3). Here, we are interested in the true risk financing cost. We thus assume that there is no loading factor to cover administrative cost ($\lambda=0$) so $P_{\Delta} = AAL + c \cdot \sigma_{\Delta}$. We will study two market conditions: a soft market, with $P_{\Delta} = AAL + 0.4 \cdot \sigma_{\Delta}$ and a hard market, with $P_{\Delta} = AAL + 0.7 \cdot \sigma_{\Delta}$. Table 7.1 summarizes the price of reinsurance for different layers under these two market conditions.

TABLE 7.1. PRICE OF REINSURANCE UNDER SOFT AND HARD MARKETS $P_{\Delta} = AAL + c \cdot \sigma_{\Delta}$ (IN \$ BILLION)

	Layer 1 [\$5; \$10]	Layer 2 [\$10; \$20]	Layer 3 [\$20; \$40]	Layer 4 [\$40; \$80]
Soft market (c = 0.4)	\$2.5	\$2.9	\$3.0	\$2.8
Hard market (c = 0.7)	\$3.4	\$4.2	\$4.6	\$4.5

It is also possible to compute the ratio $c \cdot \sigma_{\Delta} / AAL$ to measure the effect of volatility on reinsurance prices. As Table 7.2 illustrates, higher reinsurance layers cost more than lower reinsurance layers relative to the expected loss due to their higher volatility.

TABLE 7.2. CHANGES IN ($c \cdot \sigma_{\Delta} / AAL$) RATIO FOR DIFFERENT REINSURANCE LAYERS (IN \$ BILLION)

	Layer 1 [\$5; \$10]	Layer 2 [\$10; \$20]	Layer 3 [\$20; \$40]	Layer 4 [\$40; \$80]
Soft market (c = 0.4)	0.88	1.30	2.15	3.66
Hard market (c = 0.7)	1.55	2.28	3.76	6.41

Step 4 determines the AAL for each postal zone. Using the hurricane model for Florida, the results are shown in the maps in Figure 7.3. The darker the color, the higher the AAL for each of the regions of the state being studied. Not surprisingly, for the first layer there are several dark areas where the AAL is the highest. These dark areas recede as we move up from Layer 1 to Layer 4.

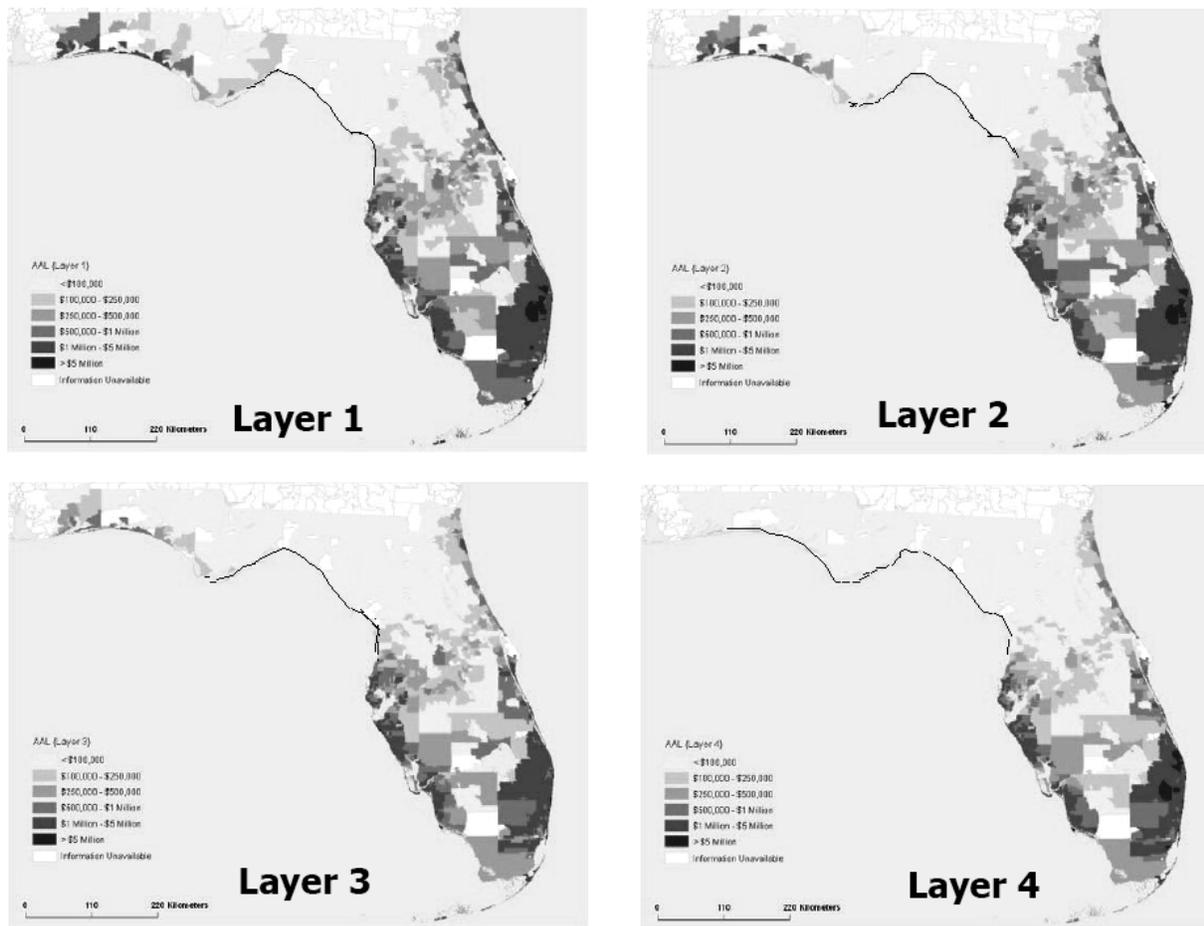


FIGURE 7.3. POSTAL ZONES’ AAL FOR EACH OF THE FOUR REINSURANCE LAYERS

The three remaining steps (Steps 5-7) are illustrated using one specific postal zone. First, one determines the AAL contribution from this postal zone to the total exposure for each layer of reinsurance. One then calculates the postal zone’s contribution to the overall reinsurance cost under a soft and hard market. Assume that the contribution of the chosen postal zone for losses below Layer 1, where there is no reinsurance, is \$25.9 million. For the first layer of reinsurance, the AAL contribution of that postal zone is \$14.6 million. Given that $c\text{-}\sigma_{\Delta}/\text{AAL} = .88$ for Layer 1 under the soft market (see Table 7.2), the postal zone will contribute to \$12.9 million of the reinsurance cost for that layer. Table 7.3 provides results for this illustrative example.

By repeating this exercise for each layer, we can determine the contribution of that postal zone to the reinsurance cost including the retention portion of it below Layer 1 and above Layer 4: it is \$207.3 million under the soft market and \$329.3 million under the hard market ($25.9+22.6+43.7+63.5+155.0+18.6$). Under the soft market, the ratio “true cost of risk financing over AAL” is $207.3/119.3 = 1.74$. Under the hard market, the ratio “true cost of risk financing over AAL” is $329.3/119.3 = 2.76$. This represents a 58 percent increase between these two market conditions.

TABLE 7.3. CONTRIBUTION OF A GIVEN POSTAL ZONE TO THE PRICE OF REINSURANCE (IN \$ MILLION)

	AAL	Soft Market	Hard Market
Below Layer 1	\$25.9	\$25.9	\$25.9
Layer 1	\$14.6	\$12.9 (0.88*16.6)	\$22.6 (1.55*14.6)
Layer 2	\$19.1	\$25.0 (1.30*19.1)	\$43.7 (2.28*19.1)
Layer 3	\$16.9	\$36.3 (2.15*16.9)	\$63.5 (3.76*16.9)
Layer 4	\$24.2	\$88.6 (3.66*24.2)	\$155.0 (6.41*24.2)
Above Layer 4	\$18.6	\$18.6	\$18.6
Total	\$119.3	\$207.3	\$329.3

This exercise is repeated for each postal zone in the state. Figure 7.4 depicts the results.

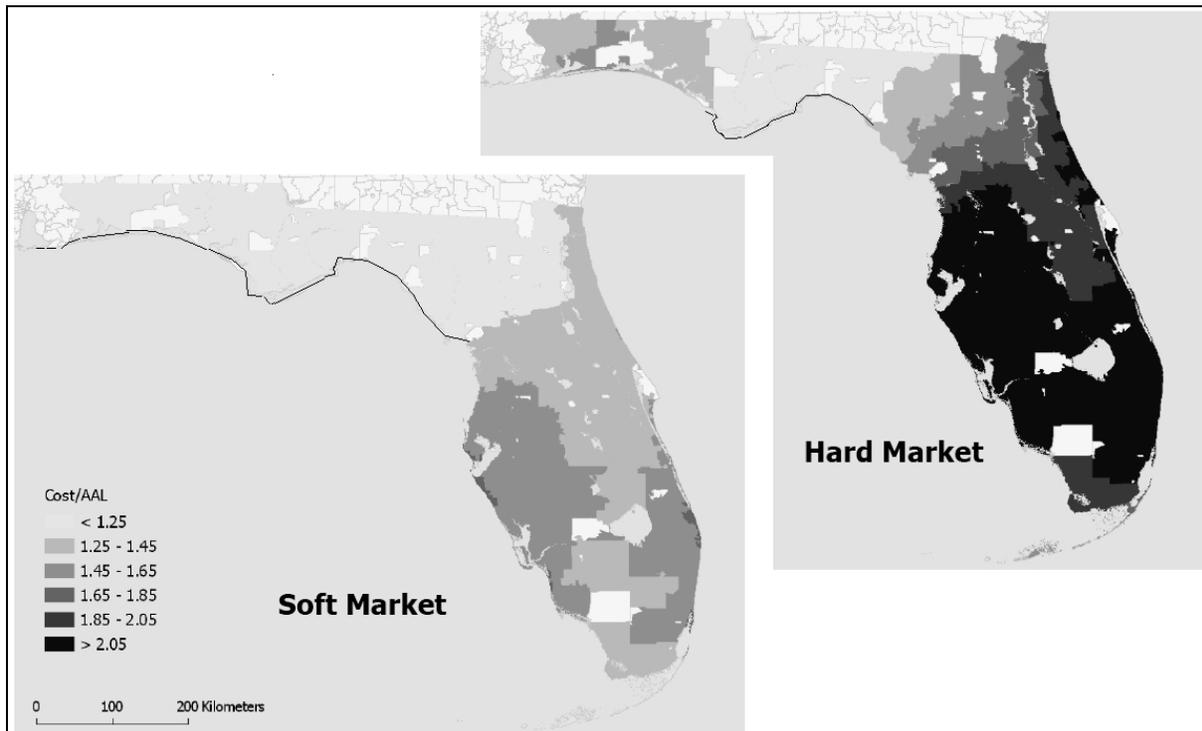


FIGURE 7.4. RATIO TRUE COST OF RISK FINANCING OVER AAL FOR SOFT AND HARD MARKETS

Source: Simulation by RMS

As Figure 7.4 illustrates, the market environment plays a critical role. The simulation reveals that the typical ratios of risk financing over AAL for the soft market are between 1.03 and 1.78. They are between 1.16 and 2.88 for the hard market. The switch from soft to hard market leads to increased reinsurance prices of 47 percent on average across all the postal zones in the state of Florida (the range is from of 12 percent to a maximum of 62 percent). We also find that the nature of the reinsurance market has its greatest impact where exposure is most concentrated. Not surprisingly, the postal zones with the highest sensitivity are in southern Florida.

In reality, reinsurers typically cover insurers for the entire country or multi-state zones and also for multiple types of hazards. Using catastrophe modeling to price reinsurance would thus require the determination of risk correlation across regions and hazards for a given reinsurer's portfolio.

7.4. Broader Empirical Data on Reinsurance Contracts

Empirical evidence supporting the above behavioral model comes from a detailed analysis by Froot and O'Connell (1999)²¹⁴ of Guy Carpenter's reinsurance contracts for catastrophic risks over the period 1970-1994. Guy Carpenter is a leading reinsurance broker. The contracts covered a wide variety of natural hazards including earthquake, fire, winter storm and hurricane. Specifically, they examined the prices and quantities offered for excess of loss reinsurance contracts.

In their analyses of these data, Froot and O'Connell (1999) found that following a \$10 billion loss in a particular region, there is a decline in quantity of 5.2 percent in surplus on average over the next year. This decline in quantity leads to an average price increase of 19 percent across all reinsurance contracts. This price increase is independent of whether the reinsurer had contracts that were affected by the disaster, although there was an additional increase in prices by reinsurers who had higher exposure in the affected region. This price behavior implies that surplus is not instantly replaced after suffering catastrophic losses, and suggests that reinsurers are concerned with the stability constraint when determining whether to offer new excess loss coverage for catastrophic risks. This post-loss phenomenon is known as the *capacity constraint theory* and is examined in detail in the next chapter of this report.

More generally, Froot and O'Connell found that reinsurance premiums at that time were considerably above the expected loss, sometimes as much as 7 times higher. Moreover, the higher attachment point for a layer with the same expected loss, the higher, on average, the premium multiple. These results reflect the cost associated with the very large levels of capital needed to underwrite reinsurance for catastrophic risks. They also found that a 10 percent increase in the variance of reinsurer exposure increased prices by about 6.8 percent. This behavior is also consistent with the premium-setting model given by equation (7.2) where the risk load plays a key role in determining the price of reinsurance.

²¹⁴ Froot, K. and P. O'Connell (1999), "The Pricing of U.S. Catastrophe Reinsurance," in *The Financing of Catastrophe Risk*, K. Froot (ed.), University of Chicago Press, pp. 195-232.

The elasticity of supply for catastrophe reinsurance contracts analyzed by Froot and O'Connell was in the order of 7. This implies that a 10 percent increase in premiums above the expected losses increases reinsurance capacity by 70 percent. Froot and O'Connell point out that this is a very small increase from what capital markets could be expected to provide for liquid instruments. This behavior suggests the importance of a survival constraint given by equation (7.1) in determining the amount of excess loss coverage that a reinsurer will provide against catastrophic risks. The authors conclude that capital market imperfections impede the flow of capital into the reinsurance sector leading to price increases and supply contractions following severe disaster losses.

An open question for discussion is whether there has been a significant change in the capital markets so that the conclusions derived from an analysis of reinsurance contracts from 1970-1994 are not relevant for today. As noted in Chapter 1, the catastrophic risk environment has radically changed in the last 10 years, with extreme events hitting the U.S. at an increasing rate, and with severe effects. Our discussions with reinsurers, coupled with the recent data from the reinsurance market presented below, suggest that there are additional pressures today being placed on capital allocation in general, and on reinsurers in particular, by rating agencies that may restrict the supply of their coverage for catastrophic losses even more than during the period studied by Froot and O'Connell.

Below, we discuss the evolution of the reinsurance market in reaction to the 2005 hurricane season, the revisions in the catastrophe models and the increased concern by rating agencies with respect to catastrophe exposure management. We then turn to a comparison of the reinsurance market of January 1, 2005 and over the period 2006-2008.

7.5. Reinsurance Market in 2005-2006

According to a report on the nature of the world reinsurance market during the period July 1, 2005 through June 30, 2006 prepared by Guy Carpenter (2006),²¹⁵ reinsurers behaved during this period of time in a manner that appears to be consistent with the model of Section 7.2 characterizing reinsurers' decisions regarding coverage and premiums. The Guy Carpenter report is based on a sample of more than 200 layers of catastrophe data within Guy Carpenter's catastrophe analysis database that has been tracked consistently from 1989-2006. We discuss some of the key findings from this report and related studies below.

Impact of Reinsurer Losses on Pricing, Coverage Availability and Profitability

The storms of 2005 placed a disproportionate burden on the reinsurance industry. Reinsurers estimated their losses for 2005 to be \$40 billion, approximately half of which were due to Hurricane Katrina. This immediately changed the market to a hard market. As a direct application of the pricing process described in Section 7.3, reinsurance premiums as measured by rate on line (ROL; premium charged for a layer of coverage over the amount of coverage) increased significantly in the United States, rising 76 percent between July 1, 2005 and June 30, 2006 as depicted in Figure 7.5.

²¹⁵ Guy Carpenter (2006), *The World Catastrophe Reinsurance Market*.

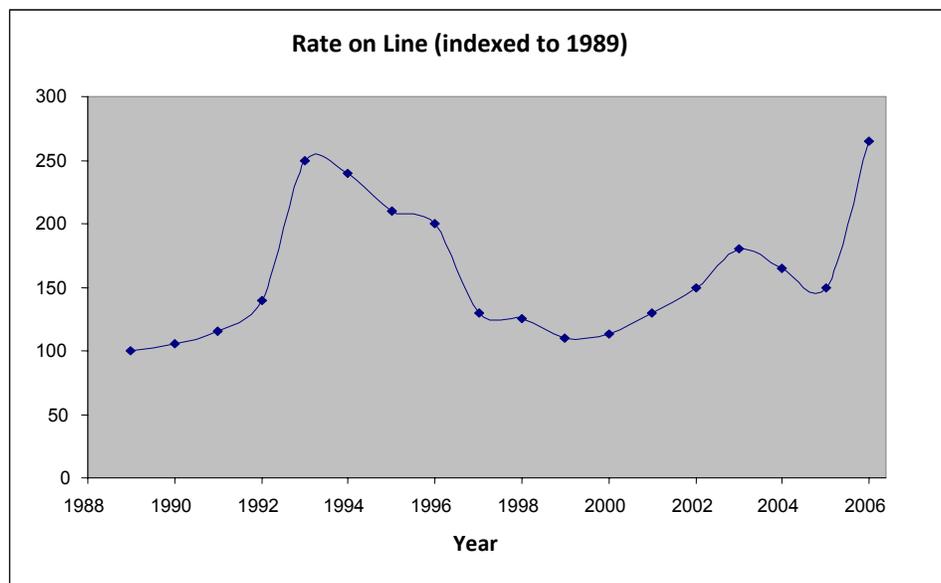


FIGURE 7.5. CATASTROPHE PROPERTY RATE ON LINE (ROL) INDEX FOR THE U.S. (1989-2006)

Source: Data from Guy Carpenter

The large increase in premiums attracted new capital into the market with eight new major entrants. The Guy Carpenter report points out that “many investors viewed the anticipated reinsurance price increases and capacity shortages as compelling motivators to enter the market.”²¹⁶ An estimated \$26-27 billion of capital flowed into existing reinsurance companies, through new start-ups and other alternative risk transfer instruments between Hurricane Katrina and June 30, 2006.²¹⁷ Despite the influx of new capital in the market, those regions with high exposure to windstorm, notably Florida and the Gulf Coast, experienced a much harder market for catastrophe reinsurance. This hard market has led to significant increases in ROL premiums. Private U.S. insurers thus increased their retention limits in 2006 by 40 percent on average from the previous year, as shown in Figure 7.6, which is based on a select group of companies tracked consistently between 1989 and 2006.

These same insurers also increased the average limit of reinsurance coverage by 11.4 percent. This increase reflects their concern with the possibility of increased catastrophic losses as indicated by the modeling companies, as well as continued pressure from rating agencies on capital adequacy and the management of catastrophe exposures (see Section 6.5 for a more detailed discussion of these points). In addition, the increased population growth in hazard-prone areas and the large hurricane losses in 2004 and 2005 heightened insurers’ awareness of their catastrophe loss potential. The Guy Carpenter report also projects that the increased limits in reinsurance coverage would have been considerably higher if the ROL for catastrophe coverage had not increased dramatically, and capacity had been more plentiful.

²¹⁶ *Ibid.* p. 4

²¹⁷ State Board of Administration of Florida (2006), *A Study of Private Capital Investment Options and Capital Formation Impacting Florida’s Residential Insurance Market*, September 19.

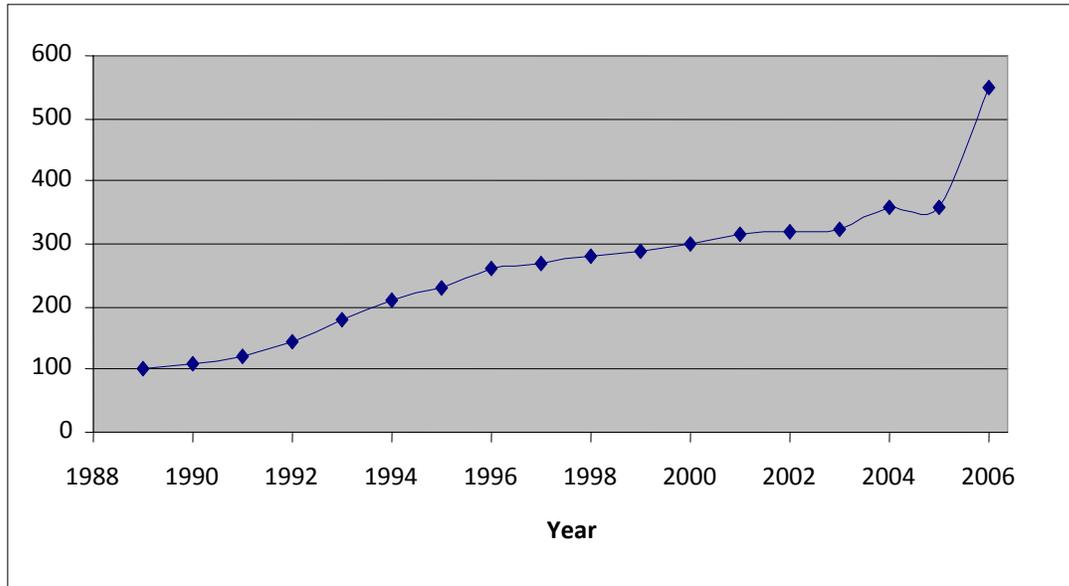


FIGURE 7.6. AVERAGE RETENTION PER PROGRAM INDEX FOR UNITED STATES (1989-2006) (1989 INDEX)
Source: Data from Guy Carpenter

An indication of the scarcity of reinsurance for catastrophe coverage in these high risk regions of the U.S. is highlighted, for a given reinsurance program, by an increase in attachment points, the reduction in expected loss and the higher premiums and risk loads between 2005 and 2006 for national companies, regional companies and insurers that write only in Florida, as depicted in Figures 7.7-7.9. The figures show that catastrophe reinsurance premiums increased significantly for all insurers between 2005 and 2006 but were noticeably higher for stand-alone Florida companies. The risk loads were also substantially higher than in the previous year. This reflects the reinsurers' perception that the hurricane risk is now higher, as indicated both by the modeling companies' upward revisions in their estimates of frequency of hurricanes, as well as the more stringent requirements by rating agencies. As a result, reinsurers might be less exposed today (lower expected loss) because they are providing less coverage in these high-risk areas.

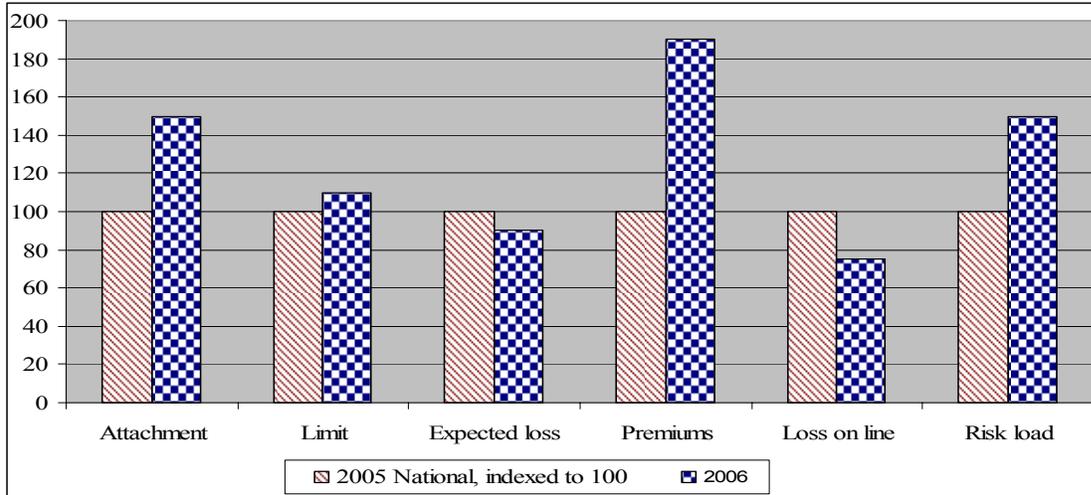


FIGURE 7.7. COMPARISON OF KEY RENEWAL STATISTICS FOR NATIONAL COMPANIES - 2005/2006

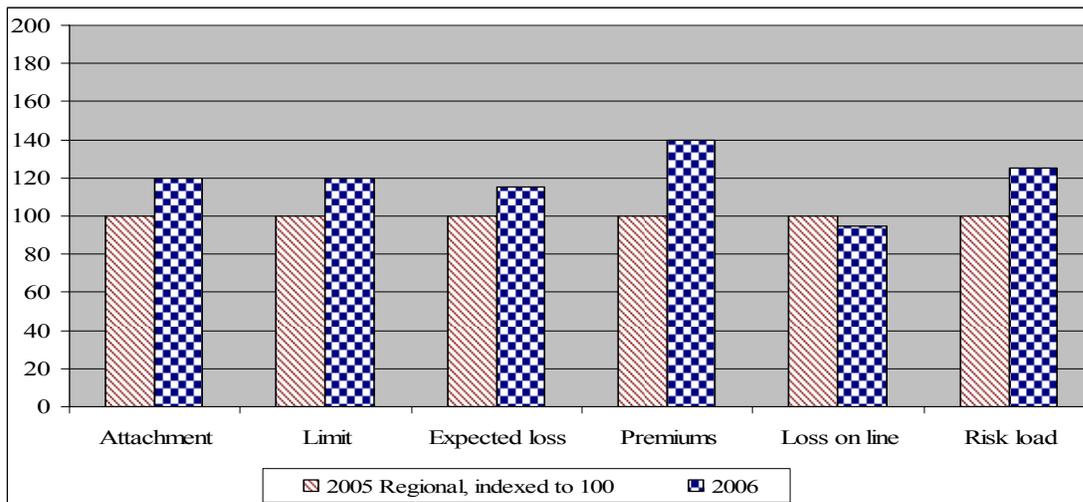


FIGURE 7.8. COMPARISON OF KEY RENEWAL STATISTICS FOR REGIONAL COMPANIES - 2005/2006

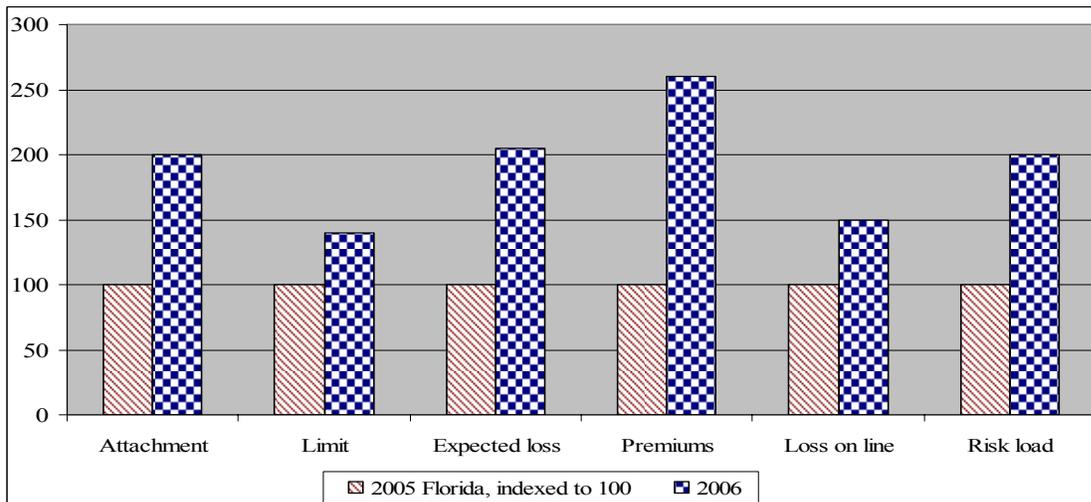


FIGURE 7.9. COMPARISON OF KEY RENEWAL STATISTICS FOR FLORIDA-ONLY COMPANIES - 2005/2006

Source: Data from Guy Carpenter

To determine the expected profitability of reinsurers for different layers of coverage for any given period, one needs to compute several different measures:

- *Rate on Line (ROL_J) for each layer J.* This is the ratio of the premium charged for this layer of coverage over the amount of coverage.
- *Loss on Line (LOL_J) for each layer J.* This is the ratio of the *expected* loss over the amount of coverage for this layer of coverage. The expected loss for layer J is determined by multiplying the probability (p_{ij}) of each loss (L_{ij}) within a given layer J. $LOL_J = \sum_i p_{ij} L_{ij}$
- *Expected underwriting profitability for each layer J.* $E(\Pi_J) = ROL_J - LOL_J$

The higher the attachment point, the lower the LOL for a fixed layer of coverage because of the lower frequency at the higher attachment points. To illustrate this, if one provides excess loss reinsurance coverage to a given insurer for \$50 million in excess of \$100 million (i.e., losses between \$100 million and \$150 million), one has to recognize that there is a higher LOL for this layer than for \$50 million in excess of \$500 million.

Figure 7.10 indicates that the ROL (y-axis) for 2006 (upper line) was considerably higher than for 2005 (lower line) for all layers of reinsurance as reflected in the LOL (x-axis). The lines between the two years are approximately parallel, indicating that the increases in ROL for 2006 were proportionately higher at lower LOL, which corresponds to higher reinsurance attachment levels, suggesting that reinsurers expected profits for a fixed layer of coverage increases as the attachment point increases.

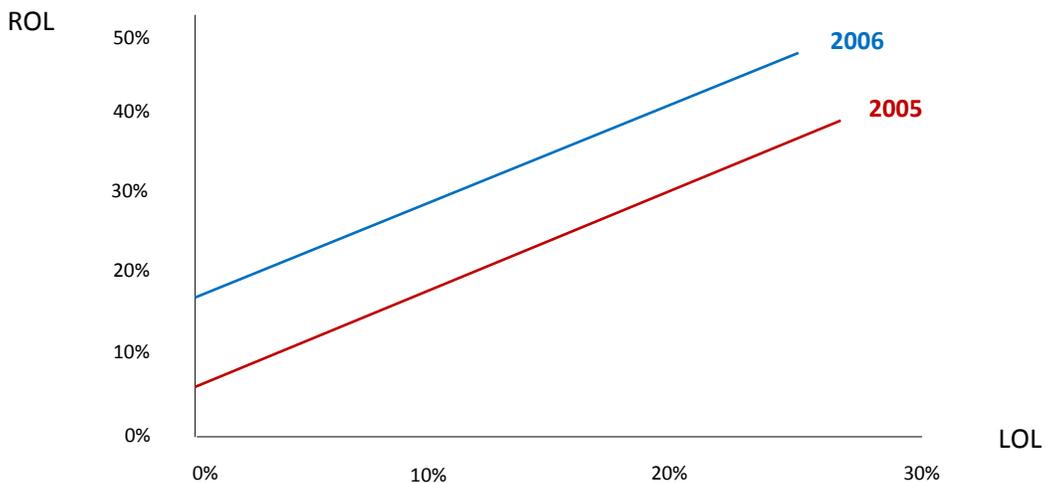


FIGURE 7.10. RATE ON LINE (ROL) AS A FUNCTION OF LOSS ON LINE (LOL) FOR 2005 AND 2006
 Source: Guy Carpenter, *The World Catastrophe Reinsurance Market (2006)*

There may be several explanations for this behavior:

- The LOL values in Figure 7.10 may not reflect the current estimates of expected loss based on the modeling companies' upward revisions in the spring of 2006;
- Reinsurers are now more conservative because of more stringent rating agency requirements and the higher capital costs associated with holding more surplus to protect themselves against catastrophic losses;
- The expected profitability of a given layer is overstated if one defines it as $E(\Pi_j) = ROL_j - LOL_j$. There are other expenses (e.g., capital costs) that need to be incorporated in determining $E(\Pi_j)$.

Reinsurance Capacity for Covering Catastrophic Natural Disaster Losses

One issue that is somewhat controversial today is the available capacity of the reinsurance industry to cover catastrophic losses from natural disasters. We have had considerable discussion on this point with our Sponsors as well as several large brokers. We have concluded that it is difficult to pinpoint any specific figure that could be used as a "magic number" in the current policy debate regarding the role of the private and public sectors in providing coverage for high layers of catastrophe exposure. Even providing a range of values might be misleading for the following reasons:

- The amount of reinsurance provided by any company is partially determined by the premium that it can obtain for coverage. The higher the premium for a given layer, the more reinsurance that will be provided. In other words, the amount of available reinsurance depends on the insurers' willingness to pay for coverage for a given exposure to loss.
- The U.S. market is only one of the markets where reinsurers operate. It is important to keep in mind the international aspect of insurance and reinsurance markets. Indeed, the way a given reinsurer will allocate its limited capacity between risks in different regions (e.g., earthquake in the U.S. or in Japan, storms in Europe, hurricanes in the U.S., typhoons in Asia) and increase/decrease capacity in some of these regions depends on many factors related to the specificities of its portfolio, the relative likelihood of these catastrophic risks, the demand for coverage in these different regions and the availability and price of other sources of capital to expand its capacity.
- The amount of capacity of a reinsurer will also depend on its loss experience and the amount of surplus it has available. For example, the absence of hurricanes hitting the U.S. during the 2006 season implies that there was a larger surplus on hand to allocate for natural disaster risks in 2007 and hence, capacity was expanded.
- The modelers' upward estimates of expected losses coupled with more stringent rating agency criteria for dealing with catastrophe risks may make reinsurers more conservative in their willingness to provide certain layers of coverage against such losses.
- Finally, there is no standard for defining and measuring *capacity*, so the definition also varies across reinsurers.

Florida Reinsurance Market in 2006

The Florida property insurance market relies heavily on the Florida Hurricane Catastrophe Fund (FHCF) and the private reinsurance market for protection. Approximately 50 percent of primary residential insurance premiums are typically ceded to reinsurers in comparison with the national average of approximately 33 percent (State Board of Administration of Florida, 2006).²¹⁸ According to V.J. Dowling (*IBNR Weekly*, August 28, 2006), total direct written premiums (DWP) in the private insurance market for Florida was \$5.6 billion, of which \$4.1 billion is written by insurance carriers writing only in Florida. A comparison of Figures 7.7 - 7.9 reveals that the Florida-only companies experienced the sharpest increase in cat reinsurance premiums (about 150 percent). Many were unable to find capacity or decided not to buy at the elevated prices. Hence, they are exposed to more risk today. It is unclear how they will fare should another severe hurricane hit Florida next year.

One of the key issues that we have been exploring is what is required for premiums to reflect risk. According to V.J. Dowling (*IBNR Weekly*, October 2, 2006), Florida gross premiums need to reach \$10.6 billion or 56 percent above pre-rate approval base to generate a 12 percent return on equity (ROE). In other words, if insurers are forced to provide coverage in high-risk areas of Florida at the current regulated premiums, their ROE will be less than the return that will be competitive given their earnings on other coverage they provide. Assuming all pending rate increases are approved in their entirety, V.J. Dowling estimated that the rates need to rise another 22 percent from their levels in October 2006.

We also obtained data on the reinsurance programs of Florida's Citizens so it is possible to compare the programs for 2005 and 2006. Our understanding is that Citizens elected in the spring of 2006 to forego \$500 million of private reinsurance should its losses exceed \$5 billion because of the relatively high cost for this coverage (\$137 million) (i.e., the rate on line (ROL) is \$137 million/\$500 million = 27.4 percent). Instead, Citizens purchased \$5 billion of coverage in excess of \$1.35 billion for only \$250 million from the Florida Hurricane Catastrophe Fund (FHCF) (i.e., ROL: \$250 million/\$5 billion = 5 percent or 6 times lower than what was available from the private market as of June 2006).²¹⁹

The new legislation passed in Florida in 2007 (see Chapter 3) is likely to have a considerable impact on the private reinsurance market in Florida. An important feature of this new legislation is the significant expansion of reinsurance coverage provided to insurers by the FHCF. The FHCF will charge insurers reinsurance prices based on average long-term annual loss. These prices are therefore likely to be lower than current rates charged by private reinsurers. Nevertheless, at the July 2007 renewal, private reinsurers had not significantly reduced their premiums (compared to January 2007).

²¹⁸ State Board of Administration of Florida (2006), "A Study of Private Capital Investment Options and Capital Formation Impacting Florida's Residential Insurance Market," September 19.

²¹⁹ We do not have price information for Citizens' reinsurance program in 2007.

Profitability of the Reinsurance Industry in 2006

The absence of major catastrophic losses combined with better catastrophe exposure management and a significant increase in reinsurance prices contributed to a record profit year for reinsurers in 2006. According to Guy Carpenter, “This has helped quickly replenish whatever capital was extracted from the market in 2004 and 2005.”²²⁰ In addition, \$17 billion in new capital that entered the reinsurance market in 2006 bolstered capacity in the marketplace. Coupled with the \$25 billion of new capital in the fall of 2005 (see Chapter 8), the reinsurance industry has had an infusion of approximately \$40 billion since Hurricane Katrina.

7.6. Reinsurance Market at 2007’s and 2008’s Renewals

Data supplied by reinsurance brokers provide a picture of the changes in the market between January 1, 2006 and July 1, 2007. According to Benfield,²²¹ January 1, 2007 pricing for national and multi-regional companies was slightly below July 1, 2006 but still remains 30 to 50 percent higher than they were for the January 1, 2006 renewals and significantly higher than January 1, 2005 prices. A Guy Carpenter report published in September 2007 depicts the evolution of pricing (rates on line) for lower and higher layers of reinsurance programs for national and regional companies (excluding Florida-only accounts) between January 1, 2005 and January 1, 2007.

Figure 7.11 shows that national companies saw prices for lower layers of reinsurance programs decrease by 17 percent and prices for higher layers by 14 percent from July 1, 2006 to January 1, 2007. Still, the January 1, 2007 prices represent a 28 percent increase for lower layers (9 percent for higher layers) when compared to January 1, 2006 pricing of coverage. The figure also reveals that January 1, 2007 prices are more than twice as high as they were at the January 1, 2005 renewals for both the lower and higher layers for national companies. As shown in Figure 7.12, regional companies followed a similar path between January 2006, July 2006 and January 2007. On average, both the lower and higher layers saw a nearly 30 percent reduction in price during the past 6 months, but are 20 to 30 percent higher than the previous year and more than twice what they were in January 1, 2005.

²²⁰ Guy Carpenter (2007), “U.S. Reinsurance Renewals at January 1, 2007.”

²²¹ Benfield (2007), “Global Reinsurance Market Review,” January 2007.

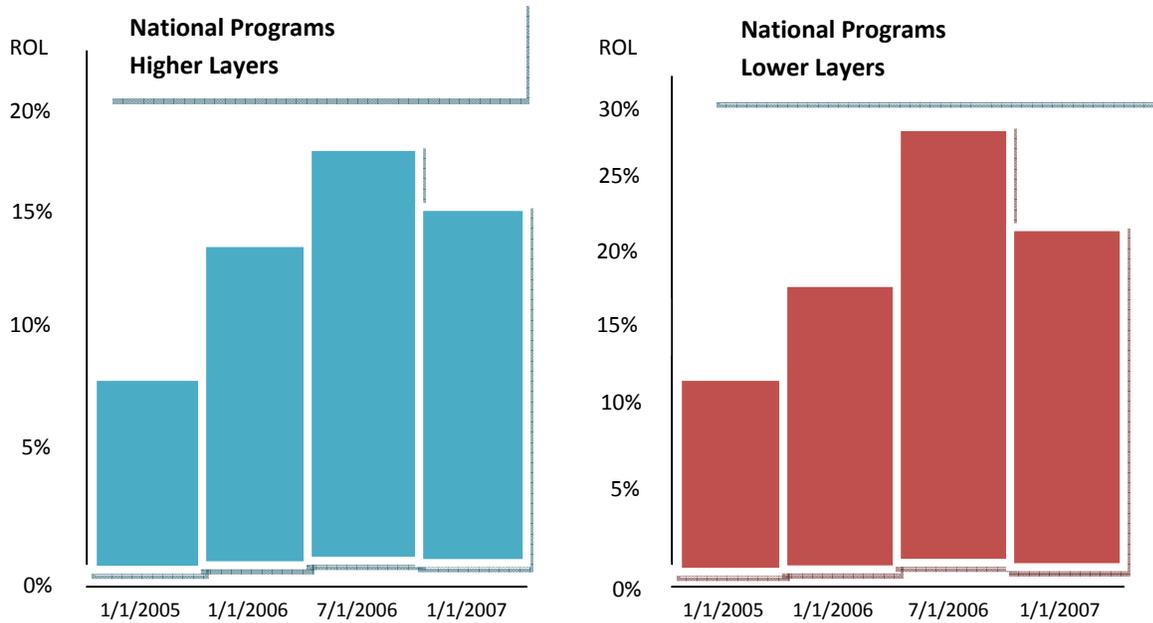


FIGURE 7.11. COMPARISON OF RATE ON LINE FOR NATIONAL COMPANIES – JANUARY 2005 - JANUARY 2007
 Sources: Guy Carpenter (2007) Op. Cit.

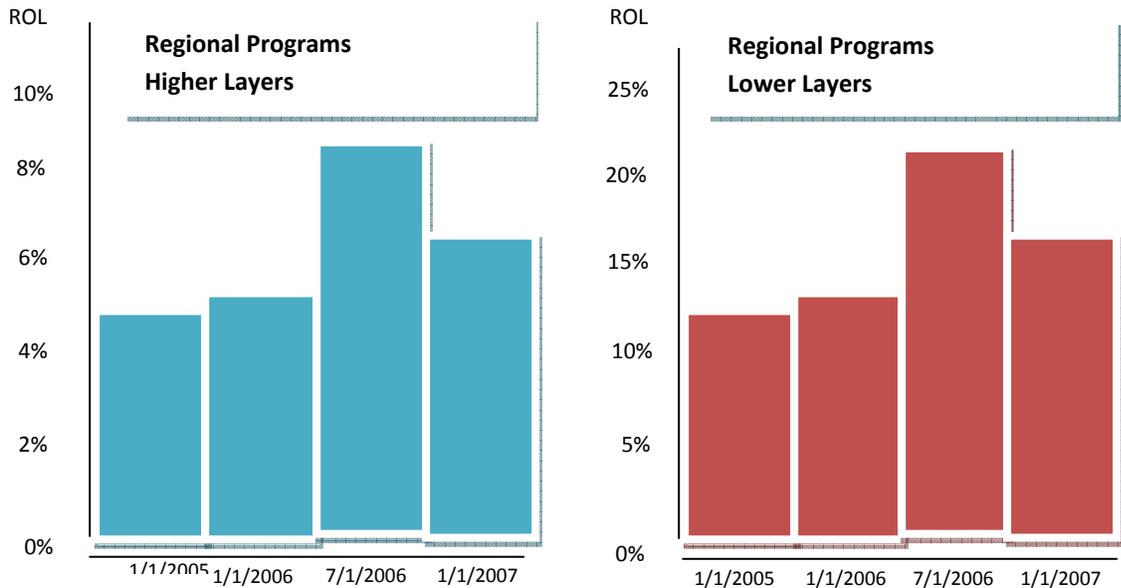


FIGURE 7.12. COMPARISON OF RATE ON LINE FOR REGIONAL COMPANIES – JANUARY 2005 - JANUARY 2007
 Sources: Guy Carpenter (2007) Op. Cit.

To provide some perspective on the price movements in the catastrophe reinsurance market over the past 24 months, Guy Carpenter used the benchmark of a 1 percent loss on line (LOL) (tranches of reinsurance with a 1-in-100 year chance to be triggered). Figure 7.13 depicts the evolution of prices between January 1, 2005 renewals and July 1, 2007's. Rates for these 1 percent LOL layers had then returned to approximately the level of January 2006, which is still twice what they were at the beginning of 2005.

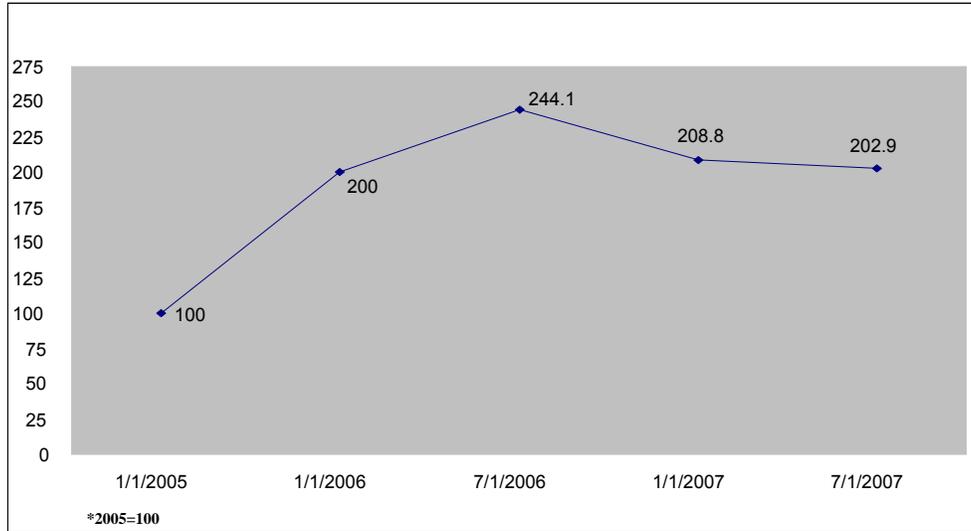


FIGURE 7.13. CATASTROPHE REINSURANCE PRICING INDEX IN THE U.S.: RATE ON LINE BENCHMARK PRICING FOR LOSS ON LINE OF 1 PERCENT (INDEX 100: 01/2005) (JANUARY 1, 2005 - JULY 1, 2007)

Source: Data from Guy Carpenter

In the absence of a major reinsurance catastrophe in the U.S. in 2007, the U.S. reinsurance market has continued to soften. At the January 1, 2008 renewals, reinsurance prices had decreased about 10 percent compared to what they were on July 1, 2007.²²² Despite the slight decrease in price, retentions and limits on reinsurance programs continued to increase in 2007, but at a much slower pace than in the previous year. More specifically, after a 40 percent jump in 2006 (Figure 7.6), retentions increased approximately 5.6 percent in 2007 (from roughly 540 to 570 on the 1989 index). Reinsurance programs on average are attaching at around the 15-year return period level. As depicted in Figure 7.14, average reinsurance limits have increased by 8 percent in 2007 over 2006, much in line with historical trends.²²³

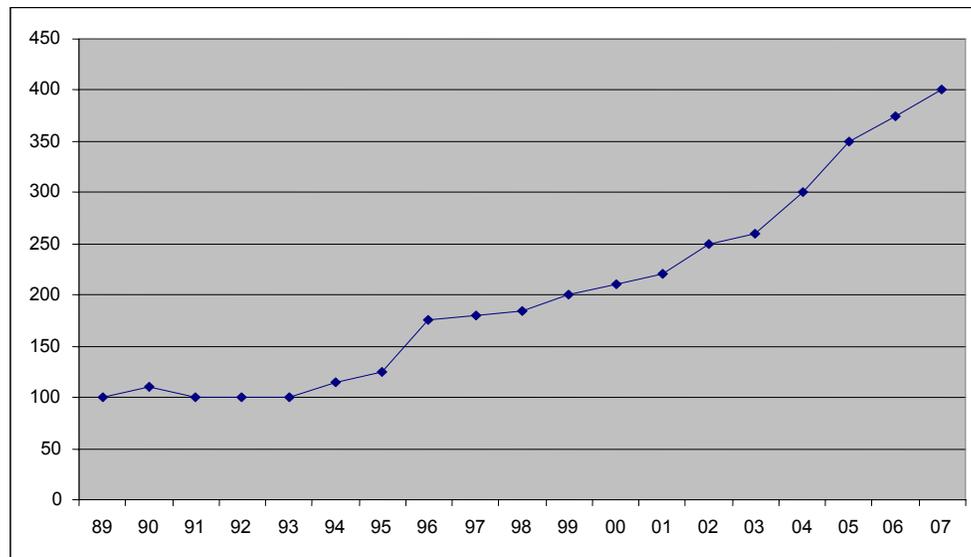


FIGURE 7.14. AVERAGE LIMIT PER PROGRAM INDEX IN THE U.S. (INDEX 100: 1989) (1989-2007)

²²² Guy Carpenter (2008), "2008 Reinsurance Market Review: Near Misses Call for Caution."

²²³ Guy Carpenter (2007), "The World Catastrophe Reinsurance Market: New Capital Stabilizes Market," Sept. 2007.

SUMMARY OF CHAPTER 7

This chapter focuses on the role of reinsurance in providing financial protection to insurers against catastrophic losses from natural disasters. We first develop models for characterizing reinsurers' decisions on what coverage to offer and how to price specific layers of protection. The pricing of a layer of reinsurance needs to cover the expected claims as well as marketing, brokerage and claims processing expenses while at the same time ensuring that the coverage earns a high enough expected return on equity (ROE) so that it is attractive to investors. The reinsurer is also concerned with the impact of the variance of its portfolio under soft and hard market environments, given the cost of capital.

The 2005 hurricane season created a hard market that had similar features to the post-Hurricane Andrew environment in 1992-1993. The data collected by Guy Carpenter, a large insurance and reinsurance broker, revealed significant increases in price in Florida (in the 50 percent to 100 percent range) as well as other parts of the U.S. in 2006, even though \$26-27 billion of new capital entered the market. Between July 1, 2006 and January 2008, prices fell slightly but were still considerably higher than in January 2005. Despite the slight decrease in price, retentions and limits on reinsurance programs continued to increase in 2007, but at a slower pace than in 2006.

CHAPTER 8

COVERING EXTREME EVENTS: HOW FINANCIAL MARKETS CAN HELP
THROUGH INNOVATIVE INSURANCE-LINKED SECURITIES

KEY FINDINGS

Evolution of insurance-linked securities (ILS). The significant increase in reinsurance prices after the 2005 hurricane season in the U.S., along with more stringent criteria by rating agencies for providing protection against catastrophic risk has led to historic records in catastrophe bond issuance and the development of a multi-billion dollar market for other innovative instruments, such as industry loss warranties, catastrophe bonds and sidecars. Securitization still represents a small proportion of the capital in the global insurance market today.

The *Industry Loss Warranties (ILWs)* market today focuses almost exclusively on catastrophic risks, and has increased significantly after Hurricanes Katrina, Wilma and Rita.

Catastrophe bonds (cat bonds) offer an important element of stability for insurers in the context of highly volatile reinsurance prices (their maturity is typically 3 years today), by guaranteeing a pre-defined price over several years unless the entire capital of the bond is triggered by a disaster. In 2006, twenty cat bonds were issued (\$4.7 billion issued and \$8.7 billion capital outstanding), compared with eleven in 2005 (\$2.1 billion issued and \$2.9 outstanding), the previous record. In 2007, the total value of cat bonds issued for natural disasters alone was \$7.1 billion. Furthermore, the size of cat bonds has also increased over time; a \$1.2 billion “jumbo” cat bond was successfully issued in 2007.

A *sidecar* is a special purpose company that provides reinsurance coverage exclusively to its sponsor (a reinsurer or a large insurer) by issuing securities to investors. Between November 2005 and July 2006, over \$3 billion of hedge fund money was invested in sidecars that cover natural disasters in North America. In 2006, a total of nineteen sidecar transactions were completed, providing \$4.2 billion of capacity to the insurance market; that volume decreased to \$1.7 billion in 2007.

Benchmark: credit and weather derivatives. There is a need to make the ILS market more significant, in comparison to other instruments created in the past ten years, such as *global credit derivatives* (\$20 trillion in 2006), and *global weather derivatives* (\$19.2 billion between April 2006 and March 2007).

Looking forward: financial innovations. “Tranching” (several distinct risks pooled together with the resulting portfolio divided into multiple tranches with different expected returns) constitutes a natural way to expand the market, by reaching investors other than the traditional hedge and cat funds. Standardized index-based derivatives (like catastrophe-related futures and options introduced in 2007 on the New York Mercantile Exchange (NYMEX) and the Chicago Mercantile Exchange (CME)) present attractive features for investors as well. The concept of equity volatility dispersion using swaps (covering both underwriting and asset management volatility) may also be a way of providing protection against catastrophic risks.

CHAPTER 8

COVERING EXTREME EVENTS: HOW FINANCIAL MARKETS CAN HELP THROUGH INNOVATIVE INSURANCE-LINKED SECURITIES²²⁴

8.1. Introduction

As discussed in Chapter 7, there was a significant increase in reinsurance prices for catastrophic risks in the U.S. in the aftermath of the 2005 hurricane season. In particular, the fact that the size of the retrocession market (reinsurance of reinsurers) was dramatically reduced increased reinsurers' uncertainty as to whether or not such coverage will be available to them in the long term.

These developments provided an impetus for the expansion of Alternative Risk Transfer (ART) instruments that complement traditional insurance and reinsurance. The field of ART grew out of a series of insurance capacity crises in the 1970s through 1990s that led purchasers of traditional reinsurance coverage to seek more robust ways to buy protection. While ART instruments can comprise a wide range of alternative solutions (including the creation of captives or risk retention groups), we focus on instruments that transfer part of the exposure to catastrophic losses to investors in the financial markets. Most of these risk transfer techniques permit investors in the capital markets to play a more direct role in providing insurance and reinsurance protection. Investors see these products as a way of enhancing their returns by allocating funds to instruments that are not highly correlated with other financial risks (e.g., fluctuations in interest rates).

We are interested in the role that insurance-linked securities (ILS) can play in the securitization markets for catastrophes. How has the market for industry loss warranties and catastrophe bonds (cat bonds) evolved as a result of the unprecedented 2004 and 2005 hurricane seasons? What are some recent innovations in the ILS market? What has been the impact of the respite from major hurricanes in the U.S. in 2006 and 2007?

Since their inception more than a decade ago, insurance-linked securities have often been presented as a very promising solution to address the capital needs of companies exposed to potential catastrophic risk. In a relative sense, the 2005-2007 period has been a clarion call for new investment opportunities (Lewis, 2007)²²⁵ and we have witnessed historic records in cat bond issuance and the development of a multi-billion dollar market for other innovative instruments. In absolute terms, however, this market remains a tiny niche. Securitization represents only a small proportion of the capital in the global insurance market today.

²²⁴ This chapter is based on Michel-Kerjan, E. and F. Morlaye (2008), "Extreme Events, Global Warming, and Insurance-Linked Securities: How to Trigger the 'Tipping Point,'" *The Geneva Papers on Risk and Insurance*, 33(1): 153-176.

²²⁵ Lewis, M. (2007), "In Nature's Casino," *The New York Times Magazine*, August 26.

The recent evolution of ART instruments is promising, though. Can the period 2005 to 2007 be considered a tipping point for this market? In other words, have we reached a critical mass in issuances to trigger enough interest from investors and potential risk hedgers (all types of companies, including – but not limited to – insurers and reinsurers)? If not, what are the necessary conditions so that the insurance-linked securities will become a much larger market on its own? This chapter suggests ways to address some of the current limitations, and also innovative approaches to expand this market further.

8.2. Financial Capacity Provided by Insurance-Linked Securities: Past and Present

In this section we discuss three types of insurance-linked securities instruments²²⁶ provided by the capital markets: industry loss warranties (ILWs), catastrophe bonds, and sidecars. The first two are similar to excess-of-loss reinsurance, whereas sidecars are more often quota-share-like coverage and therefore similar to proportional reinsurance.

Industry Loss Warranties (ILW)

The first ILWs were issued in the 1980s to cover airline industry losses, and then were developed in the property and casualty insurance industry in the aftermath of major natural disasters that occurred in the past 15 years. As the name indicates, an industry loss warranty (ILW) (also known as original loss warranty, OLW) is a financial instrument designed to protect insurers and reinsurers from severe losses due to extreme events such as natural disasters. The ILW market today focuses almost exclusively on catastrophic risks, and has increased significantly after Hurricanes Katrina, Wilma and Rita.

ILWs operate as follows: The buyer who wants to hedge his risk pays the seller a premium at the inception of the contract. In return, the buyer can make a claim in the event of a major industry loss. The payout of an ILW can be structured in a simplified way such that the buyer can make a claim equal to the limit of the ILW if a pre-defined industry loss index (IL) exceeds a threshold known as the trigger (T) for a particular state/region, regardless of the buyer's actual amount of incurred loss.²²⁷

$$\text{Claims} = L \text{ if } IL \geq T$$

$$\text{Claims} = 0 \text{ if } IL < T$$

²²⁶ For a comprehensive discussion of alternative risk transfers markets at the beginning of the 2000s, see Lane, M. (ed.) (2002), *Alternative Risk Strategies*. London: Risk Waters Group; Dischel, R. (ed.) (2002), *Climate Risk and the Weather Market: Financial Risk Management with Weather Hedges*, London: Risk Books; and Hartwig, R. and C. Wilkinson (2007), "An Overview of the Alternative Risk Transfer Market," in D. Cummins and B. Venard (eds.), *Handbook of International Insurance: Between Global Dynamics and Local Contingencies*, New York: Springer.

²²⁷ We give here the example of a derivative swap, which is the most commonly used ILW contract. But it does not have to be. There could be a first indemnity-trigger (loss encounter by the buyers), then a second trigger based on industry loss. There could also be several thresholds with which are associated different payments (L).

For example, the buyer of a \$200 million limit U.S. wind ILW in New York in 2008 attached at \$20 billion will pay a premium to a protection writer (e.g., a hedge fund acting as a reinsurer) and in return will receive \$200 million if total losses to the insurance industry from a single U.S. hurricane in New York in 2008 exceed \$20 billion.

In this sense, ILWs are similar to excess-of-loss reinsurance but where the insurer now has some *basis risk*: the covered loss of the insured's book of business does not necessarily correlate perfectly with the amount of claim collected from the index-based contracts (Zeng, 2000).²²⁸ Note that as an ILW is very similar to a non-indemnity cat bond, it presents the same basis risk issues (see below). To date, most ILW buyers have been large companies who see these instruments as another way to spread their exposure. For those that write a large portion of market share, the basis risk might be reduced as well, because their losses are likely to be representative of the industry losses in the aftermath of a major natural disaster. ILWs are particularly attractive for single state insurers/reinsurers or companies with a higher concentration of business in a limited number of locations, thus enabling them to take on larger books of business in their primary area of operation.

The estimation of the industry losses is thus critical. In the U.S., the Insurance Services Office (ISO) is the organization that will measure the total amount of industry insurance losses in the aftermath of a catastrophe and be used as the reference index. In Europe, however, there is no centralized structure that estimates industry losses. Recently, there have been calls to create such a European organization in order to provide both hedgers and investors with more clarity, and then foster this market.

One of the main advantages of ILWs is that they involve relatively low transaction costs both for the buyers (insurers or reinsurers) and sellers (e.g., hedge funds). The sellers do not have to evaluate the expected loss to the (re)-insured portfolio of a specific company from the trigger event, only the exceedance probability curve of the entire industry which typically reduces the uncertainty and hence the cost associated with a higher level of volatility.

In the spring of 2006, Lane Financial published an analysis of the evolution of ILW premiums between 2005 (pre-Katrina) and April 1, 2006, for different trigger levels (from \$5 billion up to \$50 billion insurance industry losses) and different types of risk (wind in Florida, wind nationwide, earthquake in California). The study was based on information obtained from specialist dealers over the last five years. Although this information is not exhaustive, we feel Table 8.1 provides a reasonably accurate picture of the nature of those changes (Lane, 2006).²²⁹

²²⁸ Zeng, L. (2000), "On the Basis Risk of Industry Loss Warranties," *Journal of Risk Finance*, 1(4): 27-32.

²²⁹ Lane, M. (2006), "How High Is Up? The 2006 Review of the Insurance Securitization Market," *Lane Financial*, April.

TABLE 8.1. EVOLUTION OF ILW PREMIUMS IN APRIL 2006 COMPARED TO PRE-KATRINA 2005

ILW Trigger	Florida Wind	U.S. All Natural Perils	California Earthquake
\$5.0	54%	NA	43%
\$10.0	83%	85%	75%
\$12.5	87%	105%	76%
\$15.0	92%	111%	81%
\$20.0	132%	133%	100%
\$25.0	164%	124%	89%
\$30.0	176%	130%	49%
\$40.0	178%	157%	44%
\$50.0	113%	160%	42%
Average	120%	126%	66%

Source: Lane Financial (2006)

As Table 8.1 indicates, for a \$5 billion trigger, estimated prices increased by 54 percent, and for a \$50 billion trigger, by 113 percent due to a major hurricane in Florida, compared with prices prior to Hurricane Katrina. Despite this increase, the market has grown significantly in the aftermath of Katrina, which indicates a strong appetite from insurers and reinsurers for access to other sources of capital than traditional reinsurance or retrocession. It is estimated that nearly \$4 billion in ILWs were issued between September 2005 and September 2006 (SBA Florida, 2006).²³⁰ As most of these transactions were done company-to-company though, it is difficult to precisely know the aggregate volume and prices.

Catastrophe Bonds (“Cat Bonds”)

Catastrophe bonds enable an insurer or reinsurer to access funds if a severe disaster produces large-scale damage, in a manner similar to ILWs. Cat bonds typically cover narrowly defined risks on an excess-of-loss basis. They are issued in the form of debt with high coupons.

To illustrate how cat bonds work, consider an insurer or reinsurer, *SafeCompany*, who would like to cover part of its exposure against catastrophic losses. In order to do so, it creates a new company, *BigCat*, whose only purpose is to cover *SafeCompany*. In that sense, *BigCat* is a single purpose reinsurer (also called “special purpose vehicle, SPV”). When the reinsurance contract is signed, the sponsor (*SafeCompany*) pays premiums to *BigCat*. On the other side, investors place their funds with the SPV *BigCat*; these funds constitute the initial principal for the bond to be issued by *BigCat*. Reinsurance premiums collected from *SafeCompany* will be used to provide the investors with a high enough interest rate to compensate for a possible loss should a disaster occur.

Suppose the losses from a disaster covered by the cat bond exceed a pre-specified trigger. Then the interest on the bond, the principal, or both, are forgiven, depending on the specifications of the issued catastrophe bond. These funds are then provided to *SafeCompany* to help cover its claims from the event. In addition to the interest rate on the cat bond, there are at least four other components for the investor to consider: the protection of the principal, the nature of the trigger, the size of the bond and the maturity of the bond. We explain each of these now.

²³⁰ State Board of Administration of Florida (2006), “A Study of Private Capital Investment Options and Capital Formation Impacting Florida’s Residential Insurance Market,” September 19.

Protection of the Principal. The principal of a catastrophe bond often consists of different tranches, which might or might not be protected. A *protected tranche* guarantees that the investor will receive the principal from this tranche when the bond matures. For this tranche, if a covered event occurs, the SPV stops paying interest and can extend the maturity of the loan for several years. An *unprotected tranche* has both principal and interest at risk should a covered event occur.²³¹

Trigger. The nature of the trigger varies from one bond to another. The trigger can be *indemnity-based*, meaning that the transaction is based on the actual losses of the sponsor. This eliminates the basis risk for the sponsor, but also reduces the transparency of the transaction for the investors. The trigger can also be based on industry losses using a predetermined *industry index of losses* (e.g., the index is calculated by the Property Claim Services – “PCS” in the United States). The trigger can also be determined by a *parametric index*, such as an earthquake of magnitude 7 or greater on the Richter scale occurring in the San Francisco Bay area, or a Category 4 hurricane in Florida. A parametric index provides transparency for the investors, but sponsors may have significant basis risk (see discussion on basis risk above for ILWs).

Size of the Bond. The size of the bonds issued has increased over time. For example, of the five bonds that were issued in 1997, only one had capitalization higher than \$200 million; in 2000 there were two such bonds, and in 2005 there were four (out of a total of ten). Likewise, there were two bonds with capital lower than \$50 million in 1997 (out of a total of five), but none of the 43 new bonds issued between 2003 and 2006 had capital lower than \$50 million (Guy Carpenter, 2007).²³² The transaction costs associated with the complex execution of these instruments (compared to traditional reinsurance) contributes to this trend toward larger bonds.

In 2007 State Farm issued a “jumbo” cat bond: a \$1.2 billion risk capital bond which is the largest cat bond ever issued. (The original attempt had been to issue a \$4 billion bond, but it was scaled down to the \$1.2 billion note and term loan.) The bond is innovative in that it is cumulative: the company covers its portfolio in the case of cumulative losses due to a series of pre-defined events (hurricanes in the U.S., earthquakes in Japan, among others) over the three-year maturity of the bond.

Maturity of the Bond, or How to Stabilize Insurance and Reinsurance Prices. The maturity of a bond is the period during which the SPV will cover *SafeCompany*. One advantage of cat bonds over traditional one-year reinsurance contracts is that they can typically offer longer term coverage – one to five years. Over time, the proportion of cat bonds with longer maturity has increased, an indication that these instruments are gaining trust within the reinsurance/finance community. Table 8.2 specifies the maturity of cat bonds that were issued between 1997 and 2006 (2007 data is not yet available). The average maturity is about three years, with some cat bonds having only a 1-year maturity and others having five years or more.

In the context of highly volatile reinsurance prices that often occur after large catastrophes, cat bonds offer an important element of stability for insurers by guaranteeing a pre-defined price over several years, assuming that the entire capital of the bond is not triggered (in which case a new bond has to be issued under price conditions that are likely to differ). We believe that this stability has been largely undervalued so far.

²³¹ For a theoretical treatment of optimal climate risk hedging through weather bond, see Baurriou, P. and N. El Karoui (2002), “Reinsuring climatic risk using optimally designed weather bonds,” *The Geneva Papers Risk and Insurance Theory*, 27: 87-113.

²³² Note that before the 2004-2005 hurricane season, the largest bond issued ever was the \$470 million Zenkyoren’s Phoenix in 2003 to cover earthquakes in Japan. Since then we have witnessed the issuance of much larger cat bonds, such as the \$1.2 billion bond issued by State Farm in 2007 (Merna Re).

TABLE 8.2. MATURITY OF CAT BONDS ISSUED BETWEEN 1997 AND 2006

Maturity	1 year	2 year	3 year	4 year	5 year	10 year
1997	2	1	1	0	0	1
1998	7	0	0	0	1	0
1999	5	0	3	0	2	0
2000	3	1	4	0	1	0
2001	2	1	3	1	0	0
2002	0	1	4	2	0	0
2003	0	1	3	1	2	0
2004	1	2	1	1	2	0
2005	1	2	7	0	1	0
2006	2	4	12	1	1	0
Total (91)	23	13	38	6	10	1

Source: Authors' calculation, with data from Guy Carpenter

With many firms complaining about price increases for coverage against catastrophes in the aftermath of the 2005 hurricane season, and with pressure from rating agencies for more stringent catastrophe exposure management, the price stability offered by cat bonds with multi-year maturity might be important for insurance companies and other issuers as well.

Bonds do not have to cover only natural disasters, nor are they issued only to protect a commercial enterprise. For example, the first bond that insured against terrorism was issued in Europe in August 2003. The world governing organization of football (soccer), the International Federation of Association Football (FIFA), which organized the 2006 World Cup in Germany, developed a \$262 million bond to protect its investment. Under very specific conditions, the catastrophic bond covered losses resulting from both natural and terrorist extreme events that would have resulted in the cancellation of the World Cup final game without the possibility of it being re-scheduled to 2007 (Kunreuther and Michel-Kerjan, 2004).²³³ Moreover, the government of Mexico, which through its FONDEN facility sponsored the \$160 million CAT-Mex transaction in May 2006, was the first government to issue a cat bond.²³⁴

The sponsor of a cat bond also does not have to be an insurer. For instance, in 2002, Vivendi Universal (Universal Studios) issued a \$175 million bond, Studio Re, to cover its production studios against an earthquake in southern California; The Walt Disney Company issued a bond to cover its large theme park in Japan. The first European corporate bond was issued in 2003 by EDF, the French electrical company; this \$230 million bond, Pylon, covers the company against windstorms in France. In 2006, another corporate sponsor went with coverage by cat bond: Dominion Resources, an energy producer, obtained protection for oil-drilling assets located off the coasts of Louisiana and Texas by issuing a \$50 million bond, Drewcat.

²³³ Kunreuther, H. and E. Michel-Kerjan (2004), "Challenges for Terrorism Insurance in the United States," *Journal of Economic Perspectives*, 18 (4): 201-214.

²³⁴ The cat bonds were part of a \$450 million reinsurance transaction with European Finance Reinsurance, a wholly owned subsidiary of the reinsurance company, Swiss Re. Swiss Re retained \$290 million of the contract exposure and issued \$160 million in cat bonds with a three-year maturity through a special purpose vehicle, CAT-Mex.

More and more cat bonds cover against multiple events. In fact, in 2005 and 2006, over half of the capital at risk through cat bonds was for multi-event bonds rather than single-event bonds. Whether more companies, trade associations and state and federal governments, working in collaboration with experts in the field, will diversify their coverage through ILS shall be a key factor in developing these instruments.

The maturity of cat bonds leads to an important distinction between *issued* bonds and *outstanding* bonds. Consider the following example: if a \$200 million bond is issued on January 1, 2007 for one year, then the 2007 risk capital issuance is \$200 million and the capital outstanding is also \$200 million. Imagine now that this bond is issued for five years: the maturity of the bond is thus December 31, 2011. For 2007, the capital issued is \$200 million, but for the next four years, the capital issued is \$0. As the bond is outstanding for five years – each year between 2007 and 2011 – the amount of capital *outstanding* is \$200 million (if the bond has not been triggered in the meantime). In other words, issuance tells us about new deals, while outstanding capital tells us about present and past issuances.

Cat bonds have been on the market for about ten years now, which enables one to make some comparisons as to the evolution of issuances and capital outstanding. At the end of 2004, there was nearly \$4 billion in cat bond principal outstanding (including \$1.14 billion of new issuances that year). At the end of 2005, outstanding risk capital grew to nearly \$5 billion with nearly \$2.1 billion of that issued.

Figure 8.1 illustrates the evolution of risk capital issued and outstanding, and the number of bonds issued between 1997 and December 2006.²³⁵ The market recorded total issuance of over \$4.7 billion in 2006 (20 new issuances, almost twice as many as in 2005), a 125 percent increase over the \$2.1 billion in 2005. This is a new record high, and a 75 percent increase over the \$1.14 billion issued in 2004, and a 20 percent increase over the \$1.73 billion issuance in 2003 (the previous record). The risk capital issued over 2005 and 2006 was equal to the total issued over the preceding five years. Bonds outstanding increased significantly as well, which reflects the issuance of multi-year bonds in previous years.

At the end of 2006, outstanding risk capital continued to significantly grow to \$8.5 billion, with nearly \$4.7 billion of that being issued. As of December 2007, capital issued was \$7.1 billion and over \$15 billion was outstanding.²³⁶

²³⁵ The figure combines bonds for natural disasters in the U.S. and abroad, as well as the first liability cat bond (Avalon Re) issued by Oil Casualty Company in 2005 for \$405 million.

²³⁶ Personal correspondence with Michael Millette at Goldman Sachs; December 20, 2007.

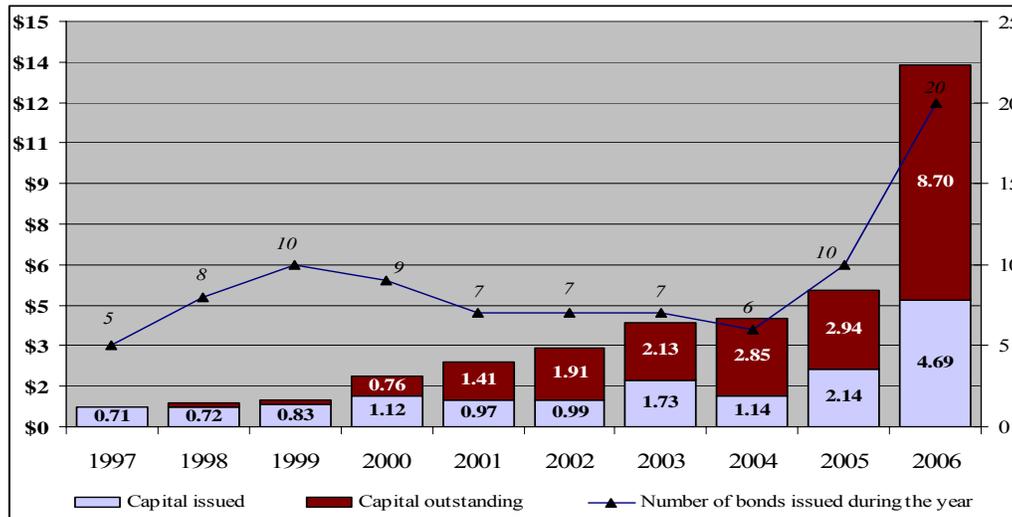


FIGURE 8.1. NATURAL CATASTROPHE BONDS: CAPITAL RISK ISSUED AND OUTSTANDING 1997-2006 (IN \$ BILLION)

Sources: Data from Swiss Re Capital Markets, Goldman Sachs, and Guy Carpenter

Sidecars

A phenomenon of the post-Hurricane Katrina market environment has been the development of so-called *sidecars*. A sidecar is a special purpose company that provides reinsurance coverage exclusively to its sponsor (a reinsurer or a large insurer) by issuing securities to investors. The company which offers the sidecar has to be licensed as a reinsurer. Unlike ILWs or cat bonds that generally provide excess-of-loss reinsurance, sidecars are often based on quota-share reinsurance. The sidecar company shares the risks of certain insurance/reinsurance policies with the underwriter in exchange for a portion of the premiums (generally up to 50 percent) and dividends in shares. Figure 8.2 shows a simplified diagram to illustrate the stakeholders that are involved in a sidecar.

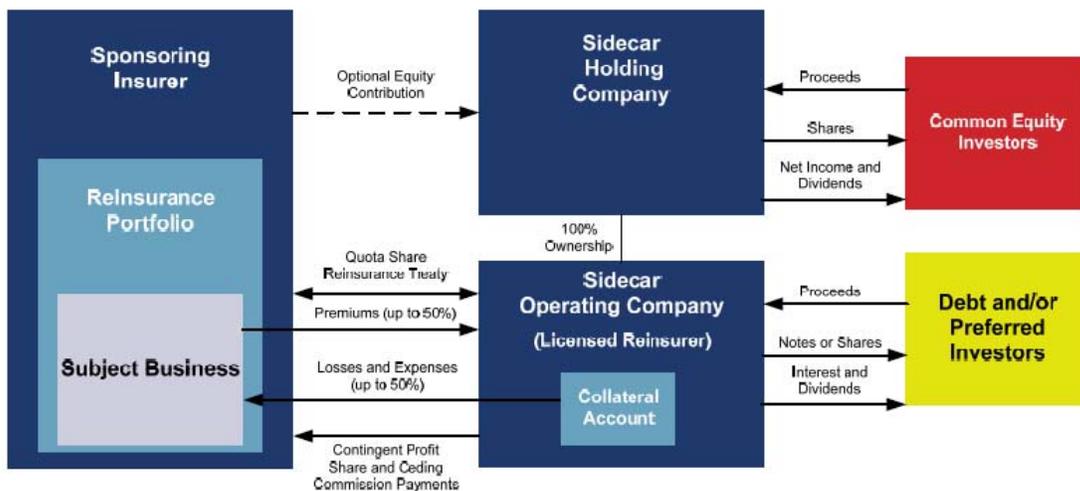


FIGURE 8.2. OPERATION OF A SIDECAR

Source: Goldman Sachs

Like cat bonds, sidecars are complex financial transactions. They typically require a larger investment than cat bonds (in the \$200-\$300 million range, although there have been several sidecars with investments lower than \$100 million). A sidecar company is designed to operate two years or less, and then self-liquidate or renew, depending on market conditions, whereas cat bonds have been issued for 5 years for even longer. Another difference is that cat bonds are typically designed to hedge low-probability, high-impact events, whereas sidecars allow investors to take a slice of the whole business of a reinsurance program in quota-share.

Figure 8.3, compiled by Goldman Sachs, gives the name, capital and sponsor of some of the sidecar companies that were created between April 2005 and December 2007. In 2005, the total volume was \$2.2 billion, in 2006 it was \$4.2 billion, and in 2007 the volume was \$1.7 billion.

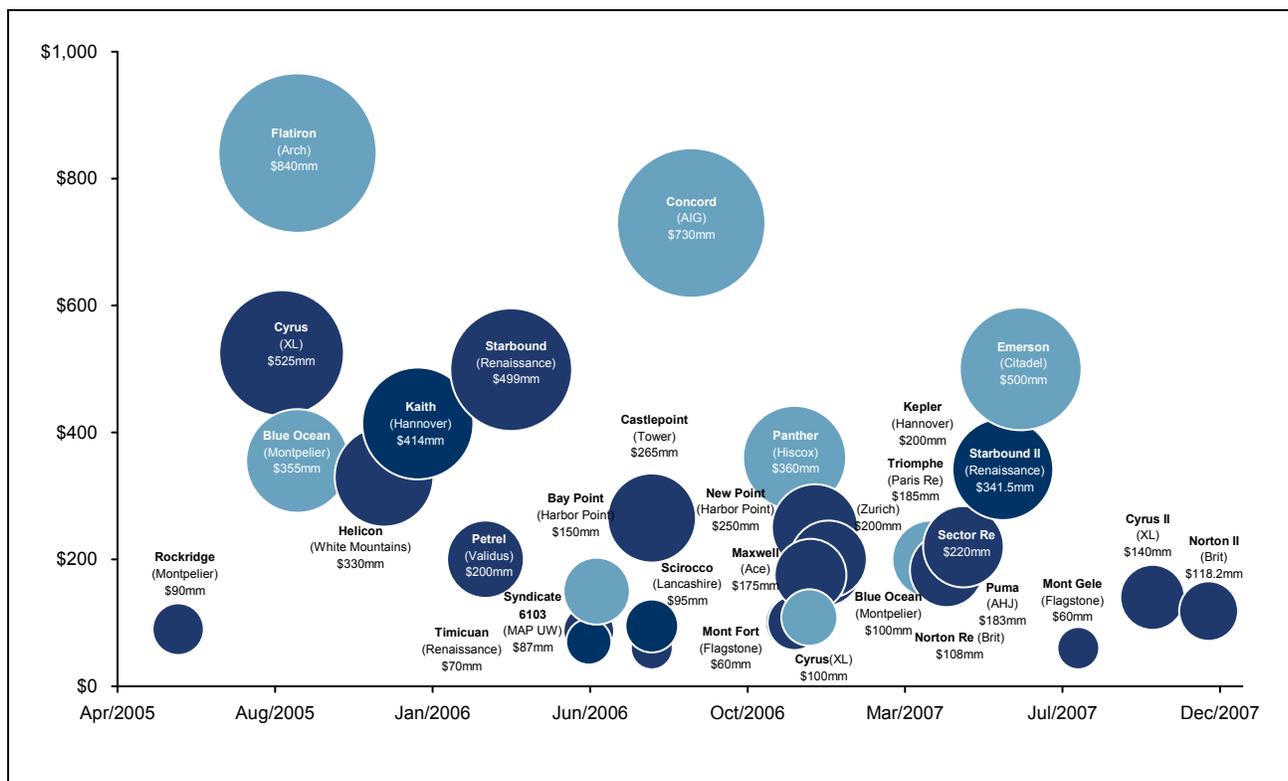


FIGURE 8.3. REINSURER SIDECARS - REACTION TO 2005 HURRICANE SEASON: APRIL 2005 - DECEMBER 2007

Source: Goldman Sachs

While all the sidecars that were created in the aftermath of the 2005 hurricane season were sponsored by reinsurance companies, in August 2006, Lexington Insurance Company, a member of AIG, set up its own sidecar, Concord Re, to reinsure business on a quota-share basis. This was the first sidecar structured for a primary insurance company. Concord Re is capitalized with \$730 million from equity securities issued by Concord Re's parent holding company, Concord Re Holdings. Looking back at the year 2006 as a whole, a total of nineteen sidecar transactions were completed, providing \$4.2 billion of capacity (Goldman Sachs, 2007).²³⁷

²³⁷ Personal correspondence with Michael Millette at Goldman Sachs; December 20, 2007.

To sum up, the 2005 hurricane season has led insurers and reinsurers, along with some other issuers, to use Alternative Risk Transfer instruments at an unprecedented level and the trend has continued. One important element to note here is that Hurricane Katrina swamped KampRe, a \$190 million catastrophe bond arranged by Swiss Re for Zurich. It was the first cat bond to completely call in investor funds.²³⁸ The 2005 hurricane season also wiped out a \$650 million sidecar, Olympus Re (Moyer, 2006).²³⁹ These events might actually have had a favorable impact on the market. First, these losses did not stop investments in those new instruments in 2006. Investors who bet against the odds of devastating Atlantic hurricane seasons in 2006 and 2007 profited, as, contrary to expert predictions, both seasons turned out to be the mildest in years. Second, these were the first ILS to pay something back to their sponsors, which might make these instruments more “real” from a financial protection perspective.

Despite recent encouraging movement and increased trading volume, we see potential to increase this market more broadly. Over the past ten years, ILS market activities have been triggered primarily by the occurrence of major catastrophes followed by significant increases in reinsurance price, creating the need to gain access to less expensive financial protection. Although the data points to an increase in these extremely costly disasters in the coming years, it is unlikely that this will be sufficient to generate a large, liquid and sustainable ILS market.

8.3. Benchmark: The Market for Credit and Weather Derivatives

Credit Derivatives

In order to think creatively as to how to enhance the ILS markets for extreme events, it is worth making a comparison to the development of other financial products over the past ten years. We now turn to two of them: *credit derivatives* and *weather derivatives*.

Credit derivatives are one of the most successful capital market developments, despite being seriously compromised by the subprime crisis in 2007. With \$20 trillion of outstanding credit derivatives in 2006 (Figure 8.4), this market allows investors to trade the risk of default on a certain security (in general, a debt or a loan) independently from the other risks they face. To put this figure into perspective, the credit derivatives market was “only” \$40 billion of outstanding notional value in 1996, and \$180 billion in 1997, according to the British Bankers Association.²⁴⁰

²³⁸ Although not all the relevant insurance claims affecting this issue have been processed, the bonds are trading as though complete loss is expected.

²³⁹ Moyer, L. (2006), “Hedge Funds’ Sidecars,” *Fortune*, July 27.

²⁴⁰ British Bankers Association (2006), *BBA Credit Derivatives Report 2006*, London: BBA Enterprises.

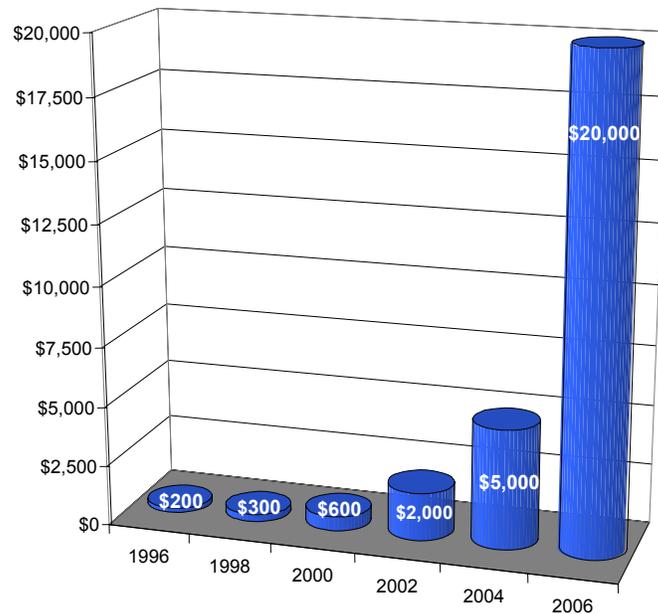


FIGURE 8.4. GLOBAL CREDIT DERIVATIVES MARKET 1996-2006 (IN \$ BILLION)

Credit derivatives can be structured in multiple ways, but the two dominant types of products are the Credit Default Swap (CDS) and the Collateralized Debt Obligation (CDO). The CDS is a contract that transfers, for a premium, the risk of default on a type of debt underlying, and which pays off if a registered case of default occurs. The cases of defaults have been progressively standardized, thanks to the work of the International Swaps and Derivatives Association. The CDO is a new type of security (or securities, as there are many tranches for a single issue) that constitutes a pool of debt instruments securitized into one financial instrument. The pool typically consists of hundreds of individual debt instruments. CDOs are issued in several tranches which divide up the pool of debt into bond with varying degrees of exposure to credit risk. One can buy different tranches so as to gain exposure to different levels of loss.

The comparison between credit derivatives and ILS is relevant, as both share common features, such as relative illiquidity of underlying risks and a high loss potential.²⁴¹

²⁴¹ As this report goes to press, it is not clear how the credit derivatives market will be corrected by the subprime crisis.

Weather Derivatives

The first weather derivative contract was developed in 1996, about the same time that the first cat bonds were created.²⁴² The weather derivatives market increased in 1997. As the market for these products grew, the Chicago Mercantile Exchange (CME) introduced the first exchange-traded weather futures contracts (and corresponding options) in 1999.

Recent years have seen a significant increase in this market. According to a survey released in June 2006 jointly by the Weather Risk Management Association (WRMA) and PricewaterhouseCoopers, the total weather derivatives market had grown more than ten-fold over where it stood two years before. (Figure 8.5.)

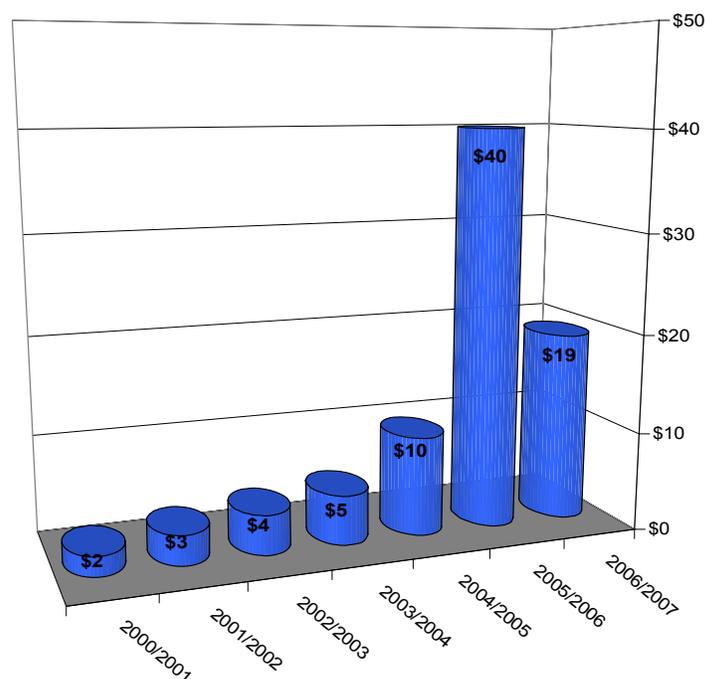


FIGURE 8.5. GLOBAL WEATHER DERIVATIVES MARKET, 2000-2006 (IN \$ BILLION)

The WRMA's 2007 industry survey shows that the total number of contracts traded worldwide – both over-the-counter and on the CME – was 730,087 for the period April 2006 through March 2007. This reflects a decline from 2006's total of just over 1 million contracts, but is substantially higher than in earlier years. Likewise, the value of contracts traded between April 2006 and March 2007 was \$19.2 billion, substantially higher than in other years (if one sees 2005-2006 as an exception due to very peculiar market conditions following the 2005 hurricane

²⁴² The first deal was made in July 1996, when Aquila Energy structured a dual-commodity hedge for Consolidated Edison Co. in July 1996. The transaction involved ConEd's purchase of electric power from Aquila for the month of August. The price of the power was agreed to, but a weather clause was imbedded into the contract. This clause stipulated that Aquila would pay ConEd a rebate if August turned out to be cooler than expected. The measurement of this was referenced to Cooling Degree Days (CDDs) measured at New York City's Central Park weather station. If total CDDs were from 0 to 10 percent below the predefined expected level, the company received no discount to the power price, but if total CDDs were 11 to 20 percent below normal, ConEd would receive a \$16,000 discount.

season in the U.S. that significantly increased the demand for these instruments): in 2004 and 2005, the total value of contracts was \$4.6 billion and \$8.4 billion, respectively (Weather Risk Management Association, 2007).²⁴³

Temperature-related contracts on both CME futures and the OTC market accounted for the vast majority of deals, with a notional value of \$18.9 billion. Notional values for rain- and wind-linked contracts were steady at \$142 million and \$36 million only, respectively. To date, most of the activity in weather derivatives has occurred in U.S. markets. This might change, however, with Euronext launching in 2007 a joint venture with Meteo France to develop a customized weather index to help corporations understand and design weather hedges.

8.4. Enhancing Capital Market Solutions: The Need to Address Stakeholders' Concerns

Capital market solutions, despite the recent movements, remain marginal in the global risk transfer market. But this picture can be misleading. Here we discuss some factors that have impeded more significant growth. If they are addressed, we are confident that ILS will play a more important role in covering the financial consequences of weather-related events and other extreme disasters.²⁴⁴

Issuers' Concerns

Issuers typically turn to ILWs because they are increasingly aware of their catastrophe exposure due to recent disasters, the resulting increased pressure from rating agencies to better manage their exposure, and regulatory changes.

Until recently, the regulatory pressure was mostly visible in the U.S. But the situation is changing in Europe as well. With the new series of regulations under Solvency II, the landscape is evolving into more regulatory pressure. For example, under Solvency II, insurance companies will now be obligated to sustain a 1-in-200 year event. Interestingly, as the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS)'s aim is to align solvency capital to risk-based economic capital, capital relief will be obtainable through risk transfer instruments, either reinsurance or securitization.²⁴⁵ It is foreseeable that reinsurance programs and allocation of capital to P&C lines of business will be affected by Solvency II, as it has been by changes in the Capital Adequacy models of rating agencies. These elements should have a positive effect on the insurance-linked security market.

²⁴³ Weather Risk Management Association (2007), "Strong Demand Seen for Weather Risk Management Contracts: Annual WRMA survey shows industries regard weather risk tools as essential," Miami, FL, May 11, 2007.

²⁴⁴ For a discussion of the recent developments in ILS markets published recently, see Butt, M. (2007), "Insurance, Finance, Solvency II and Financial Market Interaction," *The Geneva Papers on Risk and Insurance*, 32(1): 42-45; De Mey, J. (2007), "Insurance and the Capital Markets," *The Geneva Papers on Risk and Insurance*, 32(1): 35-41; Wu, Y.C. and D. Soanes (2007), "Insurance and the Fixed Income Capital Markets," *The Geneva Papers on Risk and Insurance*, 32(1): 46-57; Ramella, M. and L. Madeiros (2007), "Bermuda Sidecars: Supervising Reinsurance Companies in Innovative Global Markets," *The Geneva Papers on Risk and Insurance*, 32(3): 345-363; and Csiszar, E. (2007), "An Update on the Use of Modern Financial Instruments in the Insurance Sector," *The Geneva Papers on Risk and Insurance*, 32(3): 319-331.

²⁴⁵ The European directive for reinsurance will make securitization of risks easier for the insurance market with the recognition of the Special Purpose Reinsurance Vehicle. The directive is due to be translated into national law by 2008 in the European Union.

One concern of potential issuers relates to the design of the ILS. The definition of the trigger is central, because it determines both the profile of risk transfer to capital markets and the impact on target return on investment for the issuer (e.g., how solvency margin, economic capital or rating capital are affected, along with the distribution of expected P&L). Issuers typically favor indemnity triggers because they reduce basis risk for the company (compared to parametric or index-based solutions). On the other hand, investors favor these latter solutions because they typically rely on a well-defined index provided by a third party to measure the trigger (modeling firms, U.S. Property Claim Service for losses, etc.).

Not surprisingly, the pricing of ILS remains a challenge. On one hand, ILS have often been non-competitive with traditional providers of reinsurance from a single “rate on line” prospective, except for very specific risks like higher tranches of retrocession, or peak exposures in risk-prone areas (e.g., Florida).²⁴⁶ They typically remain highly structured and customized products. On the other hand, as we discussed above, ILS present important attractive features, even though they might be harder to quantify and price. As collateralized (largely or fully) and multi-year programs, ILS address the issue of credit risk and price volatility. They also allow issuers to draw from an alternative source of capital and to leverage their bargaining power with traditional risk financing providers (insurance and reinsurance). These advantages have to be integrated into the price of these instruments.

Investors’ Concerns

What is the demand for insurance-linked securities? Over the past few years, the investor base has not only surged in volume but has also changed its structure. Once viewed as an alternative source of financial protection for reinsurance and insurance companies familiar with the risks and eager to diversify their exposure, ILS have now become another family of investment products for “alternative investors” such as hedge funds, dedicated cat funds and private equity funds/money managers. In 1999, these three categories of investors represented 40 percent of the new issue volume of cat bonds; in 2006 they represented over 90 percent (Swiss Re, 2007).²⁴⁷ These investors are very specialized and sophisticated and are drawn by the features of the ILS (i.e., high Sharpe ratio²⁴⁸ and low correlation with traditional capital market assets). Mutual funds and money managers are also becoming more active in the market, eager to benefit from the high yielding instruments in the context of flat interest rates and historically low yield on government and corporate bonds.

In order to enhance investors’ appetite, several issues need to be addressed. First, it is important to make the risk/reward profile more explicit – a key element for investors who are faced with alternative investment opportunities (equity, bonds, credit, commodities, etc.). In this environment, insurance risks are appealing, but the further development of these products depends on the capacity to develop more standard quantitative models, the confidence of investors in these products, and the reliability of catastrophe models.

²⁴⁶ In both cases, limits in available capacity were also a strong force driving the issue of ILS.

²⁴⁷ Swiss Re, (2007), Insurance Linked Securities Market Update, August.

²⁴⁸ The Sharpe ratio is a measure of the excess return on a risk adjusted target of return, divided by volatility of the product. It is a key indicator for investors as it helps discriminate between investments with the same level of risks measured by volatility of expected return.

Second, the new investors in this market are very yield-sensitive (hedge funds and cat funds have minimum threshold for their investments, and leverage is often necessary to reach adequate rates of returns). As a result, investors were until recently interested only in high-yielding tranches which translated into bonds attaching around 1 to 2 percent of annualized probability of first loss. These levels of attachment made the ILS unsuited for traditional investors, concerned about a loss in their principal. In parallel, the high level of due diligence that is required limited the penetration of these products among money managers. Recently, ILS were issued with a broader range of yielding tranches.

Moreover, while rating agencies did not usually rate investment-grade cat bond tranches for single event triggers, S&P decided in early 2007 to rate single event cat bonds up to BBB+ if the first loss is sufficiently remote (below 20bps). For investors compelled to hold only investment grade paper, this constitutes a critical move. As the products become more standardized and the range of issuers and programs increases, traditional investors will have more flexibility. For example, Pioneer, the asset manager, launched in July 2007 a fixed income fund in which significant amounts of cat bonds were added to enhance yield (*The Economist*, 2007).²⁴⁹

An additional point under scrutiny by investors was the liquidity of the investment. (Re)insurance risks can be underwritten under multiple wrappers, from retrocession contracts to ILWs, from cat bonds and cat swaps to shares of sidecars. Some hedge funds and private equity funds, given their expertise in illiquid and buy-and-hold strategies, would be keen on taking stakes in sidecars, high-yielding but totally illiquid before dissolution of the sidecar. At the other end, mutual funds and cat funds focus on cat bonds that can be traded in the secondary market.

8.5. Looking Ahead: Solutions and Innovations for Reaching the Tipping Point

The ILS market is still developing and undoubtedly will be quite different five years from now. We conclude this chapter by providing four axes of development which will help structure the market in the near future.

Increasing Investors' Interest in Insurance-Linked Products through Tranching

To develop further, the ILS market must draw more investors beyond hedge funds and private equity firms. The increasing popularity of securitization among issuers will help increase the range of risks available in the market, but other solutions have to be found as well. Tranching is likely to help: several distinct risks are pooled together and the resulting portfolio is divided into multiple tranches with different expected returns. The tranching technology allows structuring firms to transform low-rated bonds into investment grade securities by concentrating the risks in lower quality tranches stemming from subordination and overcollateralization. These higher risk tranches, called junior or equity, are usually bought by alternative investors attracted by the potential profit they would receive if no triggering event occurs. Some groundbreaking deals have reached the market, with notable recent transactions by ABN Amro and Guy Carpenter (Bay Haven Re in 2006, and Fremantle Re in June 2007).

²⁴⁹ *The Economist* (2007), "Catastrophe bonds. Ports and storms," August 4-10, p. 64

So far, investors were able to pick up the risks they were offered when issuers went to the market. In the future, investors could approach insurers and define the risks they are seeking; structuring firms or risk transfer hubs would emerge to find these risks or create them through tranching.

Addressing the Basis Risk Challenge through Index-Based Derivatives

As parametric insurance-linked securities will always retain basis risk, solutions to address this concern will be found in other corners. Standardized products such as Deutsche Bank-sponsored Event Loss Swaps and index based derivatives present attractive features for investors. The first attempt more than ten years ago to launch index-based products failed to attract attention and liquidity (cat index on the Chicago Board of Trade in 1995). Capital markets have dramatically evolved since then, and the investor base is deeper today. Recently, the New York Mercantile Exchange (NYMEX) and the Chicago Mercantile Exchange (CME) both added natural catastrophe-related futures and options for trading.²⁵⁰ Derivatives will be written on these indices, and in years to come will further illustrate the attractiveness of insurance risks to capital market investors.

Innovating through the Development of New Products

Until 2005, the range of ILS was limited to a few products among them cat bonds and ILWs. In 2005 and 2006, sidecars were developed. Other innovations will be developed to better tailor issuers' needs and investors' appetites, and also help lower the price of financial protection. A second generation of contingent capital products and "just in time capital" was developed recently and has been successfully marketed. For example, Goldman Sachs launched for XL the Stoneheath sidecar in November 2006, which also embeds contingent issues of capital in case of pre-defined events. Other solutions of convertible securities are being discussed, but have not publicly emerged yet.

Derivative Solutions Based on Equity Volatility Dispersion

Alternative solutions will also expand beyond the debt or equity forms, and even beyond the tradable securities form. Today, the capital market offers a wide range of tools and products, especially in the derivative universe.

There is one innovation that we believe could lead to major value creation: developing investment strategies based on equity volatility dispersion will provide another promising solution. The idea is to reduce the volatility of a given portfolio by buying a product that pays off if the volatility of a given industry portfolio fluctuates more than the one of a given index (e.g., S&P 500) over a pre-defined period of time. By *equity volatility dispersion* we mean the difference between the volatility of that portfolio (or basket) minus the volatility of the underlying index (e.g., S&P 500 or other predefined indices). Companies typically want to

²⁵⁰ This new initiative is very encouraging almost ten years after the CBOT stopped trading such options. The NYMEX product is based on the final aggregate annual ISO's PCS loss estimate for the contract year (3 years available to trade). The CME product is settled on a parametric index for individual hurricanes making landfall in the U.S. (there are contracts for three subsequent hurricane landfalls in five U.S. regions available to trade).

reduce their volatility, and if one can create solutions to cover excess volatility there should be a market for this protection. While not specific to insurance, equity volatility dispersion would actually help in the face of catastrophic risks.

Insurance companies who conducted an in-depth analysis of their peak risk exposure (natural hazards, pandemics, mega-terrorism risks) realized that the probability of these peak risks is often difficult to quantify with certainty. Such large-scale events affect both underwriting results (huge claims) and equity investments (stock markets of insurance companies typically go down in the days following a major catastrophe and then go up again to reflect expected future gains from increased premiums).²⁵¹ When structured adequately and based on a portfolio of stocks potentially highly impacted by such extreme events (e.g., a portfolio representing the insurance and reinsurance companies operating in the U.S.), the derivative solutions have proven highly efficient by providing broad financial protection.

How does it work? The company buys a special product (e.g., a swap) that pays off if the volatility of the insurance industry portfolio is more than X points higher than the volatility of a given index. For instance, Company A will receive \$10 million for each point difference between the volatility of its portfolio and the volatility of the index; if at the maturity of the product (let's say one year), the realized dispersion (difference between the two volatilities) is 5, then the company will receive \$50 million. Having an industry portfolio (instead of the portfolio of a specific company) gives investors the advantage of higher transparency, but sponsors may have significant basis risk.

Figure 8.6-A illustrates in a simplified way the payoff of such a strategy, designed to hedge a pandemic outbreak. In the case of a pandemic event or financial crash, the investment tested here would over-perform, allowing the investors to recover their claim or asset losses with financial gains on the instrument. Indeed, we see in Figure 8.6-A that the volatility of the basket (highest curve) is much higher than the volatility of the index (middle curve). The dispersion curve (lowest curve) is the difference between the two. Figure 8.6-B focuses on the volatility dispersion curve and depicts some major events between November 23, 1990 and April 28, 2007. We can see that dispersion would have remained relatively stable until 9/11, but would have increased significantly and steadily after 9/11, and continued to climb due to the uncertainty about the war in Iraq.

²⁵¹ For instance, what is the probability of a "dirty bomb" exploding in Europe this year? What would be the direct and indirect impacts of such an attack? Michel-Kerjan, E. and B. Pedell (2006), "How Does the Corporate World Cope With Mega-Terrorism? Puzzling Evidence from Terrorism Insurance Markets," *Journal of Applied Corporate Finance*, 18 (4): 61-75.

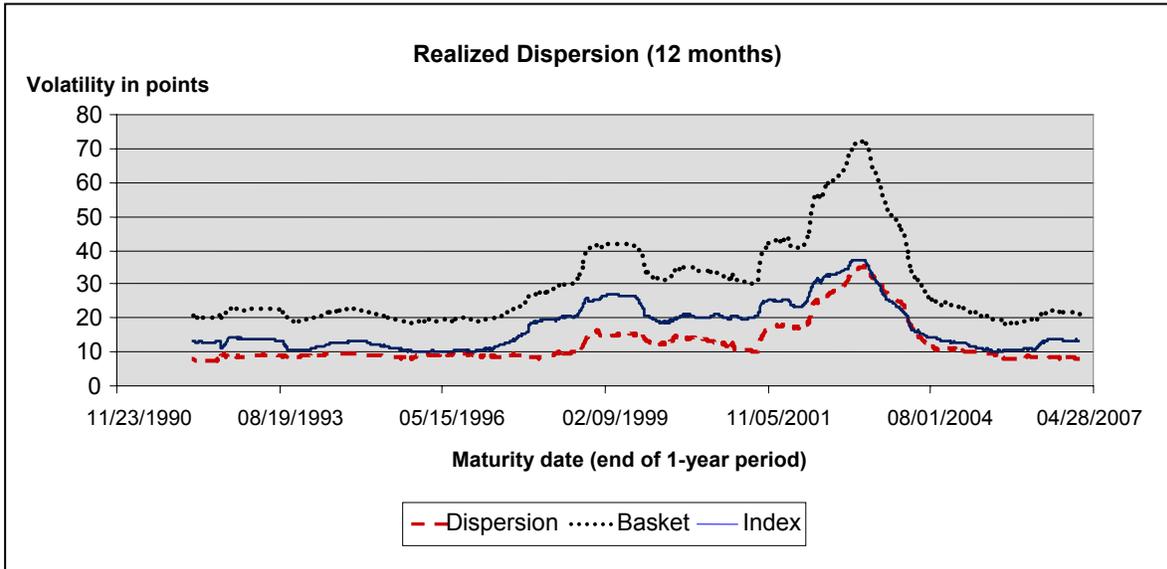


FIGURE 8.6-A. VOLATILITY OF THE BASKET AND INDEX, AND DISPERSION BETWEEN THE TWO

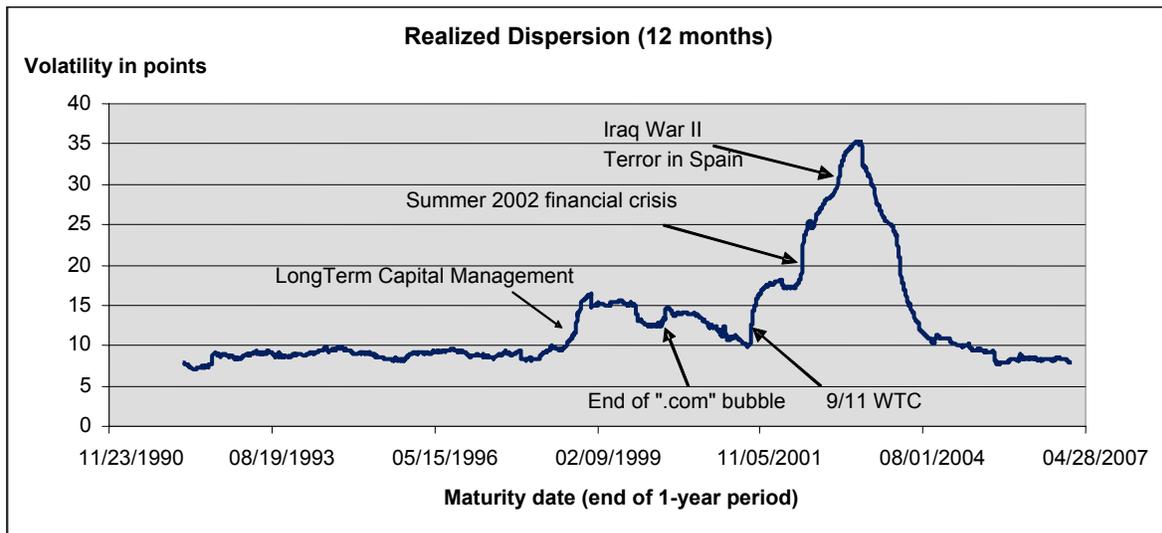


FIGURE 8.6-B. DISPERSION SOLUTION GRAPH BASED ON IMPACT OF MAJOR EVENTS
 Simulated payoff ranging from less than 10 points to more than 30 points
 (Each point gets a payoff of several million dollars)

Fortunately, no pandemic event occurred during the studied period – but the payoff of the strategy illustrates that both insurance events and financial market events are “covered” thanks to the instrument. This last example of a capital market solution clearly illustrates the emergence of a new approach in the risk transfer industry²⁵² that goes beyond the pure traditional “underwriting management” or pure “asset management” approach. Innovative and simple ways are thus possible, leveraging new asset classes based on second order risks, such as equity volatility dispersion. The potential of this new approach in hedging catastrophic risks remains mostly unexploited as of today.

While securitization represents a small proportion of capital in the global insurance markets worldwide today, the past three years have seen a significant increase in ILS use and the development of several new innovative products. With over \$25 billion of outstanding capital today for property/casualty coverage (including cat bonds, sidecars, ILWs, etc.) coupled with the annual rate of growth we have witnessed in recent years, we believe we could easily see \$50-\$75 billion outstanding capital in the next five years.

²⁵² For a discussion on other similar multi-function instruments, see Barrieu, P. and H. Loubergé (2007), “Hybrid Cat-Bonds,” paper presented at the SCOR-JRI Conference on “New Forms of Risk Sharing and Risk Engineering,” September 20-21, Paris.

SUMMARY OF CHAPTER 8

During the past 10 years, new financial instruments in the form of insurance-linked securities (ILS) have been developed to complement catastrophe risk coverage provided by traditional reinsurance. This chapter discusses the principle ILS products (industry loss warranties, catastrophe bonds, and sidecars), tracks their development over time and the main drivers of the upward shift in the ILS market after the 2004 and 2005 hurricane seasons. We provide up-to-date information on the evolution of this market for 2006 and 2007 as well.

Notwithstanding this very encouraging development, it is still surprising that despite the tremendous capacity offered by financial markets today, the ILS market has not expanded to a larger extent. Securitization represents just a small proportion of capital in the global insurance markets worldwide today.

We propose three complementary ways to increase interest in these instruments that could effectively trigger a much more significant volume of U.S. capital entering the ILS market: (1) increasing investors' interest through tranching; (2) addressing the basis risk challenge through index-based derivatives; and (3) the development of new products such as investment strategies based on equity volatility dispersion.

CHAPTER 9

A FRAMEWORK FOR SUPPLY AND DEMAND OF DISASTER INSURANCE

KEY FINDINGS

The supply of catastrophe insurance is determined primarily by the capacity of insurers and reinsurers, coupled with the availability of insurance-linked securities.

The price of catastrophe insurance is usually high relative to expected claims because of the large variance in losses that can be costly due to the insurer's need to allocate extra capital to provide protection against this risk.

The cycle in insurance prices is triggered by losses following major disasters due to the reduction in capacity. New inflow of capital normally expands capacity in a relatively short period of time.

One way to ration insurance capacity is to force policyholders to take higher deductibles so that more coverage can be provided by the insurer.

Regulation of insurance prices reduces the supply of coverage and can reduce the incentives for insurers to mitigate risks.

CHAPTER 9

A FRAMEWORK FOR SUPPLY AND DEMAND OF DISASTER INSURANCE

In order to evaluate the effectiveness of alternative disaster insurance programs, one needs to understand the supply of coverage and demand for protection by homeowners. This chapter complements analyses provided in previous chapters and develops a framework at a conceptual level for understanding the interaction of supply and demand prior to a natural disaster as well as after a catastrophe occurs.

Our intention is to see whether the insurance market is functioning effectively, given the play of market forces as shaped by existing regulations. To do this, we need some normative benchmarks to see whether the market provides an appropriate balance between the needs of consumers for adequate coverage and the need of investors who provide this protection to secure an appropriate return on their investment. We will separately look at the conditions governing the intersection of insurance demand and supply, and ask whether the market clears at an acceptable price.

9.1. Supply of Disaster Insurance

Investors will supply capital for insurers if they believe they can realize an expected rate of return that more than compensates them for their risk. In turn, the insurer will allocate capital to underwrite catastrophic risk if the addition of that business improves (or at least maintains) the risk-return properties of its existing portfolio. Another way of expressing this is that the additional capital needed to underwrite that cat risk must bring a return that at least compensates the insurer or reinsurer for the additional costs of risk-bearing that are imposed by the additional business.

Insurance supply is affected by the possibility of catastrophic losses due to the high correlation of risks within any confined region, thus imposing considerable tail risk. To deal with this problem, insurers writing policies where there is the likelihood of catastrophic risk will need to be highly capitalized to deal with these potentially large losses. This implies that the cost of capital is a very important factor in determining insurance supply. Alternatively, the insurer can economize on capital by reinsuring (or otherwise hedging) its catastrophe exposure through insurance-linked securities. In this case, the supply of insurance is largely conditioned by the price and availability of reinsurance and other alternative risk transfer instruments.

“Cycles” in Insurance

Insurance lore propounds that the insurance market is cyclical, with hard markets (capacity is scarce and prices are high) alternating with soft markets (capacity is abundant and prices are accordingly low). There is considerable research on the insurance cycle and it is clear that markets are indeed sometimes hard and sometimes soft. However, the notion of a “cycle”

implies there is some regularity and predictability in the turning of the market, and it is this regularity that is questionable.

The mainstream theory of the cycle is known as the “capacity constraint” model (see Gron, 1994 and Winter, 1988).²⁵³ The short-run insurance supply of each firm, and therefore of the market, is determined by the level of required capital. Short-run insurance supply is price elastic up to the point at which regulators, rating agencies and customers consider existing capital to be inadequate given the additional liabilities. This is known as the *capital constraint model*. To induce investors to provide more capital requires higher premiums. Moreover, the supply of additional capital takes time, as insurers, like most firms, prefer to accumulate capital internally rather than going to the capital market for new equity.²⁵⁴ This supply function is shown in Figure 9.1 along with an insurance demand function. The short-run equilibrium is shown as price, P^* and quantity, Q^* which is met within the internal capital supplied by the industry. The capacity constraint is shown as Q^C .

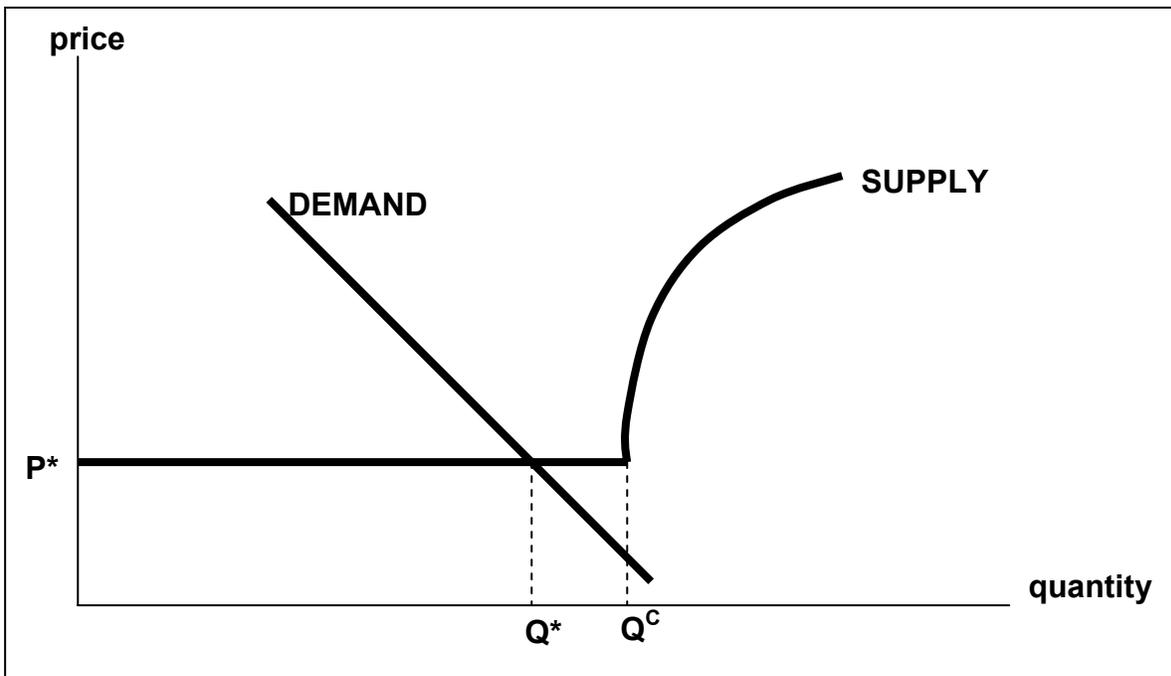


FIGURE 9.1. DEMAND WITH CAPITAL CONSTRAINED SUPPLY FUNCTION

²⁵³ Gron, A. (1994), “Capacity Constraints and Cycles in Property-Casualty Insurance Markets,” *Rand Journal of Economics*, 25: 110-27; Winter, R. (1988), “The Liability Insurance Crisis and the Dynamics of Competitive Insurance Markets,” *Yale Journal of Regulation*, 5: 455-499.

²⁵⁴ The so-called *pecking order* theory explains the preference for internal capital. In addition to the direct transaction costs of external capital, there are also agency costs which take the form of controls to prevent insiders diverting wealth to themselves. For more details see Myers, S. and N. Majluf (1984), “Corporate Investment and Financing Decisions When Firms Have Information That Investors Do Not Have,” *Journal of Financial Economics*, 13: 187-222.

The dynamics of the model are thrown into play when the industry suffers a capital shock, caused by either a sudden loss, such as Hurricane Katrina or the terrorist attacks of September 11, 2001, or by an asset loss such as what happened at the end of the bull market in 2000. This loss of capital shifts the insurance supply function upwards, as shown in Figure 9.2. Depending on the circumstances of the loss, the demand function also might shift to the right. For example, after major disasters, more people purchase insurance to make sure they are protected should such an event happen again.

The new equilibrium price and quantity are shown as P^{**} and Q^{**} in this diagram. Notice several things: The equilibrium price has increased considerably, thus illustrating the post-loss hard markets that are typically experienced after such capital shocks. Figure 9.2 also shows that the new output, Q^{**} exceeds the new capital constraint Q^C so supply can only be generated with a very large price increase to compensate the insurer for its deterioration in credit quality. Such pressure on credit quality was felt, for example, by all reinsurers in the early 2000s following the combination of the burst of the asset bubble (which affected mostly European insurers who tended to be more heavily invested in stocks) and the cost of insured losses due to the September 11, 2001 terrorist attacks. Thus, the post-loss hard market interestingly combines higher prices and pressure on credit quality.

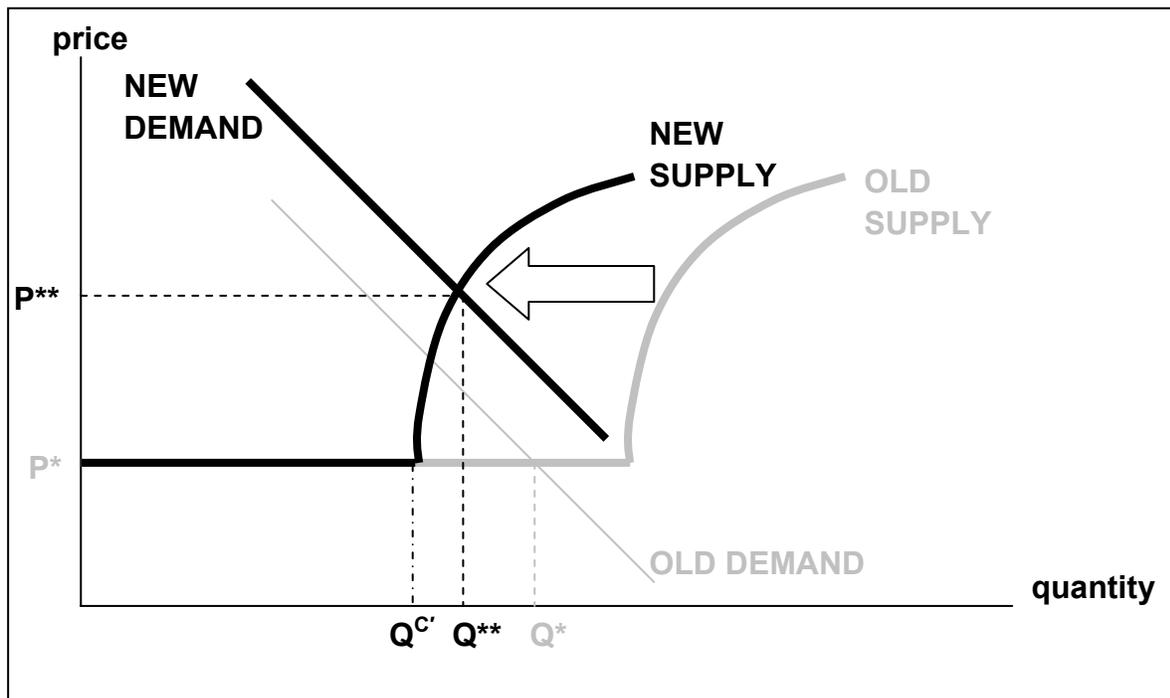


FIGURE 9.2. THE GRON-WINTER CAPITAL CONSTRAINT MODEL

The hard market typically does not last. Since internal capital is cheaper than external capital, insurers will prefer to replenish gradually through retained earnings because of the hard market. However, if the price increase is sufficient to overcome the additional costs of external capital, then new capital may indeed flow in. For example, while Hurricane Katrina alone accounted for over \$46 billion in insured losses, the new capital flow to the industry in the ten months that followed the catastrophe was estimated to be \$27 billion (as of June 30, 2006).²⁵⁵

The combination of retained earnings and new capital will begin to push the supply function outwards again as shown in Figure 9.3. Eventually, a new equilibrium is established with the market clearing at an output level within the limits of the replenished capital.

The capacity constraint model shows that the cycles of hard and soft markets (triggered by capital shocks) is a normal market mechanism for allocating scarce and varying capital. It does lead to the uncomfortable result that price and availability of insurance are adversely impacted by catastrophic losses: the markets will clear, though at a higher price. The market will self-correct in time with the inflow of new capital. Under this model, insurance is not rationed.

Further empirical evidence suggests that the disruption can be more severe. Prices usually rise after major losses and this alone (absent other effects such as an increase in the demand function) would tend to depress insurance purchases. However, insurers sometimes wish to ration coverage even at the higher prices. There may be several reasons for this. One is that insurers need to keep the geographical diversity of their portfolios in balance. If a catastrophic loss in one region leads to a re-estimate of risk, which shows an increase in local probability or severity, then insurers may need to reduce local capacity. This will be necessary to rebalance their spread of risk and thereby preserve their credit status. However, there is a compounding reason why coverage might be rationed after a loss. Insurers will be more willing to allocate capacity to states if they retain the flexibility to withdraw that capacity after a loss when their capital is highly depleted (Doherty and Posey, 1997).²⁵⁶ This model, for which there is empirical support, suggests that any attempt by regulators to retain capacity in a post-loss situation is likely to impede the future flow of capital into that state.

²⁵⁵ State Board of Administration of Florida (2006), "A Study of Private Capital Investment Options and Capital Formation Impacting Florida's Residential Insurance Market," September 19.

²⁵⁶ Doherty, N.A. and L.L. Posey (1997), "Availability Crises in Insurance Markets: Optimal Contracts with Asymmetric Information and Capacity Constraints," *Journal of Risk and Uncertainty*, 15: 55-80.

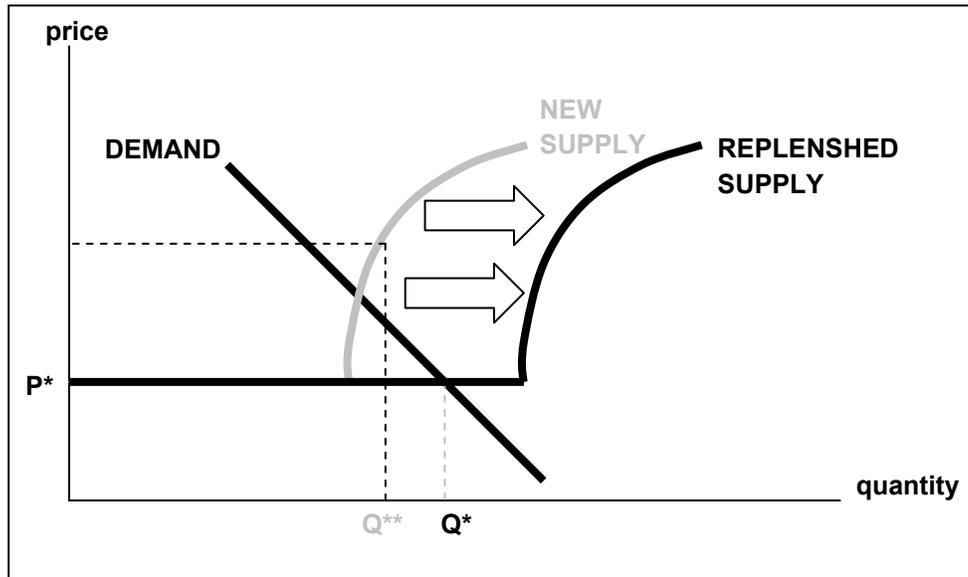


FIGURE 9.3. LONG-RUN EQUILIBRIUM WITH CAPITAL REPLENISHMENT

9.2. Demand for Disaster Insurance and Role of Deductibles

The demand for insurance stems from many factors including financial concerns and a latent aversion to risk, hence the desire to transfer risk to another party who can absorb that risk more effectively. The demand is also influenced by the consumer's knowledge and perception of the risk. In an ideal rational world where consumers were fully informed of the risk they face and maximized their expected utility, the risk was perfectly known, and where there were insurers who could bear that risk with no transaction costs, consumers would buy full insurance.

Consumers would avoid all the costly risk they would otherwise face, without imposing any real cost on insurers who could easily diversify that risk. In reality, consumers may be ill informed of their risk exposure – even insurers cannot model this risk with great accuracy – and the risk itself is not easily diversifiable, thereby requiring insurers to hold considerable costly capital to support the underwriting of catastrophe risk.

Just as it would be nice to offer all people unlimited and free medical care and education, it would be nice to also make available unlimited “free” risk transfer, that is, where the premium simply equals expected claim cost and no reward is given to the insurer for transferring risk. But of course, there is an opportunity cost and the best we can do is to allocate coverage (and health care and education) in a manner that balances the costs and benefits. In effect, this means that full coverage is not ideal. Rather, it is reasonable for policyholders to carry a deductible on their policy.

Paying for small losses doesn't usually stress people's budgets or increase their risk very much (since small losses are affordable and fairly frequent). Furthermore, deductibles can result in significant premium savings. First, they avoid the transaction costs of handling small claims (which would have to be built into the premium). Second, deductibles put some of the

policyholder’s “skin in the game” thus providing an incentive for loss mitigation and alleviating potential moral hazard problems. This reinforces the social objective of reducing overall exposure to catastrophes.

The benefit of insurance to the policyholder is more than the value of the expected losses transferred to the insurer; the benefit includes the removal of the uncertainty or risk surrounding the expected loss. In Figure 9.4 we show the benefit declines as the level of the deductible increases. With small deductibles there is little decline, because the small losses are frequent and predictable, and bearing such losses imposes little uncertainty on the policyholder. Increasing the deductible significantly reduces the benefit, because the policyholder now has a large stake in the low-frequency, high-consequence losses. In contrast, the premium may fall quite dramatically because the insurer avoids the transactional expenses of handling frequent small claims. A further reduction in premiums can arise because the policyholder now has a stake in the loss and will be more inclined to invest in protective measures such as installing storm shutters to reduce hurricane losses. The optimal deductible maximizes the difference between expected benefits and costs as illustrated in Figure 9.4.

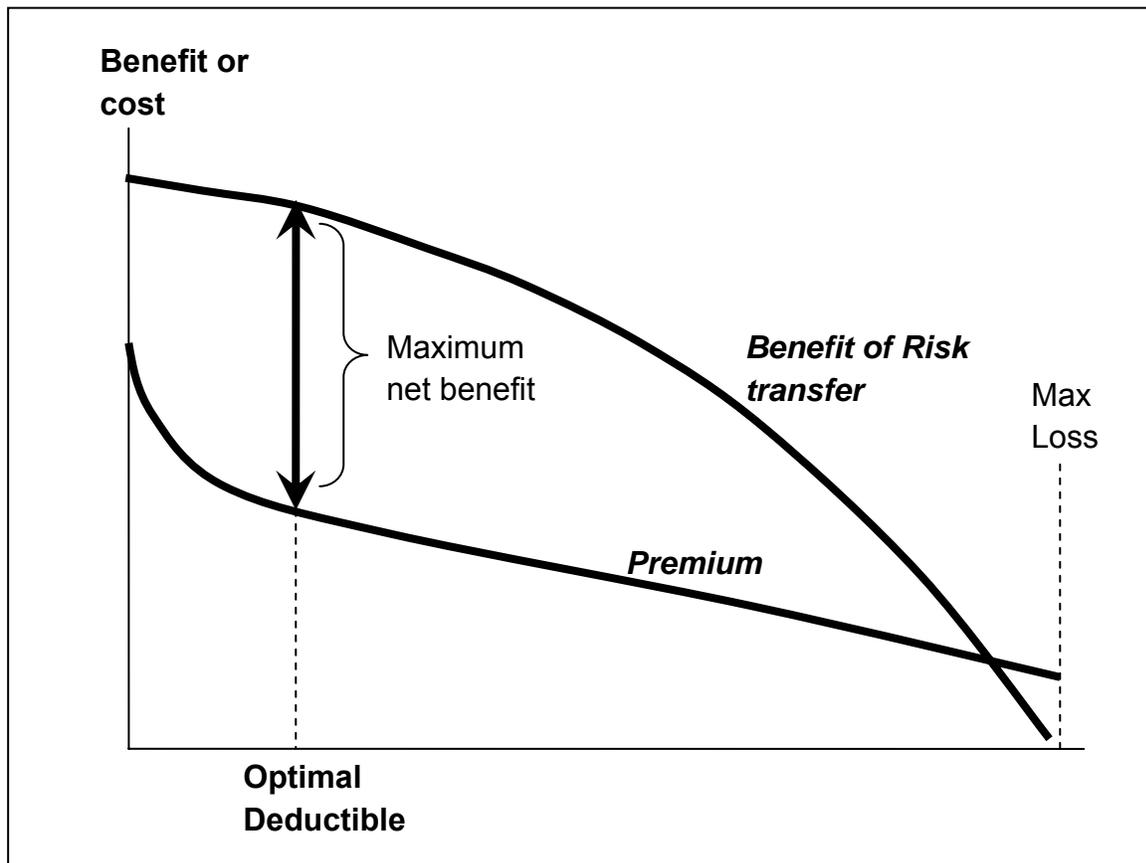


FIGURE 9.4. OPTIMAL DEDUCTIBLE WHEN INSURANCE HAS TRANSACTION COSTS

9.3. Market Clearing Prices and Quantities

Like other markets, the interaction of supply and demand should result in a price that will clear the market. The above considerations suggest that the clearing price for catastrophe insurance might be high relative to the expected losses. This does not reflect excess profits by insurers, but simply the high cost of capital associated with providing protection against possible catastrophic losses.

Impact of Regulation

One way in which regulation can impact insurance supply is through price regulation. Insofar as regulators are able to hold prices below their normal market clearing level, there will be excess demand (supply shortage) for insurance. The normal mechanism adopted by regulators to address this excess demand is to establish a residual market mechanism (see the discussion of Florida’s Citizens in Chapter 2). This can lead to a higher volume of insurance transacted at a lower price than for an unregulated market, as depicted in Figure 9.5.

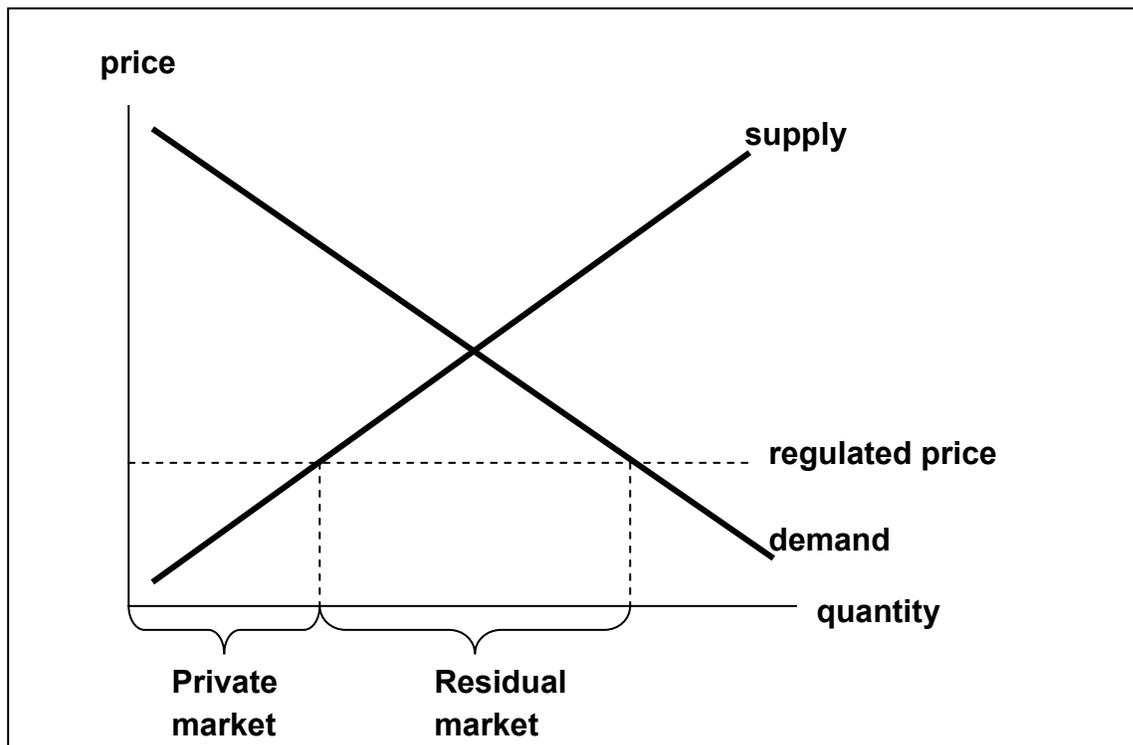


FIGURE 9.5. SUPPRESSING THE MARKET CLEARING PRICE WITH A RESIDUAL MARKET

Undiversifiable Catastrophe Risk and Policy Design

As we have shown above, basic economic theory holds that, when insurance encounters transaction costs (so that the competitive premium exceeds the expected loss), then it is desirable for a policyholder to retain some risk in the form of a deductible. In other words, individuals should really share in their own risk, absorbing the smaller losses which they can usually afford to pay, and thereby saving on expensive insurance premiums. We now make further supply side arguments as to why it is desirable for policyholders to share in their own losses.

It is the nature of catastrophes that risk is highly correlated among sections of the population. The same hurricane hits many property owners in the same coastal region, and the same earthquake damages houses of many thousands of people in that locale. The implication is that the insurer cannot diversify the risk by simply holding more policies in its portfolio. Certainly, insurers can and do reinsure, and reinsurance companies will hold geographically diversified portfolios. This helps spread the catastrophe risk widely through the market, but the diversification is not complete. Thus insurers can, and do, have sudden spikes in their profitability and sudden hits to their capital when large catastrophes occur.

For this reason, catastrophe insurance is not like automobile or life insurance, where pooling in the insurance market, in effect, makes the risk disappear.²⁵⁷ No matter how far catastrophe insurance risk is spread, there is some unavoidable residual risk cost that must be absorbed somewhere. If this were to be borne by investors, then insurers would charge a risk premium and policyholders would be better off economizing on their premiums by accepting a co-share in the risk, such as a deductible.

Alternatively, the remaining risk could be borne by the government. The government could be the last-resort reinsurer, or could provide *ex post* compensation to victims, as happened after Hurricane Katrina. But, of course, government aid ultimately comes from the taxpayers and firms who would end up bearing their own risk (or those of others) either through additional taxes or cuts in other programs.

This reasoning takes us to the basis of modern insurance theory, the Borch theorem.²⁵⁸ Insofar as risk is undiversifiable, then the optimal social arrangement is that individual risk is insured, but the undiversifiable component is shared amongst the population. Thus, each policyholder should retain a stake in the social risk. In practical terms this can be achieved in several ways:

- Deductibles could vary according to the size of the aggregate loss. With large losses such as those caused by Hurricane Katrina, the deductible would be very large, and conversely would be small when smaller catastrophes occurred.
- Policyholders could be reimbursed for their total losses, but pay an *ex post* assessment so that the industry could recover part of its capital. The practical problem with such assessments is that they may not be collectable, especially from victims with low income and/or those who suffer severe damage.
- Policyholders could pay higher initial premiums to contribute to the insurance pool's capital and be given an ownership stake in the insurance pool. In other words, insurance could be mutualized. Policyholders would then receive a dividend which would vary according to the overall results of the pool, so that when a large catastrophe occurred, the dividend would fall to zero (or perhaps be negative – an assessment).

²⁵⁷ Strictly, the average risk per policy converges to zero as the number of policies in the pool gets very large. Thus the average burden of risk in a large pool is close to zero.

²⁵⁸ Borch, K. (1962), "Equilibrium in a reinsurance market," *Econometrica*, 30(3): 424-444.

The policy task is to recognize that insurance does not provide full protection when applied to catastrophic risk and that we all have to bear the undiversified risk. What, then, is the most efficient way of distributing this lumpy risk over policyholders or over society more widely? There is no easy answer to this question but it provides a basis for understanding the importance of mitigation and the need for public-private partnerships for dealing with the risk. In the next chapter we will examine the current status of demand and supply of insurance by analyzing empirically the markets for homeowners insurance in four states, Florida, New York, South Carolina and Texas. Part III of this report looks at the role of mitigation, the insurance considerations involving low-income homeowners, and an analysis of alternative ways of providing protection to homeowners against catastrophic risk through private-public partnerships.

SUMMARY OF CHAPTER 9

The supply of catastrophe insurance is determined primarily by the capital that insurers can and wish to allocate to protect themselves against large losses, and by the availability of reinsurance and insurance-linked securities. In turn, reinsurance capacity is determined by the reinsurers' capital base. However, the underlying capital varies according to both claims experience and investment experience of insurers and reinsurers, thus causing the "cycle" in prices and insurance capacity. Hard markets (capacity is scarce and price is high) following major losses do arouse policy concerns, though these conditions are usually self-correcting over time with the inflow of new capital. The price of catastrophe insurance is usually high relative to expected claims primarily because of the high cost of capital needed to back this type of coverage. Requiring policyholders to take deductibles is an efficient way to ration expensive insurance capacity.

While we expect an unregulated market to clear with some risk-sharing in the form of deductibles and at prices that reflect claims and transaction costs, this equilibrium will be disturbed by regulation. Price suppression and the inability of insurers to base premiums on risk, affect insurance capacity, the incentive to mitigate risk, and the participation of different risk groups in the insurance market.

CHAPTER 10

DEMAND AND SUPPLY OF HOMEOWNERS INSURANCE: A MULTI-STATE ANALYSIS

KEY FINDINGS

ANALYSIS AT A COUNTY LEVEL

Demand is approximately unit elastic. We find the demand for insurance policies at the county level to be approximately unit *elastic* (i.e., a given percentage increase in price will result in a similar percentage decrease in demand). For example, our results indicate that a 10 percent increase in the average premium will result in an 8.9 percent decrease in the amount of insurance purchased. This level of sensitivity to price is not surprising as the home is a typical household's biggest asset and there is no other way to hedge fire or wind risks except through insurance.

In Florida, the cross elasticity between private insurance and insurance supplied by Citizens, the state's insurer of last resort, is 0.218. This implies that a 10 percent increase in the average market premium is associated with a 2.18 percent increase in the amount of insurance demanded from the private market. We also find that a ten percent reduction in the price of Citizens' product will yield a 1.54 percent decrease in the demand for private insurance. In other words, lower prices for Citizens' products will cause people to purchase less insurance from private companies.

Supply is very elastic. We find that the elasticity of supply at the county level is very high. The elasticity suggests that a 10 percent increase (decrease) in price that homeowners are willing to pay for coverage will yield a 27 percent increase (decrease) in the quantity of policies supplied by the insurers. This high supply elasticity has important implications for rate regulation. If rates are suppressed, then there is likely to be a severe availability problem due to a large decrease in the quantity of policies offered by private insurers.

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KEY FINDINGS, cont.**ANALYSIS AT A POSTAL ZONE LEVEL**

Insurance premiums are high in Florida, Texas and South Carolina, relative to New York. We find that for Florida and South Carolina the price of insurance is *high* relative to other states. The median policy premium for our sample companies is \$6,160 for Florida, and approximately \$5,000 for South Carolina. In contrast, the average premium in Texas is \$2,375, and \$760 in New York. In terms of premiums per thousand of dollars of coverage we found that Florida had the highest at \$8.13, followed by Texas at 7.89, and South Carolina (\$5.14) and New York (\$3.94). Florida faces the highest risk of hurricane losses, so it is not surprising that it has the highest median premium. South Carolina faces a lower but still significant level of hurricane risk. New York faces the lowest hurricane risk among the four states. Hence, the pattern we see in median premiums among these three states is consistent with what we would expect. We should note that our data for this analysis is for the period 2001-2005. Based on updated risk analysis following the 2004-2005 storm seasons, insurers increased their rates.

Demand is unstable in Florida. In Florida, estimates of price and income elasticity of demand are unstable over the period 2001-2005. The price elasticity ranged between 0.06 and 0.50. This could be due to shifting consumer perceptions of risk and the importance they placed on having adequate insurance coverage, among other factors. For the same four year period, the results in South Carolina and New York are more stable. In South Carolina the price elasticity was between 1 and 1.5, implying a 10 percent increase in price yields a 10 percent decrease in quantity demanded. In New York, the price elasticity was approximately 0.60, suggesting that a 10 percent increase in price causes a 6.0 percent decrease in quantity demanded.

Many people choose low deductibles for their homeowners policy. A large percentage of the policies from our sample have relatively low deductibles. In Florida, over 50 percent of the homeowners have wind deductibles of \$500 while the average wind deductible was \$1,565. The difference between the median and mean wind deductible suggests some homeowners chose much higher deductibles. We would expect this to be especially true in the highest-risk coastal areas where the premium savings from choosing higher deductibles will be the greatest. Furthermore, we expect that median and mean deductible levels have risen since 2005. In South Carolina, with an average wind deductible of \$531, over 50 percent of the policyholders have \$500 or less in wind deductibles. Finally, for New York, the average wind deductible is \$508, but 75 percent of homeowners have a wind deductible of \$500 or less.

CHAPTER 10

DEMAND AND SUPPLY OF HOMEOWNERS INSURANCE: A MULTI-STATE ANALYSIS

10.1. Developing a Model of the Demand and Supply of Insurance²⁵⁹

The basic demand problem for the homeowner is to select the best insurance policy from among the menu of policies offered in the market. Demand arises from the optimal consumer choice of a bundle of product and company attributes, given the personal characteristics of each homeowner and the economic and demographic characteristics of the neighborhood (i.e., postal zone) where he or she resides. The theoretical foundation for this demand analysis and the interacting market equilibrium are based on a model of price-quality competition (Gal-or, 1983).²⁶⁰ In a perfectly competitive market, the differences in what homeowners are willing to pay for various features will be reflected in the price at which various bundled products with these features sell.

Thus, in our analysis of the demand for and supply of property insurance in hurricane-prone areas, we model a regression of observed price in the market against various features of the products sold and the companies that sell them. We are interested in the factors that seem to influence demand. We determine whether these factors appear reasonable on the basis of theory and, if so, we quantify the effect of each of these factors. Since there is considerable evidence that many homeowners do not search thoroughly for “best offers,” we are also interested in aspects of the market that appear to arise from behavioral considerations (Kunreuther, 1998)²⁶¹ including the price dispersion of similar policies offered in the same geographic area or “rating territory.”²⁶²

We rely on the following features of the homeowners insurance market in modeling the supply and demand for insurance. While the structure of this market may be workably competitive, it is nonetheless a regulated market (Klein, 1998; Klein, 2007).²⁶³ On the demand side, this does not cause any theoretical difficulties as the model we develop only attempts to explain, for policies actually offered in the market, how various features are valued. We examine

²⁵⁹ Portions of this section came from Grace, M.F., R.W. Klein, P.R. Kleindorfer and M. Murray (2004), *Catastrophe Insurance: Supply, Demand and Regulation*, Boston: Kluwer Academic Publishers.

²⁶⁰ Gal-or, E. (1983), “Quality and Quantity Competition,” *Bell Journal of Economics*, 14: 590-600.

²⁶¹ Kunreuther, H. (1998), “The Role of Insurance in Dealing with Catastrophe Risks from Natural Disasters,” in *Alternative Approaches to Insurance Regulation*, R.W. Klein (ed.), Kansas City: National Association of Insurance Commissioners.

²⁶² We should note that one source of price dispersion is the fact that insurance companies differentiate themselves in term of underwriting stringency. Insurers with more stringent underwriting standards, labeled “preferred insurers,” tend to have the lowest prices. “Standard” and “non-standard” companies tend to have higher prices. Some insureds may pay higher than necessary prices if they would qualify for coverage from a preferred insurer, but intentionally or inadvertently purchase coverage from a standard or non-standard insurer.

²⁶³ Klein, R.W. (1998), “Regulating Catastrophe Insurance: Issues and Options,” in *Earthquake Insurance: Public Policy Perspectives from the Western United States Earthquake Insurance Summit*, Western States Seismic Policy Council, pp. 105-124; Klein, R.W. (2007), “Catastrophe Risk and the Regulation of Property Insurance,” Working Paper, Georgia State University, September.

“within-feature” changes (e.g., various deductible levels) and “across-features” tradeoffs (e.g., deductible levels versus type of coverage). It is important to bear in mind that, because of regulation, the set of policies offered in the market, and their prices in particular, are not the result of a perfectly competitive market. In other words, the prices, products and other aspects of insurance transactions are subject to certain regulatory constraints and mandates.

The basic supply decision of the insurer is guided by its expectation that a commitment of capital will yield an adequate rate of return. In turn, this requires that the insurer be able to underwrite a portfolio with an adequate spread of risk (and/or that it have access to adequate reinsurance) and that the insurer can price its policies to cover the expected costs of claims with some margin for risk and its cost of capital. In most states, the insurer is not operating in an entirely free market, though the effect and form of regulation varies between states (see Chapter 2 on insurance regulation). In designing its policies and coverage decisions, we assume that an insurer seeks to maximize expected profits, subject to regulatory constraints. This implies that insurance companies find the imposed regulatory constraints are not so onerous as to cause them to leave the state. Nonetheless, because of such constraints, catastrophe coverage in some areas might require cross subsidies from other lines of business such as non-catastrophe coverage and catastrophe coverage in low-risk areas.

These cross subsidies may be sustainable if they allow insurance companies to earn an acceptable rate of return on all lines of business. At the same time, we must recognize that there are limits to the magnitude of the cross subsidies that can be sustained in a private, competitive market when consumers can choose among multiple insurers. The continuation of these cross subsidies over time implies further inertia by insurers (and insureds) that may, at least in part, be due to regulatory restrictions on terminating policies and other insurer and consumer considerations.²⁶⁴ Beyond the obvious implications for understanding rate adequacy and precision, this suggests the importance of detecting cross-marketing synergies in the demand and supply analysis, as well as detecting trends in the aggregate supply of particular insurers in terms of increasing the diversification of their portfolios of insurance policies.

10.2. Study 1: County Level Supply and Demand Analysis

We have obtained a dataset at a county level from the Florida Office of Insurance Regulation (FLOIR) which represents the entire homeowners insurance market for the state of Florida in 2006 (both private insurers and the state-run company, Citizens). From this dataset we have information concerning the policies-in-force and the average premium on a company basis for each county. This allows us to estimate both a supply and demand function for Florida. An important caveat is that the aggregation level of the data is at the county level, which may not provide enough variation to test all hypotheses. However, it does provide us a glimpse at the Florida homeowners market which has not previously been seen. The advantage of this analysis, compared with our postal zone level analysis discussed later, is that it reflects all insurers writing homeowners insurance in Florida. Our postal zone level data analysis uses more detailed information but it is confined to a select number of major writers of homeowners

²⁶⁴ See Bartlet, D., R.W. Klein and D. Russell (1999), "Attempts to Socialize Costs in Voluntary Insurance Markets: The Historical Record," *Journal of Insurance Regulation*, 17: 478-511 for a discussion of how regulation-imposed insurance price subsidies may be sustained for a period of time.

insurance in Florida. Hence, we conducted analyses using both datasets to obtain the best insights possible with respect to demand and supply conditions.

In addition to the data provided by the FLOIR, we used three other sources of data. From the 2000 U.S. Census Bureau, we obtained information about the Florida counties' demographics as well as housing characteristics. From the National Association of Insurance Commissioners (NAIC) financial database (based on insurers' regulatory annual financial statements), we obtained information for each company writing in Florida. And from A.M. Best, a nationally known insurance rating agency, we were able to obtain some information about most insurers operating in Florida

We employ the two-stage least squares methodology to estimate a demand and a supply function for Florida at the county level. Table 10.1 provides a description of the variables that we use in the analysis. We break our data into six categories for the demand analysis (prices, income, housing characteristics, location characteristics, insurance company characteristics and other factors).

For the supply analysis we break the variables into four groups (price of insurance, reinsurance, insurer characteristics, and government). These categories correspond roughly to elements of the demand equations we estimate.

One of the major problems with undertaking an analysis of demand or supply in the insurance sector is that defining the quantity demanded (or supplied) is difficult.²⁶⁵ Similarly, constructing a theoretically justified proper definition of price of insurance is also difficult. In this portion of the report we will use policies-in-force as our measure of quantity (Q). This is obtained from the Florida Office of Insurance Regulation's county level Quarterly Supplementary Report (*Quasar*) 2006 data. Each company reports the number of policies-in-force in each county as well as the total premiums written. For price, we use the average premium (which is the Total Company Premiums in a county/Company Policies-in-Force in the county).

²⁶⁵ For a further discussion of this point see Grace, M.F., R.W. Klein, and P.R. Kleindorfer (GKK) (2004), "Homeowners Insurance with Bundled Catastrophe Coverage," *Journal of Risk and Insurance*, 71(3): 351-379.

TABLE 10.1. DESCRIPTIVE STATISTICS OF VARIABLES EMPLOYED IN SUPPLY AND DEMAND ANALYSIS

Variable	Mean	Std. Dev.	Min	Max
Insurer Characteristics				
A.M. Best Rating of A	0.168	0.374	0.000	1.000
A.M. Best Rating of A-	0.155	0.362	0.000	1.000
A.M. Best Rating of B+,B,B-	0.161	0.367	0.000	1.000
A.M. Best Rating of C+,C, C- and NR	0.258	0.438	0.000	1.000
Age of Company in Years	37.415	42.335	0.000	196.000
Independent Agency Marketing System	0.552	0.497	0.000	1.000
Reinsurance Assumed (Premiums Assumed to DPW)	0.645	2.324	0.000	18.730
Reinsurance Ceded (Premiums Ceded to DPW)	0.911	1.449	0.000	12.311
A.M. Best Rating Downgrade 2005	0.869	0.338	0.000	1.000
Florida Domiciled Company	0.409	0.492	0.000	1.000
Florida Domiciled Company part of a Group	0.252	0.434	0.000	1.000
Member of a Group	0.808	0.394	0.000	1.000
HHI Index of Concentration at County Level	0.000	0.004	0.000	0.298
Publicly Traded Company	0.057	0.231	0.000	1.000
Stock Company	0.904	0.295	0.000	1.000
South Florida Indicator for Wind Risk	0.099	0.299	0.000	1.000
Housing Characteristics & Location Characteristics				
Number Of Homes (1-4) Units	86221.850	111065.900	0.000	503864.000
Median Age of Home In County	1982.024	3.614	0.000	1989.000
Median Value of Occupied Home	97141.480	29274.840	0.000	241200.100
Population Density	346.120	524.618	0.000	3291.000
Indicator for Coastal County	0.572	0.495	0.000	1.000
Overall Liquidity Ratio (%)	234.535	226.444	0.000	999.900
Percent HH in Urban Areas	0.649	0.317	0.000	0.999
Percentage of Housing Units with Mortgage	0.641	0.101	0.000	0.829
Percent Of County Covered By Water	0.153	0.125	0.000	0.733
Price and Income				
Average Premium for Company In County	1667.848	1806.238	0.000	37876.820
Policies-in-Force	615.744	2623.090	0.000	61688.000
Median Income 2004	38351.680	6728.835	0.000	55712.000
N = 5277 (except for Liquidity Ratio where N=5089)				

Demand Equation Estimation

The demand model is a two stage model. The first stage is a price regression to determine those variables which affect price.²⁶⁶ The second stage estimates a quantity demand for company i in county c ($Q_{i,c}^d$) using the estimate of price from the first stage regression along with other explanatory variables as shown in equation 10.1:

$$Q_{i,c}^d = f(\text{prices, income, housing characteristics, company characteristics, other}) + e \quad (10.1)$$

For prices, we include the firm's own premium, the average premium of a Citizens' policy in the county, and the average premium of all policies (excluding Citizens) in the county. These are the three prices which influence the demand for homeowners insurance. It should be pointed out here, that these are the actual premiums charged by the insurer and, as such, they do not provide the best measure of the cost of transferring risk because we do not have explicit levels of loss costs. In addition to expected losses, premiums also account for loss control services, expected claims payment costs, as well as marketing and other expenses. In contrast, in the contract level demand analysis undertaken later in this chapter we measure price as the premium loading which measures the markup above the expected loss. We discuss this further below, pointing out why the price markup is a more accurate representation of price. However, for this first analysis, the best available data is based upon the actual premiums in the market.

As shown in Table 10.1 we obtained information from the U.S. Census Bureau on county-wide median income and information on housing characteristics, such as the number of units eligible for homeowners' coverage in the county (one or more single or attached homes with four or fewer units), the percent of households in urban areas, the median value of an occupied home, the percentage of household units with a mortgage, the number of building permits in the county, and the median age of an owner-occupied home in the county.

We also obtained firm-specific information about the insurer. For example, as shown in Table 10.1 we use an indicator for whether the insurer uses an independent agency marketing system. Agents provide consumers with information as well as loss adjustment services. Finally, we also have indicators for whether the insurer is a stock or mutual company or is a member of a group. A stock company is owned by shareholders who are not necessarily policyholders while a mutual company is owned exclusively by the policyholders. It is likely that a mutual company may have different ties to the consumer and thus we use the stock/mutual variable to control for this relationship. In addition, many of the insurers in Florida sell only homeowners coverage. If the insurer is a member of a group of affiliated insurance companies, it is more likely that the insurer can cross-market life and other non-life types of policies (such as auto or boat owner). There could be other relevant differences between "stand-alone" companies versus companies belonging to groups, such as potential access to group capital infusions in the event of heavy losses (i.e., broader pooling of risk and geographic and product diversification).²⁶⁷

²⁶⁶ In our first stage regression which we use for both the supply and demand equation, we include the following additional instrumental variables: log of capital and surplus, indicator for coastal county, change in population, percent area of the county covered by water.

²⁶⁷ Group operations would not be expected to subsidize business in a specific state, but group capital and diversification could help insurers deal with the random element of the risks they underwrite.

Because prices are endogenous, we estimate the demand equation using the two-stage approach described above. Our first stage regressions (not shown) provide evidence of reasonable explanatory power so that we can use these predicted prices in the second stage with some degree of confidence that we are estimating a demand equation.

Demand – Discussion of Results

Table 10.2 provides the results of our estimation. The second column of the table titled “Coefficient” will be the main focus of our analysis. This coefficient is an estimate of the elasticity between the quantity demanded and the variable of interest.²⁶⁸ *The elasticity is defined as how a percentage change in the variable under discussion is related to a percentage change in the quantity demand for insurance.* For example, the elasticity with respect to the average premium for the insurer in the county is -0.893. This means that a 10 percent increase in the average company premium will yield a reduction in the number of policies sold for that company of 8.93 percent ($10 \cdot 0.893$), implying that demand is elastic. A relatively low number implies insensitivity to price changes, and demand would then be classified as inelastic. In addition to examining the effect of the individual company’s price (the so-called *own price elasticity*), we can also look at how other prices influence the demand for the insurers’ products. We can examine the cross-price elasticity, that is, the sensitivity between a competitor’s price and the firm’s quantity demanded. In particular, it would be interesting to know how the price of a Citizens’ contract, measured by the average premium for a Citizens’ contract in the county, affects private insurers’ quantity demanded. The cross-price elasticity here is 0.159. This implies that a 10 percent increase in Citizens’ premium is associated with a 1.59 percent increase in the quantity demanded by the private market company. The reverse is also true. A Citizens’ price reduction will reduce the quantity demanded in the private market. This is especially important today, as Citizens is allowed to compete with private market companies. Prior to 2007, Citizens was required to set prices in a manner which wouldn’t undercut the private market. As discussed in Chapter 2 and elsewhere, the more risk underwritten by Citizens (i.e., the state) the greater is the risk that may ultimately be transferred to other insurance buyers (and even taxpayers) across the state.

Finally, we see that the average premium in the county for private market insurers is also positively (but not significantly) related to the quantity demanded. This is consistent with the fact that competitors’ policies are substitutes to the insurer’s own products. While the elasticity is not significant, it is close to standard levels of statistical significance (i.e. 10 percent) and is consistent with economic theory.

²⁶⁸ The elasticity is a result of the fact that we employ a logarithmic transformation to variables on both sides of the regression estimation equation.

**TABLE 10.2. TWO STAGE LEAST SQUARES DEMAND EQUATION AT COUNTY LEVEL
DEPENDENT VARIABLE IS POLICIES-IN-FORCE BY COMPANY IN COUNTY**

Variable	Coefficient	Std. Err.	T-stat	Prob > 0
Intercept	-1.522	3.078	-0.490	0.623
Prices				
* Log of Average Premiums	-0.893	0.145	-6.150	0.000
* Log of Average Premium in County	0.226	0.137	1.650	0.104
* Log of Citizens Avg. Premium	0.159	0.085	1.860	0.067
Income				
Log of Median Income	0.025	0.461	0.050	0.958
Housing Characteristics				
Log of the Number of Housing Units (1-4)	0.850	0.065	13.160	0.000
Percent HH in Urban Areas	-0.139	0.204	-0.680	0.499
Percentage of Housing Units with Mortgage	0.188	0.258	0.730	0.467
Log of the Number of Building Permits	0.028	0.044	0.640	0.526
Log of Median Home Value In County	0.272	0.300	0.910	0.368
Log of the Age of Median Home	-0.895	0.310	-2.890	0.005
Company Characteristics				
Independent Agency Marketing System	-0.434	0.047	-9.280	0.000
Stock Company	0.151	0.055	2.740	0.008
Member of a Group	-0.145	0.064	-2.260	0.027

N=5121

R²=.245

Note: Robust standard errors reported.

* endogenous variable

More generally, Table 10.2 reveals that the demand for insurance (based on policies-in-force) is relatively insensitive to the price of insurance. The income elasticity is not significant, indicating that the quantity of insurance purchased is insensitive to homeowners' earnings. This compares with the findings of Grace, Klein and Kleindorfer (GKK) (2004) where there was a slightly positive income elasticity for Florida homeowners insurance, though they employed a different definition of price and quantity than the ones used here.²⁶⁹ Further, there may not be enough variation in income across the counties to provide a strong enough statistical test of differences.

²⁶⁹ In GKK (2004), Op. Cit. the researchers used the price mark-up as a measure of price rather than average premiums.

In terms of housing characteristics, we see that two variables are significant. First, the number of eligible residences (single and attached houses up to four units)²⁷⁰ is significantly related to the policies-in-force, as is the median age of a home within the county. A 10 percent increase in the number of eligible homes in a county leads to an 8.5 percent increase in the demand for policies. Similarly, a 10 percent increase in the age of the housing stock in a county yields a decrease in the demand for insurance by approximately 8.95 percent. While one might expect that there should be a relationship between quantity demanded and housing value, we do not find significant relationships for the median value of the home.²⁷¹

Company characteristics are also related to the demand for insurance. Insurers using agents, companies which are members of a group, or which have a specific organization form (stock or mutual), may also influence consumers preferences as to whom they choose to purchase homeowners insurance from. Agents, which are traditionally thought of as information providers, have a negative influence on demand, all other things equal. Since we are examining the decision as to whether to purchase a policy (and not the details of all the optional contract terms), the agent does not appear to create additional demand for coverage. In fact, the presence of a company's independent agency marketing system is associated with lower demand for the company's products, all other things held constant. This result is a bit puzzling but there are some possible explanations. One possible explanation is that insurers identified as exclusive agency insurers or direct writers may have a stronger brand reputation because of their extensive advertising efforts and this may cause consumers to have a higher demand for their products.

The firm's organizational form also appears to influence demand. One might hypothesize that policyholders who are also owners of a company (as in the case of a mutual) may have a different relationship with a company than policyholders who are merely customers. We see that stock companies have higher demand for their products, all other things held constant. Finally, one might buy from a company who is a member of a group. Groups are often able to offer more types of coverage because of the broader reach of the expertise within the overall company. Thus, a company may be able to offer life as well as non-life coverage. In Florida, many of the companies writing homeowners policies specialize in one line of business. Thus, there might be a benefit in terms of greater opportunities for selling across lines of business if a firm is a member of a group. In fact, we see group membership is negatively associated with demand, suggesting that the consumers do not value these potential cross opportunities when purchasing homeowners insurance.²⁷²

²⁷⁰ Only owner-occupied single- or multi-unit residential structures are eligible for homeowners insurance, with the limit on multi-unit structures usually set at 4-5 units. Dwellings that are not owner-occupied or structures that have more than 4-5 units would be typically covered under a commercial property insurance policy.

²⁷¹ Two reasons exist why one might not see a relationship with this data. First, there may be multicollinearity between housing value and income—this implies that multiple variables are essentially explaining the same thing (i.e., people with higher incomes tend to live in more valuable houses). We checked using a number of techniques and found that the resulting estimates were similar to those presented in Table 10.2. In addition, our definition of quantity is a policy. The purchase of a policy by itself is less likely to be influenced by the value of a home. Our data at the county level do not allow us to examine the type of policy purchased. For example, certain policies contain more options which may be valuable to people with higher-valued homes and too expensive for people with lower-valued homes.

²⁷² Some qualification of this statement is warranted. Many personal lines insurers offer both home and auto insurance and offer a discount if a consumer buys both products from them. This suggests that there are at least economies of scope for insurers if not for consumers. However, economies of scope or consumer benefits may not exist for the cross-selling of insurance products other than auto and home insurance.

Supply Estimation

We now turn to the estimation of a supply function in a manner similar to the demand function. Again, we employ a two stage approach where the first state is the same as in the demand analysis. Our quantity supplied is the number of policies-in-force and the price is the average premium for policies written by company i in a county c . Again, our underlying first stage results, while not as powerful as those in the first stage demand equations, provide the proper signs for our supply function.

$$Q_{i,c}^s = f(\text{Prices, Reinsurance, Risk, Company Cost Characteristics, Government}) + v \quad (10.2)$$

Discussion of Results

Table 10.3 details the results of the two stage least squares regression. The first variable of interest is the price variable. The average premium's coefficient, which reflects the price elasticity, is positive and is 2.754. The elasticity suggests that a 10 percent increase (decrease) in price will yield a 27 percent increase (decrease) in the number of policies supplied. This price elasticity has an important implication for rate regulation. If rates are suppressed, then the high price elasticity implies that there would be a severe availability issue due to the large decrease of policies supplied by private insurers. If rates were most suppressed in high-risk areas, then availability would be especially severe in these regions of the state. We do see significantly higher proportions of policies written by Citizens in high-risk areas, but we cannot measure how much of this is due to rate suppression/compression *per se*, versus other factors. The supply elasticity result also suggests that if Florida reversed its policies which cause insurers to exit the state completely or to refrain from selling in high-risk areas of the state, it would likely spur entry and marketing of coverage in these regions.

We also control for the reinsurance profile of the insurer. We calculated the ratio of ceded premiums to direct premiums written, as well as a ratio of assumed to direct premiums. If an insurer reinsures a greater proportion of its risks, then it will have a high ratio of ceded premiums to direct premiums. If an insurer assumes reinsurance, then it is taking on risks. We find that firms which cede premiums to a reinsurer are more likely to increase their supply of policies in Florida and that firms which assume risks from others are less likely to supply insurance. This is consistent with our expectations, as insurers can increase their capacity by ceding certain risk to others. In fact, our results suggest a 10 percent increase in the ratio of ceded premiums to direct premiums written yields just under a 1 percent increase in the quantity of policies sold. In contrast, a 10 percent increase in the ratio of assumed to total premiums reduces supply by 1.85 percent ("assumed premiums" refer to reinsurance premiums received by an insurer for assuming a portion of the risk/premiums ceded to it by another insurer).

**TABLE 10.3. TWO STAGE LEAST SQUARES ESTIMATION OF SUPPLY FUNCTION
DEPENDENT VARIABLE IS POLICIES-IN-FORCE BY COMPANY IN COUNTY**

	Coefficient	Std. Err.	T-stat	Prob > 0
Intercept	-14.645	5.881	-2.490	0.015
Price				
Log of Average Premiums	2.754	0.903	3.050	0.003
Reinsurance				
Log of Ratio of Premiums Ceded to Total Premiums	0.097	0.032	3.000	0.004
Log of Ratio of Assumed Premiums to Total Premiums	-0.185	0.061	-3.030	0.003
Risk				
Indicator for Coastal County	0.081	0.448	0.180	0.858
South Florida Indicator for Wind Risk	-0.641	0.589	-1.090	0.280
Company Characteristics				
Stock Company	-1.837	0.218	-8.410	0.000
Publically Traded Company	-0.662	0.176	-3.770	0.000
Member of a Group	1.161	0.319	3.640	0.001
Florida Domiciled Company	1.561	0.427	3.650	0.001
Florida Domiciled Company Part of a Group	-0.379	0.435	-0.870	0.387
Independent Agency Marketing System	-0.906	0.093	-9.760	0.000
A.M. Best Rating of A	0.183	0.149	1.230	0.223
A.M. Best Rating of A-	0.642	0.216	2.970	0.004
A.M. Best Rating of B+,B,B-	0.977	0.079	12.370	0.000
A.M. Best Rating of C+,C, C- and NR	-0.489	0.127	-3.850	0.000
A.M. Best Rating Down Grade 2005	-0.018	0.072	-0.250	0.800
Overall Liquidity Ratio (%)	-0.0005	0.000	-3.090	0.003
Government				
Log of Citizens Market Share	-0.068	0.130	-0.520	0.605

N = 5,089

R² = .26

We also make a crude attempt to control for location as it relates to the wind risk associated with hurricanes by employing the coastal county indicator and a south Florida indicator, but neither is significant. This lack of significance is likely due to the high level of aggregation of the data so that one cannot easily distinguish high-hazard areas from other parts of the county.

Our regression estimation also included a number of company indicators which may affect the costs of doing business for the firm. The first significant variable is an indicator for whether the firm is publicly traded. It is statistically significant and negative. There is an argument that shareholders of publicly-traded companies are not willing to risk their capital in a market like Florida if they can earn a higher, and perhaps more secure, return in other parts of the insurance industry or in other business. This hypothesis suggests a negative sign on this coefficient and is what we observe.

A company that is a member of a group is statistically more likely to have a higher level of supply than a company outside of a group. As a member of a group, a company may access lower-cost internal capital to increase supply. A company that is not a member of a group may have a harder time raising capital, as it must either raise prices or seek additional capital from the market. This is also consistent with what we observe in Table 10.3.

According to our regression results, companies *domiciled* in Florida (both members of a group and single companies) are also more likely to supply insurance. This is likely due to the recent growth in the number of Florida domestic start-ups, as well as increased wind risk, which caused national companies to readjust downward their homeowners insurance portfolios. Furthermore, the state encouraged Florida companies to enter the market and to take policies from the Florida Hurricane Catastrophe Fund (FHCF) which is the state backed entity of last resort. Many national companies have established Florida subsidiaries as a risk management strategy. In the event of the “big one,” a company with a Florida subsidiary could have the option of recapitalizing the Florida subsidiary, thus avoiding a mandatory and immediate charge to its equity.²⁷³ We find that this does not seem to have a significant effect on supply, but it does provide value to the holding company by protecting it from a forced recapitalization. Independent agency distribution systems are more costly than exclusive agent or direct operations.²⁷⁴ The regression analysis indicates that companies with independent agency systems have a lower quantity supplied, all other things equal.

In terms of A.M. Best ratings, we see that relative to A++ and A+ rated companies (which is the omitted variable), firms in the A- and B range have higher supply of policies than all other rating categories. This is consistent with the principal-agent theory which posits that shareholders (the agents, in this case) of a higher-risk firm are more willing to increase supply because more of the downside risk of default is borne by existing policyholders (the principals, in this case).²⁷⁵ For this strategy to succeed, the price of new policies should be insensitive to default risk. Thus, one might conclude that new policyholders are relatively unconcerned, or unaware, of the difference between A and B ratings. However, when the rating is in the C categories, supply is reduced relative to the A+ and A++ rated companies. This suggests that insurers anticipate that policyholders would not tolerate such a low rating and simply reduce

²⁷³ It is ironic that the regulators view this as a way of undercapitalizing their Florida subsidiaries and the state has prohibited new formation of these state specific companies. This is likely because the state regulators desire to use the surplus of the entire company (rather than just the subsidiary) in pricing homeowners insurance in the state of Florida.

²⁷⁴ The agents selling insurance for an “exclusive agent” insurer sell insurance for only that insurer. Independent agents typically represent or sell insurance for multiple insurers. Direct writers use company personnel to distribute insurance and make greater use of mail, telephone and Internet devices for interacting with consumers and policyholders.

²⁷⁵ Owners of a failed insurer lose the value of their equity holdings in the company. However, their personal assets are not at risk to cover any deficits (i.e., negative surplus) of the failed company. Hence, owners of incorporated or limited liability insurers can gain the upside of any “bets” on the market, but they do not pay the full cost of the downsides of such bets. Also, owners can extract value from insurers they own through dividends or other means which reduces the amount of equity bound in the company should it fail. This strategy can be particularly attractive in underwriting property insurance in catastrophe-prone areas because profits can be relatively high in storm-free years which have tended to more frequent than years in which hurricanes have caused heavy losses.

their market participation. Finally, we see that recent ratings downgrades do not have an effect on the supply of insurance.

We also examine the impact of the A.M. Best liquidity ratio on supply. This is the ratio of total assets to total liabilities. Essentially, it is the inverse of a leverage ratio. Supply capacity is related to the total assets brought to financially back risks in the market. One could believe that highly liquid firms have sufficient cash to support increased supply. Alternatively, one could envision that the managers (acting on behalf of the shareholders) and the policyholders may have different interests. As the managers have little downside risk due to the possibility of bankruptcy, they can reduce liquidity (become more levered) to take bigger risks. Essentially, the managers acting on behalf of the shareholders increase the probability of default at the expense of the policyholders.

One can view our results in two ways. First, higher levels of firm liquidity are associated with lower insurance supply in Florida. Alternatively, a higher level of leverage is associated with a higher level of supply. Thus, firms with “excess” liquidity will not invest in Florida. This result is consistent with the principal-agent theory whereby higher-risk insurers are willing to exploit their default potential at the expense of the policyholders by increasing supply. Again, the success of this strategy relies on the insensitivity of premium rates to the enhanced leverage risk. Normally, firms will try to raise prices if risk increases. However, if prices are fixed, then increased leverage increases the risk of the insurer.

The preceding results on credit rating and leverage are largely consistent with a principal-agent story. Alternatively, these results can be explained, or enhanced, by regulatory factors. First, the failure of prices to change for high-risk insurers might be due to regulatory price controls in which suppressed rates offer no flexibility for premiums to vary with credit quality. Second, the regulatory environment may have encouraged or otherwise facilitated the presence of lower-risk insurers.²⁷⁶ Whatever the reason, these low ratings imply significant pressure on the companies’ ability to pay claims in the event of a severe hurricane.²⁷⁷

The final variable in the supply equation is the presence of Citizens Property Insurance Company in the marketplace. The coefficient on Citizens’ market share is insignificant, suggesting that Citizens is not having a significant effect on the market. In 2006, Citizens was not allowed to compete directly with private market companies. It was not until 2007 that Florida allowed Citizens to price its premiums at levels competitive with (or lower than) the private market participants.

²⁷⁶ In 2006, companies rated the B range represented 49 percent of the policies written, while companies with any type of A rating had approximately 26 percent of the market. This leaves the C and not rated companies with approximately 25 percent of the market. Also see Chapter 2, and Klein (2007) for a more detailed discussion of regulatory conflicts of interest in adequately overseeing the financial condition and risk of insurance companies writing home insurance in hurricane prone states.

²⁷⁷ If a company defaults, any shortfall in its ability to pay claims is made up for by assessments on the companies remaining in the market. The assessment is made based on the remaining companies’ market shares.

Conclusions for County Level Supply and Demand

1. The price elasticity of demand is unit elastic, indicating that consumers have some loyalty to their current insurer.
2. However, the cross-elasticity for Citizen's policies is significantly higher, suggesting that customers are willing to switch to Citizen's policies on the basis of price comparisons if, and when, they are able to do so. This implies that if Citizens can underprice the private market, then it will attract significant new business. This is consistent with what we have observed recently in Florida, as Citizens is the largest insurer in the state.
3. Supply is highly price elastic: firms would supply more insurance if they could raise prices. This implies that even moderate price suppression will have a severe affect on availability in the private market. Further, insofar as price suppression is greatest in high-risk locations, the availability crunch in these locations will be especially severe.
4. The availability of reinsurance increases capacity.

Higher-risk firms (as indicated by leverage or credit quality) are more willing to supply policies. This may be because higher-risk firms are able to pass on the increased default risk to other policyholders without being penalized in prices. Additionally, the higher supply of high-risk insurers may have been directly facilitated by regulatory strategies that have encouraged their growth. This is consistent with actual experience (discussed in Chapter 3) in which five highly-leveraged Florida insurers wrote excessive concentrations of high-risk exposures and subsequently failed due to losses from the 2004-2005 storm seasons.

The county level study looked at the supply and demand for insurance in one state, Florida. In this study, the price was measured as the average premium paid for homeowners insurance in the county, and the quantity was the number of policies sold in that county. Thus, when we are talking about the demand elasticity we are referring to the sensitivity of the number of policies demanded to the premium charged. Thus, in saying that demand is inelastic, we mean that differences in premiums between companies in a county and across counties do not seem to be associated with big differences in demand for insurance. Similarly, our conclusion that supply is elastic means that insurers seem to be quite willing to increase (decrease) the number of policies they sell, as premiums change. The analysis does not investigate the impact that premiums have on the amount of coverage that a homeowner purchases, as we focus in this section on the decision to sell an insurance policy and not the level of coverage provided. –

There are two major issues with this analysis. First, while it is useful to examine how the *number of policies* supplied and demanded changes with price, this does not take into account how much insurance is purchased (which is best proxied by a measure of expected loss). Second, the measure of price – the actual premium – is not the best measure of the economic price to the insured of transferring risk. Much of the premium will, when averaged across the portfolio, be returned to the policyholder in the form of claims payment. A more usual measure of the economic price to the consumer is the spread between the premium and expected losses. This corresponds more closely with what economic theory says about insurance supply and demand.²⁷⁸ To address these issues, we undertook a second analysis of insurance demand across several states, Florida, South Carolina, New York and Texas, using insurance company contract data.

²⁷⁸ See, for example, Cummins, J.D. and M.A. Weiss (2000), "Analyzing firm Performance in the Insurance Industry Using Frontier Efficiency and Productivity Methods," in G. Dionne (ed.), *Insurance Handbook*, Kluwer Academic Publishers: Boston.

10.3. Study 2: Cross State Analysis of Insurance Demand Using Insurance Company Contract Data

Defining Price and Modeling Demand for Homeowner Policies

Assume that a particular homeowner, with characteristics Z (income, family status, type of structure of the house or apartment building, etc.), faces a choice among different policy options for insuring his home, where the set H gives the available policy options in the homeowners market. A typical such option " h " in the set H would be one offered by insurer i , with characteristics X_i (such as implied quality levels based on surplus level, size and visibility in the market, distribution system type – direct marketing or independent agent). Or, a typical such option " h " in the set H would be one offered by insurer i (with characteristics X_i which include characteristics such as claims paying ability, organizational form, marketing methods, and the ability to offer complementary products such as auto insurance) with certain policy features (such as deductible levels, loss settlement provisions, actual cash value or replacement cost), and with premium $P(h)$. The homeowner must choose one of the options in H and is assumed to do so by maximizing his expected utility over the risks or gambles implied by each choice h . Let us represent this expected utility $U(h, P(h))$ in quasi-linear form²⁷⁹ as:

$$U(h, P(h), Z) = V(F(h), Z) - P(F(h), Z) \tag{10.3}$$

where V represents the consumer's willingness to pay for various type of coverage or "features" of an insurance policy and $F(h)$ represents the vector of such features, including the characteristics of the company offering the policy that may make a difference to consumers.

Note that both V and P depend only on the vector of features F and the characteristics of the homeowner (possibly only the type of structure, but perhaps also on locational characteristics such as community rating or location of nearest fire department). One of these features could itself be the premium level $P(h)$. The homeowner then maximizes the function $U(h, P(h), Z)$ over the set H .

Assuming that there is a rich menu of policies available in the market, we can represent the choice problem as selecting an insurance policy by choosing optimal features of the policy. The solution is found where the marginal benefit of a policy features is equal to the marginal cost.²⁸⁰ This leads to estimation problems of the following general type, neglecting for the moment the details here of functional form:

$$P(F, X, Z) = aF + bX + cZ + \epsilon \tag{10.4}$$

²⁷⁹ As Willig (1976) has shown, this form, with constant marginal utility of income, is appropriate for demand modeling when the good in question does not absorb a significant fraction of the homeowner's budget, a reasonable assumption in the case of insurance (the typical homeowners insurance premium is around \$300-\$500 and somewhat higher in catastrophe-prone areas). This is not to say, of course, that there are no income effects to consumers, only that the marginal utility of income for each consumer is assumed constant over the range of policy options offered. Willig, R.D. (1976), "Consumer's Surplus without Apology," *American Economic Review*, 66 (4): 589-97.

²⁸⁰ Indeed, if V and P are estimated using bilinear or translog families of functions, then knowledge of one will lead (up to a constant of integration) to knowledge of the other.

We have separated the policy features into categories: those pertaining to the policy itself (the vector F); those that pertain to the company (the vector X); and those pertaining to neighborhood characteristics (the vector Z). In this model, $P(F,X,Z)$ could be either the total premium for a given policy or more likely, normalizing by units of coverage (e.g., the expected or indicated loss costs), premium per unit of coverage.

The price for insurance products, as for other products and services, is defined as the value-added per dollar of output. At the policy level, this value-added measure of price can be captured by subtracting the discounted value of expected losses covered by the policy from the premium.²⁸¹ Denoted by $L(F, Z)$, the expected losses for a policy h with features F and by $P(F,X,Z)$ its premium, we obtain the following definition of price $p(F,X,Z)$ for a homeowners policy $h = (F,X,Z)$ characterized by the parameters (F,X) and indexed by consumer and loss characteristics Z :

$$p(F, X, Z) = \frac{P(F, X, Z) - PV(L(F, Z))}{PV(L(F, Z))} = \frac{(1+r)P(F, X, Z) - L(F, Z)}{L(F, Z)} \quad (10.5)$$

where $PV(L(F, Z)) = L(F, Z)/(1+r)$ is the present value of expected losses on the policy for the policy period, and (r) is the insurer’s return on equity for the period. $L(F,Z)$ is the indicated loss costs per unit of coverage for the policy features (F) and structure (Z) in question. This was the underlying methodology used in Grace, Klein and Kleindorfer (2004) (GKK).²⁸²

The value of the $L(F,Z)$ is calculated using ISO procedures for our sample data. Examining the data across the sample firms (see description below) we have a number of variables unique to a particular firm. This is because each company has different needs for the data it collects. However, we are able to take a set of common variables to calculate an indicated loss cost for each contract. We used the ISO procedures to develop relativities for the coverage A (or the dwelling) limit, the policy deductible, the wind deductible, and the location (by ISO territory). The resulting definition of price shown in equation (10.5).²⁸³

²⁸¹ Note that we do not consider the effects of taxes in this model. See Myers, S. and R. Cohn (1987), “A Discounted Cash Flow Approach To Property-Liability Insurance Rate Regulation.” In Fair Rate of Return in Property-Liability Insurance, edited by D. Cummins and S.E. Harrington. Norwell, MA: Kluwer Academic Publishers; and Cummins, J.D. (1990), “Multi-period Discounted Cash Flow Rate-Making Models in Property-Liability Insurance,” *Journal of Risk and Insurance*, 57: 79-109. For a more detailed discussion of “price” in the insurance context, see also Cummins, J.D., M.A. Weiss, and H. Zi (1998), “Organizational form and efficiency: an analysis of stock and mutual property-liability insurers,” Federal Reserve Bank of Philadelphia, Working Papers: 98-19, for a related empirical study of price and profitability using frontier efficiency methods.

²⁸² Grace, M.F., R.W. Klein, and P.R. Kleindorfer (2004), “Homeowners Insurance with Bundled Catastrophe Coverage,” *Journal of Risk and Insurance*, 71 (3): 351-379.

²⁸³ The Coverage A limit in a homeowners insurance policy is the amount of insurance on the principal dwelling and attached structures. This is usually set at the estimated replacement cost of the dwelling. Other coverages (e.g., for contents, unattached structures, loss of use, etc.) are typically set as a percentage of the Coverage A limit. Normally, consumers opt for standard percentages for these other coverages but can choose higher or lower percentages if they wish.

Quantity Demanded

In previous work, the Indicated Loss Cost (ILC) is employed as a measure of the risk shifted to the insurer through the insurance contract (GKK, 2004).²⁸⁴ We hypothesize that the ILCs offer a good proxy for the expected losses of the policy contract. In our current dataset we do not have an indicator for losses. Thus, we employ the coverage A (dwelling) limit as an alternative measure of demand. While this is a maximum *probable* loss rather than an *expected* loss, it is used to proxy for quantity of insurance coverage demanded.

We received data from five sponsoring companies (State Farm, Allstate, Liberty Mutual, Travelers and Nationwide) and from Fireman's Fund and Citizens Property Insurance Corporation. These insurers accounted for approximately 50 percent of the Florida homeowners' insurance market in 2005. For New York, the market share coverage was approximately 20 percent, for South Carolina it was approximately 30 percent, and for Texas it was approximately 40 percent. Data were provided for a number of years over the period 2000-2005. Not every company was able to provide data for all years for every state. It is important to note that while this is not a random sample of policies across all states, it is a relatively large sample of the market.

Our data consists of individual contract information from the various insurers in Florida, South Carolina, New York, and Texas. Table 10.4 shows summary statistics for the state databases. Florida's average written premium is the highest among the four states, followed by South Carolina, Texas and New York. However, the average premium is not necessarily a good indicator of "price." We also calculate the average premium per \$1,000 of coverage using the Coverage A (or Dwelling Limit). We see that Florida still has the highest "price" per dollar of coverage at \$8.13. However, Texas is a close second with \$7.89. The other two states are lower with New York having a "price" of \$3.94 and South Carolina a "price" of \$5.14. While these prices are illustrative of differences in state markets, they do not account for the expected loss, or indicated losses, from the policy.

²⁸⁴ GKK (2004), Op. Cit.

**TABLE 10.4. DESCRIPTIVE STATISTICS FOR CONTRIBUTING COMPANIES' DATA
MEASURED AT THE POSTAL ZONE LEVEL FOR 2005**

Florida	Number	Mean	Std. Dev	Min	Max
Written Premium	2,009,576	\$ 6,163.71	101.00	\$ 482,014.00	\$ 482,014.00
Wind Deductible	2,009,576	\$ 1,849.83	-	\$ 894,852.00	\$ 894,852.00
Policy Deductible	2,009,576	\$ 1,997.82	-	\$ 894,852.00	\$ 894,852.00
Coverage A Limit	2,009,573	\$ 836,774.94	1,000.00	\$62,962,430.00	\$ 62,962,430.00
Premiums Per \$1,000 of Coverage A Limit	2,009,573	\$ 8.13	0.41	\$ 788.00	\$ 788.00

South Carolina	Number	Mean	Std. Dev	Min	Max
Written Premium	423,818	\$ 4,976.63	5,616.29	-	\$ 187,684.00
Wind Deductible	423,818	\$ 2,516.75	8,737.30	-	\$ 490,688.40
Policy Deductible	423,818	\$ 2,754.23	8,678.16	-	\$ 490,688.40
Coverage A Limit	423,818	\$1,011,175.15	1,109,672.71	\$ 5,000.00	\$ 29,524,300.00
Premiums Per \$1,000 of Coverage A Limit	423,818	\$ 5.14	2.10	-	\$ 74.33

New York	Number	Mean	Std. Dev	Min	Max
Written Premium	1,033,066	\$ 760.73	756.50	\$ 101.00	\$ 85,588.00
Wind Deductible	1,033,066	\$ 508.47	433.30	-	\$ 25,000.00
Policy Deductible	1,033,066	\$ 508.47	433.30	-	\$ 25,000.00
Coverage A Limit	1,033,066	\$ 218,865.62	186,638.66	\$ 3,000.00	\$ 24,000,000.00
Premiums Per \$1,000 of Coverage A Limit	1,033,066	\$ 3.94	3.72	\$ 0.32	\$ 791.40

Texas	Number	Mean	Std. Dev	Min	Max
Written Premium	834,520.00	\$ 2,375.72	4,171.58	\$ 101.00	\$ 170,364.00
Wind Deductible	834,520.00	\$ 3,136.08	7,363.37	-	\$ 1,201,392.00
Policy Deductible	834,520.00	\$ 1,165.17	1,255.05	-	\$ 391,250.00
Coverage A Limit	834,520.00	\$ 300,106.96	562,508.02	\$ 4,000.00	\$ 40,153,200.00
Premiums Per \$1,000 of Coverage A Limit	834,520.00	\$ 7.89	3.31	\$ 0.72	\$ 71.75

TABLE 10.5. EXAMINATION OF PRICES ACROSS RISK CATEGORIES MEASURED BY THE PERCENTAGE OF WIND LOSS COSTS TO TOTAL LOSS COSTS, 2005

Panel A. Florida

Price	N	Mean	Std Dev	1P-tile Minimum	99 P-tile Maximum
Quartile 1	157,207	1.871	3.570	-0.726	13.522
Quartile 2	157,192	1.233	0.877	-0.486	3.653
Quartile 3	157,311	1.037	0.817	-0.329	3.712
Quartile 4	157,118	0.672	0.701	-0.477	2.871
Overall	628,828	1.203	1.964	-0.595	5.730

Panel B. South Carolina*

Price	N	Mean	Std Dev	1P-tile Minimum	99 P-tile Maximum
Quartile 1	78,267	1.956	0.994	0.319	4.962
Quartile 2-3	104,655	1.835	1.122	0.168	5.496
Quartile 4	61,144	1.902	1.509	-0.368	5.977
Overall	244,066	1.891	1.135	-0.029	5.518

Panel C. New York

Price	N	Mean	Std Dev	1P-tile Minimum	99 P-tile Maximum
Quartile 1	81,904	2.148	1.098	-0.127	5.103
Quartile 2	81,520	1.850	1.002	-0.141	4.584
Quartile 3	84,480	1.739	1.239	-0.315	5.398
Quartile 4	76,119	1.9109	1.054	-0.251	4.417
Overall	324,023	1.9106	1.104	-0.232	4.885

* South Carolina quartiles 2 and 3 had the same level of wind risk.

Methodology

We estimate a demand model for each state using a two-stage least squares. The process is similar to that described above for the county level analysis (Section 10.2). We estimate a price equation at the postal zone level to control for the endogeneity of price. Similarly, we estimate the deductibles as endogenous variables.²⁸⁵ The initial results for each state are summarized in Tables 10.6-10.8.

Discussion of Results

Our main task is to show the sensitivities of insurance demand to changes in price, income and levels of deductibles and to compare these results across states that have very different regulations. However, to set the stage we present comparisons of prices across the states and across risk groups within each state in Table 10.5.

We first break the data into four quartiles based upon the ratio of modeled wind losses to total indicated losses. We rank all of the contracts based on this ratio and then break the sample into four equal sized groups. The first quartile contains the first one-fourth of the data with the lowest levels of wind risk as a percentage of total risk. The second quartile contains the next one-fourth of the contracts which represents the next 25 percent of the contracts based on wind risk. The third and fourth quartiles are defined similarly. By breaking the contracts up into these wind risk quartiles we can examine the influence of risk on prices.

This table shows the prices of insurance, as defined above, for the different risk quartiles in Florida, South Carolina and New York. We are not able to calculate similar prices for Texas because the ISO did not create the loss cost rating program for this state.²⁸⁶ In each state, the first quartile refers to the policies with the lowest level of catastrophe risk (measured as the ratio of wind loss costs to total loss costs), with succeeding quartiles having higher relative catastrophe risk. The price is an index of the percentage price-cost spread in the premium. The results show a very clear pattern in Florida. The price is much higher in lower-risk quartiles and much lower in later-risk quartiles. This reflects a pattern observed earlier by GKK (2004) whereby premiums in high-risk areas are subsidized by premiums in low-risk areas. This cross

²⁸⁵ The instruments for the first stage regressions are the percent of the postal zone covered by water, the percent of the postal zone categorized by the Census Bureau as *urban*, the median value of homes in the postal zone, the number of housing units in the postal zone, the median year housing was built in the postal zone, the percent of homes in the postal zone covered by a mortgage, the number of homes without heat, the number without plumbing or full kitchens, elevation above sea level, and ISO territory. Depending on the state, the first stage regression R^2 range from 0.2-0.6. The R^2 represents the degree to which the model explains the data; an R^2 close to zero implies no explanatory power. If R^2 is 1, then the model fits the data perfectly.

²⁸⁶ Currently, we do not have a method of determining indicated loss costs for Texas. ISO, until quite recently, did not provide indicated loss costs for Texas. Thus, we have no base loss costs or a methodology to calculate the estimated loss costs. The difference in contracts employed in the analysis is due to the fact that we could not initially estimate indicated loss costs for all contracts. For example, ISO relativities are specific to a given deductible of, say, \$500 or \$1,000. If the deductible is \$750, there may not be relativity for a \$750 deductible in the manual. We would then interpolate the result in order to obtain a "cost relativity" for the contract. We interpolated missing information and estimated the indicated loss costs (ILCs) for all contracts except for Texas, for which we had no information regarding ILCs. We have undertaken some simple tests to determine if there is any systematic bias in the set of contracts we employ in this analysis and did not discern appreciable differences. Also, the ILC contains both catastrophic and non-catastrophic indicated loss costs in a total indicated loss cost calculation.

subsidization flattens out the risk sensitivity of premiums. In contrast, in South Carolina and New York, the premium index shows little variation across quartiles. This finding would be consistent with risk based premiums.²⁸⁷

Tables 10.6-10.8 contain the results for each state's demand estimation. Two panels are presented in each table. The first (Panel A) is a demand equation elasticity results over the time period (2001-2005) for each state. The second panel (Panel B) shows the elasticities estimated at various level of wind risk as a percentage of total risk in the year 2005. As in Table 10.5, the state samples are broken up into quartiles based on the percentage of wind loss costs to total loss costs. This is used as a proxy for the importance of wind risk to the homeowners demand for insurance.

Florida

Panel A in Table 10.6 shows elasticity estimates for important variables in the demand equation. Each elasticity estimate is in relation to the quantity of insurance demanded. So we examine how price, income, deductibles, the percentage of homeowners with mortgages, and the coverage limits influence the quantity of insurance demanded. The first finding from the results in Panel A in Table 10.6 is that demand is price inelastic, since all the coefficients are less than 0.5 in absolute value. This is consistent with the result from the county level analysis, though the coefficients are not directly comparable because of the different measures of price and quantity used in the two studies. It is of interest, however, that the degree of price inelasticity appears unstable over time. This may not be surprising given the rapidly changing regulatory environment and the corresponding changes in Citizens' market share. The instability might also be associated with the market disruptions caused by actual storm losses. In other words, it is reasonable to surmise that as hurricanes began hitting Florida and other states in 2004, this caused consumers to place greater importance on having adequate insurance which would effectively increase their demand for insurance.²⁸⁸ It also appears that the price becomes less inelastic as perceived risk increases (i.e., in 2004 and 2005, based on the hurricanes), indicating that customers are more likely to engage in price shopping in high-risk locations. This makes sense when one considers that, despite the cross subsidization between risk classes, insurance will form a larger portion of the consumers' budget in high-risk areas.

In general, demand is fairly inelastic with respect to income, which is consistent with the county analysis (Table 10.6, Panel A) ranging from -0.372 to -0.461. The county level results showed that variations in income were associated with very small variations in the number of policies purchased. In contrast, the contract data result shown here reveal that, insofar as people do buy insurance, then the amount of insurance they buy is more closely related to price and income and, in the more recent data, less closely associated with the presence of a mortgage. For example, in 2005, the price elasticity and income elasticity are higher than the elasticity with respect to the percentage of mortgages in the postal zone.

²⁸⁷ It is our impression, based on anecdotal information (see Chapter 2), that rates in South Carolina and New York have been closer to "adequate" levels than in Florida. This is partly due to the lower level of risk in these other states as well as indicated by fewer/smaller disputes between insurers and regulators over the rates that insurers are allowed to charge.

²⁸⁸ One way this greater demand might be manifested is that homeowners might increased the Coverage A limit on their policy to make sure that it would fully cover the replacement cost of their home.

TABLE 10.6. FLORIDA: IMPORTANT ELASTICITY ESTIMATES BY YEAR AND BY WIND RISK PERCENT QUARTILE FOR 2005

Panel A. Two Stage Least Squares Regression Elasticity Estimates, by Year

Elasticities with Respect to				
	Price	Income	Percent of Homes with Mortgage	R ²
2001	-0.067 ***	-0.372 ***	0.113 ***	0.848
2002	-0.208 ***	-0.386 ***	0.182 ***	0.847
2003	-0.094 ***	-0.414 ***	0.178 ***	0.800
2004	-0.475 ***	-0.384 ***	0.509 ***	0.836
2005	-0.382 ***	-0.461 ***	0.267 ***	0.891

Panel B. Two Stage Least Squares Regression Elasticity Estimates, by Quartile (% Wind Risk)

Elasticities with Respect to				
	Price	Income	Percent of Homes with Mortgage	R ²
Quartile 1	-0.773 ***	0.244 ***	0.005	0.975
Quartile 2	-0.629 ***	0.063 ***	0.313 ***	0.758
Quartile 3	-0.032 ***	-0.027 ***	0.085 ***	0.986
Quartile 4	-0.003	-0.018 ***	0.018 ***	0.996
Overall	-0.382 ***	-0.461 ***	0.267 ***	0.891

*** Denotes significance at the 0.01 level.

Quartile is based on the ratio of indicated loss costs for wind to total indicated loss costs. Higher quartiles have higher wind components.

Finally, the elasticity with respect to the percentage of homes with mortgages is positive, suggesting that an increase in the percentage of homes with mortgages increases the quantity of insurance demanded. Over the five years of our study, this elasticity ranges from 0.113 to 0.509. Thus, a 10 percent increase in the percentage of homes with a mortgage yields an increase in the range of 1.1 percent to 5.1 percent for the quantity of insurance demanded.

In Table 10.6, Panel B, we focus on the wind risk quartiles for 2005. Recall that the quartiles are defined based upon the ratio of modeled wind loss costs to total indicated losses. Again, quartile 1 has the lowest wind exposure and quartile 4 has the highest. We see that as wind exposure increases, the price elasticity becomes highly inelastic. In quartile 1 it is -0.773 and in quartile 4 it is -0.003. We also see that the income elasticity becomes more inelastic and negative at the higher levels of wind exposure. In terms of the other elasticities, we see no pattern as wind risk increases, suggesting that there is no pattern in how the elasticities are related to the wind risk. This implies that as wind risk increases, people become less sensitive to changes in price when determining their demand for insurance.

South Carolina

In contrast with the Florida results, the insurance demand is elastic with response to price and this elasticity is more stable over time. Demand is income inelastic, though showing a lower elasticity than in Florida. These results reflect a more stable regulatory environment than in Florida, and the absence of market shocks caused by major storm losses such as Florida experienced.

The other elasticities shown in Panel A of Figure 10.7, such as those for the deductibles, are relatively stable. The elasticity for Coverage A is also stable and is approximately unit elasticity (meaning a 10 percent increase in the coverage A limit will yield a 10 percent increase in the quantity of insurance demanded). Finally, the percentage of homes with a mortgage is not stable. This elasticity switches signs over time, going from approximately 0.10 to -0.245 (income column). However, the elasticity is always inelastic so it does not have much effect on the quantity of insurance demanded.

Panel B of Table 10.7 shows the demand elasticities at various levels of wind risk. Again, in contrast to the Florida results, we see that as wind exposure increases, the price elasticity becomes more elastic in South Carolina. Furthermore, there is no consistent pattern to the income elasticity over the risk quartiles. This also suggests, at least on the surface, that the market dynamics and regulation are different between the two states. From Table 10.5, Panel A we saw evidence of regulatory price suppression in Florida, but not in South Carolina (Table 10.5, Panel B).

TABLE 10.7. SOUTH CAROLINA: IMPORTANT ELASTICITY ESTIMATES BY YEAR AND BY WIND RISK PERCENT QUARTILE FOR 2005

Panel A. Two Stage Least Squares Regression Elasticity Estimates, by Year

	Elasticities with Respect to			
	Price	Income	Percent of Homes with Mortgage	R ²
2001	-0.949 ***	-0.248 ***	0.089 ***	0.726
2002	-0.968 ***	-0.221 ***	0.025 **	0.812
2003	-1.637 ***	-0.139 ***	-0.293 ***	0.738
2004	-1.550 ***	-0.098 ***	-0.286 ***	0.747
2005	-1.103 ***	-0.149 ***	-0.245 ***	0.860

Panel B. Two Stage Least Squares Regression Elasticity Estimates, by % Wind Risk

	Elasticities with Respect to			
	Price	Income	Percent of Homes with Mortgage	R ²
Quartile 1	-0.043	-0.408	0.130	0.294
Quartile 2-3	-0.225 **	0.354 ***	0.007	0.466
Quartile 4	-1.730 ***	0.117	0.185 *	0.653
Overall	-1.158 ***	-0.099 ***	-0.323 ***	0.850

*** Denotes significance at the 0.01 level.

Quartile 2 and 3 had the same level of wind risk and are thus included together.

New York

New York's results are shown in Table 10.8. As in South Carolina, the price and income elasticities are fairly stable over time, though the demand is less responsive to price, hovering in the -0.6 range (compared with South Carolina where it ranges from about -1.0 to -1.6). The income elasticity measure is comparable to South Carolina in the -0.1 through -0.3 range (Table 10.8). While relatively stable, the price and income elasticities do seem to follow a time trend. Demand has become progressively less sensitive to price and progressively more sensitive to income between 2002 and 2005. Thus, in the markets where regulation is more predictable and major storm losses less frequent, demand elasticities with respect to price and income seem to be better behaved than in the more volatile market environment of Florida. Looking at the different risk quartiles, New York shows no substantial variation in price elasticities between risk groups, though the demand becomes more sensitive to income variation in the high risk quartiles.

Another interesting pattern that emerges in both New York as well as South Carolina is that the temporal trends in price elasticity and in income elasticity move in opposite directions over time. Thus, as demand becomes more price sensitive, it also becomes less income sensitive. Given that the demand elasticity measures the sensitivity of the amount of insurance purchased from company "x" to the price charged by that same company, and increased elasticity can mean either that people buy less insurance when the incumbent increases its price, or that they switch to another insurer. Given other results on cross elasticities, the likely interpretation is that increased price elasticity implies more shopping around. Thus, it seems that insurance is becoming more of a necessity even as incomes rise, but these state markets at least are showing a degree of competition in the form of more shopping around.

If we look at the three states as a group, it is clear that Florida is different from New York and South Carolina. Florida's price elasticity is volatile over time, but as the amount of wind risk increases across risk quartiles, the demand for insurance becomes more inelastic. New York and South Carolina do not show similar results and we suggest that this is due to the fact that regulation is stricter in Florida and that the underlying wind risk is also greater in Florida than in the other states. It is also important to note that high-risk exposures in coastal areas represent a much higher percentage of the total number of exposures in Florida than they do in South Carolina and New York. This may also partly account for the greater stability in the latter two states.

TABLE 10.8. NEW YORK: IMPORTANT ELASTICITY ESTIMATES BY YEAR AND BY WIND RISK PERCENT QUARTILE FOR 2005

Panel A. Two Stage Least Squares Regression Elasticity Estimates, by Year

	Elasticities with Respect to				Percent of Homes with Mortgage		R ²
	Price		Income				
2001	-1.275	***	0.009		0.076	***	0.116
2002	-0.633	***	-0.105	***	0.116	***	0.319
2003	-0.659	***	-0.135	***	0.145	***	0.318
2004	-0.645	***	-0.142	***	0.114	***	0.320
2005	-0.599	***	-0.153	***	0.096	***	0.294

Panel B. Two Stage Least Squares Regression Elasticity Estimates, by % Wind Risk

	Elasticities with Respect to				Percent of Homes with Mortgage		R ²
	Price		Income				
Quartile 1	-0.646	***	-0.071	***	0.061	**	0.253
Quartile 2	-0.673	***	-0.091	***	-0.022		0.204
Quartile 3	0.113		-0.212	***	-0.031		0.042
Quartile 4	-0.676	***	-0.225	***	0.221	***	0.536
Overall	-0.599	***	-0.153	***	0.096	***	0.294

*** Denotes significance at the 0.01 level.

** Denotes significance at the 0.05 level.

Quartile is based on the ratio of indicated loss costs for wind to total indicated loss costs. Higher quartiles have higher wind components.

Deductibles

We also examined the effect of prices, expected losses (indicated losses), and income on the two types of deductibles common to our data: the hurricane wind deductible and the policy deductible. The hurricane wind deductible is specified separately from the policy deductible in the insurance contracts covering hurricane-related wind losses. As shown in Table 10.9, the wind deductibles are much different from the general (non-wind) policy deductible for Florida and South Carolina. For Florida, the average policy deductible (\$1,658) is slightly higher than the wind deductible (\$1,565). For South Carolina, the average wind deductible is about \$531 while the average policy deductible is \$700.²⁸⁹ These differences may be due to the fact that while both Florida and South Carolina have relatively high insurance prices, the Florida prices are higher and consumers in Florida are more likely to employ higher deductibles as a way of reducing premiums. In addition, since our policy samples are not random, but are based on the data supplied by the various companies, it may be that the mix of high- and low-risk policies differs between the states.

²⁸⁹ See Chapter 4 of the report for a discussion of deductible on flood insurance policies in Florida.

TABLE 10.9. WIND AND POLICY DEDUCTIBLES BY STATE, 2005

	Wind			Policy		
	Florida	South Carolina	New York	Florida	South Carolina	New York
99%	\$ 27900	\$ 1000	\$1000	\$ 26400	\$ 1000	\$ 1000
95%	5000	1000	1000	3900	1000	1000
90%	2000	1000	1000	1700	1000	1000
75% Q3	1000	1000	500	1000	1000	500
50% Median	500	500	500	500	500	500
25% Q1	0	500	250	500	500	250
10%	0	0	250	500	500	250
5%	0	0	250	500	500	250
1%	0	0	100	0	500	100
0% Min	0	0	0	0	50	0
Average	\$ 1,565	\$ 531	\$ 508	\$ 1,658	\$ 700	\$ 508

Looking at the distribution of deductibles across the sample companies and states, we see that a relatively large percentage of policyholders have low deductibles. For example, if we look at the percentiles at the lower end of the distribution, Florida and South Carolina both have significant numbers of policyholders with either zero or \$500 deductibles. The same is true in New York where at least 75 percent of the sample has a deductible of \$500 or less. This is consistent with the evidence detailed in Chapter 4 with respect to the National Flood Insurance Program for Florida, which shows that approximately 80 percent of the insureds have the minimum deductible and is consistent with other empirical data indicating that many individuals prefer low deductibles (Kunreuther and Pauly, 2006).²⁹⁰ We must also note that homeowners in non-coastal areas represent a much larger proportion of all homeowners in New York and South Carolina than they do in Florida. Presumably, there would be little incentive for non-coastal homeowners to opt for a high wind deductible.

As part of our demand estimation, we also estimated relationships between deductibles and other explanatory variables. These results in elasticity form are presented in Table 10.10. For each state we estimated two equations of the form:

$$\log(Deductible_i^D) = f(\log(price_i), \log(median\ income_z), \log(ILC_i), others) + v \quad (10.6)$$

where *i* is the contract, *z* is the postal zone, and *D* is the deductible type (wind or policy). Price is endogenously determined and the other variables include the complementary deductible which is also endogenously determined, the percentage of the postal zone area that is water, the percent of homes in urban areas in the postal zone, the median year the home was built, and the mean elevation above sea-level of the postal zone.

²⁹⁰ Kunreuther, H. and M. Pauly (2006), *Insurance decision-making and market behavior*, Boston, MA: Now Publishers, Inc.

TABLE 10.10. DEDUCTIBLE ELASTICITIES FOR FLORIDA, NEW YORK, AND SOUTH CAROLINA, 2001-2005

Panel A: Florida

Elasticities with Respect to

	Indicated Loss Costs		Price		Income	
	Wind	Policy	Wind	Policy	Wind	Policy
2001	0.751	0.000	-0.533	0.087	0.489	-0.005
2002	0.845	0.039	-1.132	0.144	0.000	0.023
2003	0.812	0.049	-0.997	0.176	0.024	0.012
2004	0.822	0.065	-0.905	0.238	0.030	0.000
2005	0.851	0.123	0.067	0.123	0.067	0.054

Panel B: New York

Elasticities with Respect to

	Indicated Loss Costs		Price		Income	
	Wind	Policy	Wind	Policy	Wind	Policy
2001	5.986	0.060	1.858	0.203	-0.663	0.111
2002	9.533	0.587	5.947	0.405	1.019	0.194
2003	7.644	0.608	5.252	0.415	0.847	0.214
2004	8.989	0.712	6.344	0.465	1.534	0.270
2005	5.837	0.713	4.796	0.456	0.932	0.286

Panel C: South Carolina

Elasticities with Respect to

	Indicated Loss Costs		Price		Income	
	Wind	Policy	Wind	Policy	Wind	Policy
2001	-0.622	0.065	0.144	0.000	-2.299	0.239
2002	-0.528	0.061	0.557	-0.053	-2.021	0.237
2003	-4.725	0.173	14.364	-0.437	-2.808	0.106
2004	-4.283	0.171	11.535	-0.352	-1.913	0.051
2005	-3.621	0.145	11.342	-0.350	0.190	-0.005

Elasticities calculated from a 2sls regression estimated with the Demand Equation of the form $\text{Log Deductible} = f(\text{log price, log of ILC, log of other deductible, log of median income, percent area covered in water, percent urban, median year home was built, elevation})$

Florida

For the elasticity with respect to the indicated loss cost (our measure of quantity) we see a relatively stable relationship over time (see Table 10.10). A 10 percent increase in indicated losses yields a 75-85 percent increase in the wind deductible. In addition, the policy deductible is also stable and relatively inelastic over time. This suggests that consumers increase their policy deductible with an increase in expected losses. This would also be consistent with consumers attempting to maintain the same coverage limit for protecting themselves against a hurricane that causes severe damage to their property without having to increase their total insurance premium significantly.

The price elasticity is unstable over time with respect to the wind deductible. However, if we look at the beginning and end periods, we see that the elasticity has increased from -0.5 in 2001 to 0.067 in 2005. This suggests that consumers' behavior with regard to the wind deductible has changed significantly over time. A number of things have happened during this period in Florida. First, there was an increase in the frequency of hurricanes in 2003-2004, and second, there was an increase in home values. While the elasticity was negative in 2001, a 10 percent increase in the deductible in 2005 yielded a 0.67 percent increase in the price. The policy deductible price elasticity, in contrast, has been relatively stable at about 0.1 to 0.2, suggesting increases in prices were associated with increases in the policy deductible.

For income, we see a relatively stable relationship between income and the deductibles. With the exception of 2001, the wind and policy deductible income elasticities are quite low – in the near zero range. This suggests almost no relationship between income and deductibles.

TABLE 10.11. DEMAND, DEDUCTIBLES, AND RISK ELASTICITY RESULTS FOR FLORIDA, 2005

	Price	Hurricane Deductible	Policy Deductible	Income	Risk	R ²
Demand	-0.320 ***	-0.077 ***	-0.334 ***	-0.433 ***	-0.081 ***	0.93
Hurricane Deductible	-0.096 ***		-3.018 ***	0.110 **	-0.116 ***	0.38
Policy Deductible	0.237 ***	-0.069 ***		0.033 ***	0.013 ***	0.14

***Denotes significance at the 1 percent level. **Denotes significance at the 5 percent level.

Risk is defined as the log of the ratio of the standard deviation within the postal zone of RMS-modeled Average Annual Loss (AAL) divided by the mean of the AAL for the postal zone.

The results shown in Table 10.11 are derived from a two stage least squares model akin to the one used to estimate the results in Table 10.10. The first row shows the elasticities with respect to our measure of quantity demanded. Thus, the price elasticity is -0.32 consistent with our results above in Table 10.6. The second row is a regression estimation reflecting the determinants of the wind deductible and the third line shows a similar regression for the policy deductible. The main difference between these results and the results described above is that we include another variable that accounts for the wind risk in the postal zone. This risk variable comes from RMS which calculated the modeled average annual loss (AAL) for the postal zone for Florida in 2005. In addition to the AAL, RMS also provided the standard deviation of the AAL. So we have a measure of the pure modeled expected hurricane loss as well as the standard

deviation of the measure. A good proxy risk measure is the coefficient of variation which is defined as the ratio of the standard deviation to the mean of a variable. Essentially, the coefficient of variation allows us to compare different levels of uncertainty about the wind risk relative to its mean (or what one expects).

In Table 10.11, the results are reported in elasticity form. Thus, a 10 percent increase in price will yield a reduction in quantity demanded of 3.2 percent. We see that for both the hurricane and policy deductibles, the relationship to demand is relatively inelastic with the quantity demanded being particularly insensitive to the hurricane deductible. This implies that consumers' choices about the total limit on their policy are not closely related to their choices of deductible. In other words, insureds may want to be sure that they have adequate coverage in terms of having the full replacement cost of their home covered (which would be important in the event of a total or severe loss) but may be willing to accept a higher deductible regardless, as the deductible is something they may be prepared to pay out of their assets in exchange for a lower premium, all other things being equal. This would be consistent with insurance principles that place greater emphasis on transferring the risk of "unaffordable" losses and retaining smaller, affordable losses. Looking at the risk as measured by the log of the coefficient of variation of the AAL, we see that a 10 percent increase in risk lowers the quantity demanded by 0.8 percent. This is consistent with the fact that there are no real substitutes for insurance and that consumers will still purchase insurance even if risk increases.

We also see that increases in risk influences the deductibles. For the *hurricane* deductible, an increase in risk of 10 percent yields a 1.116 percent decrease in the deductible. However, for the *policy* deductible there is a positive, but almost negligible effect of 0.13 percent increase in the level of deductible for a 10 percent increase in risk. These results seem to suggest that consumers' demands for protection (at the low end where the deductible might come into use) are different for wind losses than for non-wind losses. Consumers will increase deductibles in conjunction with higher prices for non-wind risk, but not for wind risk.

New York

New York is very different from Florida in terms of the consumers' behavior towards changes in the indicated loss costs (see Table 10.10). New York shows high elasticities between deductibles and indicated losses, suggesting that small increases in expected losses causes a large increase in the deductible level. It should be noted that New York's levels of deductibles are quite low compared to the other states, so this is not too surprising. Similarly for the policy deductible, the elasticity is more sensitive than Florida's, but it is much lower than the New York wind deductible in terms of sensitivity.

The price elasticity for both deductibles is positive, which suggests that an increase in the price causes an increase in the level of the deductible. Again, like the elasticity for the indicated loss costs (ILC), our measure of output, the wind deductible price is quite elastic relative to the policy deductible price elasticity.

The New York deductible income elasticities are mostly positive. The wind elasticity is negative in one year (2001), and somewhat unstable in the other years, ranging from 0.85 to 1.5. The policy deductible is relatively stable, ranging from 0.11 to 0.28. Thus, as the median income increases by 10 percent, the deductible increases between 11 and 28 percent depending on the year.

South Carolina

South Carolina has a negative elasticity for wind deductible with respect to indicated losses as shown in Table 10.10. It is also quite high in terms of absolute value in 2003-2005. One would expect that the elasticity would be positive. A negative elasticity suggests that as indicated losses go up, deductibles decrease. In contrast, we find a positive relationship for the indicated loss costs with respect to the policy deductible in approximately the same range as for Florida. For price elasticities, we see that the wind deductible has a high price elasticity for the last three years. Thus, a 10 percent increase in the price is associated with a 140 percent increase in deductibles. This would be consistent with consumers going from \$500 deductibles to deductibles based on a percentage of the limits for the dwelling. For the policy deductible the price elasticity is negative, thus a 10 percent increase in price is associated with a decrease in the deductible. We found opposite results in New York and Florida. While this result is somewhat perplexing, there are possible explanations. One explanation might be that in South Carolina, consumers respond to higher risk (reflected in higher prices) by actually lowering their deductible because they believe that they are much more likely to have a loss. In Florida, however, the price of insurance in coastal areas is much higher (as is the price of lower deductibles), and this crosses a “tipping point” for consumers, causing them to opt for higher deductibles to make their insurance more affordable.

Finally, we see that both the wind and policy deductible are moving towards zero over time. The wind deductible started at a -2.29 in 2001 and in 2005 was 0.19. The policy deductible started in 2001 at approximately .24 and by 2005 was -0.005. This is consistent with the results in Florida where the income elasticity for the deductibles was close to zero.

We have examined the demand for insurance in three states. Each state has a different political and regulatory environment as well as experience with hurricanes. Because it is not possible to control for these types of variations among the states, it is not possible to make generalizations. Each state is a separate case study. Florida, the state with the most severe regulatory environment has had the worst experiences with hurricanes. This experience has led, in part, to the development of regulatory policy unique to Florida. South Carolina, while it has had experience with large hurricanes, has not had the frequency experienced by Florida. Its wind insurance availability problem is also focused on the coastal areas. Florida, in contrast, has potential availability problems in most of the state. New York has not had the same type of experience with major wind storms. While not completely free from risk of hurricanes, a large portion of the state’s valuable property and the source of its major economic activities is within the reach of a severe hurricane. Each state has different issues with regard to wind risk and thus the demand for insurance is likely to be quite different.

10.4. Conclusions

In this chapter we provide an initial examination of the supply and demand conditions for Florida. We note first that the demand elasticity for the purchase of any insurance is unit elastic in Florida and that the state’s intervention through Citizens provides a substitute for private market insurance.

In terms of supply, we note that it is highly elastic. This implies that insurers are willing to provide coverage, assuming that they can obtain risk-based prices. We note from Table 10.5 that the highest risk areas have the lowest price mark-ups in Florida. This suggests a degree of price suppression that reduces the availability of insurance to high-risk areas. We also note that the availability of reinsurance increases the supply of insurance. Further, higher-risk firms (as indicated by leverage or credit quality) are more willing to supply coverage in Florida. This may be because higher risk firms are able to pass on the increased default risk to existing consumers without being penalized in prices. Indeed, the presence of guarantees means that consumers do not have to worry too much about credit risk. It is also the case that the state has encouraged single state entities, often with low credit ratings, to address capacity shortages. Alternatively, the larger supply of high risk insurers may have been directly facilitated by regulatory strategies that have encouraged their growth.

This study examined Citizens' participation in the market when it was mandated to have the highest price in relation to what was offered in the private market. Thus, it really was not competing with insurance companies but was acting as an insurer of last resort. Even so, there was a positive cross price elasticity, suggesting that the public market was a substitute for private insurance products. Indeed, with cross elasticity of demand, the size of Citizens would have been constrained by its imputed high prices. In 2007 the Florida Legislature allowed Citizens to compete for customers (by pricing at what some would designate as below risk-based rates). Given cross elasticity, this would imply that Citizens could capture considerable market share from private insurers as it competes directly. This new competition might have a further effect on the long-run desirability of private insurers marketing homeowners coverage in Florida.

For our demand analysis for three states, we have a number of interesting results. In the highly regulated and loss-prone state of Florida, estimates of price and income elasticity of demand are highly unstable. While this may be indicative of some market disorder, we need to study further whether the fluctuations are systematically related to regulatory and other factors. In South Carolina and New York with lower regulation and no major losses during the study period, we find that our results on price and income elasticity are more robust. The amount of insurance purchased (conditional on one buying insurance at all) is quite sensitive to *price spread* and even ventures into the price elastic range in South Carolina. Demand is also income inelastic, although not as extremely so as indicated in the Florida county level study reported earlier (which showed the *number of policies* is highly sensitive to the percentage of people who have mortgages, and showed very little variation with respect to premiums and to income).

We also note that the deductibles are generally sensitive to the indicated loss costs (Florida and New York are positive and South Carolina is negative). However, the state markets differ in terms of price elasticities with respect to the deductibles. What is interesting is that New York, with arguably the lowest wind risk, has the typically expected relationships (as price increases, deductibles increase). Florida has negative elasticities for the wind deductible and South Carolina has negative elasticities for the policy deductible. Finally, while the income elasticities with respect to the deductibles are different across states, by 2005 both Florida and South Carolina report a near zero income elasticity for both hurricane and policy deductibles, suggesting that changes in income have no effect on the deductible.

SUMMARY OF CHAPTER 10

In this chapter we undertake a number of analyses. First, we present an analysis of the supply and demand for homeowners insurance for Florida. Second, we examine various measures of premiums in four states (Florida, New York, Texas, and South Carolina). Third, we estimate at a more refined level the demand for homeowners insurance in Florida, South Carolina, and New York. The purpose is to examine how effectively the private market functions and what prices and availability result. We also address the impact on the market of various interventions, ranging from price controls to residual market mechanisms. An empirical analysis of recent developments in the Florida can be found in Grace and Klein (2006).²⁹¹

In estimating the supply and demand functions, we are seeking to address several policy issues. In a general sense, we are interested in whether private insurance markets are effective in providing coverage at prices which reflect risk and will leave insurers with adequate, though not excessive, returns on their invested capital. Of course, we are conducting our empirical analysis on markets that are regulated to differing degrees, so this analysis provides insight into the impact of regulation on demand and supply.

In order to address these issues, we conducted two complementary empirical studies. The first study is based on data aggregated at the county level and covering the state of Florida. This study estimates the supply and demand by looking at the number of policies purchased in each county. We are able to determine income and price elasticities and estimate how the participation of Citizens Property Insurance Corporation in Florida has influenced both the demand for insurance and the supply by private insurers. This study also enables us to estimate the impact of socio-economic and risk factors that vary across counties, on supply and demand.

While this county level study is useful because of its more complete coverage of the market, it lacks insurance contract detail and the available data are limited to Florida. Thus, we conduct a second empirical study on individual contract data supplied by several insurance companies and spanning several states (Florida, South Carolina, and New York). This study provides a greater degree of granularity and enables us to look at differences across states with very different regulatory regimes. However, this study has its own limitations. First, in using insurance company data, we have no observations on homeowners who are uninsured. Thus, we can estimate the demand for insurance in the following sense – how much coverage (what deductibles and what coverage limits) will people purchase, conditional on their buying insurance. Second, the contract data is not complete insofar as it is provided by four to six insurance companies that cover 30-40 percent of the market.

²⁹¹ Grace, M.F. and R.W. Klein (2006), "After the Storms: Property Insurance Markets in Florida," Working Paper, Georgia State University, December, at <http://rmictr.gsu.edu/Papers/WP06-5.pdf>.

PART III

PROTECTING HOMEOWNERS AGAINST NATURAL DISASTERS

CHAPTER 11

**IMPACT OF INSURANCE STATUS ON ECONOMIC WELFARE
OF HOMEOWNERS IN HAZARD-PRONE AREAS:
THE AFFORDABILITY CHALLENGE**

KEY FINDINGS

Defining affordability of homeowners insurance requires making value judgments about how much income a homeowner should have left over to spend on other things after paying for insurance coverage. This value judgment is typically specified relative to some poverty line (which adjusts for family size and composition). The “affordability threshold” thus represents a community’s values and standards.

Data from the American Housing Survey on eight cities in our target states show that in all cities, for several different definitions of the affordability threshold, a significant number of owner-occupied homes are owned by households with incomes below those thresholds. If the affordability threshold is set at 200 percent of the poverty line, between 16 percent (Dallas) and 31 percent (Tampa) of owner-occupied homes are owned by households who cannot afford insurance. At 125 percent of poverty, the percentage varies from nearly 7 percent in Dallas to 17 percent in Tampa.

Among low-income households judged not able to afford insurance, a large fraction of homes are nevertheless insured, even when there is no mortgage requiring coverage. Fewer than 27 percent of low-income homeowners (San Antonio; 125 percent of poverty line) fail to purchase insurance coverage in any of the cities studied. Any plan that directs subsidies to all low-income homeowners will allocate much of the payment to those who are already insured.

While measures based on ability to consume and on household choices capture static notions of affordability, there may also be a notion of equity that people have in mind that relates to the fairness in changes in homeowners premiums. In particular, if changes in premiums are distributed very unevenly across households, one might take the view that those subject to large increases are not being treated fairly and justly. If some homeowners see their premiums jump by thousands of dollars per year, while others have modest changes, a case could be made that one subgroup is being singled out for unfair premium increases. This inequity could be addressed through public and/or private sector programs.

CHAPTER 11

IMPACT OF INSURANCE STATUS ON ECONOMIC WELFARE OF HOMEOWNERS IN HAZARD-PRONE AREAS: THE AFFORDABILITY CHALLENGE

In determining the future of insurance as a policy instrument for financing recovery from natural disasters and enhancing the adoption of adequate mitigation measures, we need to have a clearer understanding of what proportion of homeowners in hazard-prone areas currently have insurance. Furthermore, we need to understand why some have, or should have, insurance while others do not. The first portion of this chapter tackles these issues by looking at American Housing Survey data, the primary source of data on housing expenditures for metropolitan areas in the states of interest. The final section discusses the policy implications of these findings.

11.1. Who Should Have Insurance and Why?

The most serious public policy problems occur when a substantial fraction of homeowners suffering losses do not have insurance protection. If this fraction is large, there will be considerable pressure, partly political but partly altruistic, for special legislation to provide them with disaster assistance, as discussed in Chapter 5. In the United States, most homes are covered by some type of homeowners' insurance, but some are not. It is these victims' financial plight that raises the loudest calls for public assistance following natural and man-made catastrophes. When a disaster strikes, uninsured homeowners will become more impoverished unless local, state and federal governments step in, commonly in delayed, incomplete, inefficient, and arbitrary ways. Encouraging or requiring uninsured homeowners to obtain insurance prior to a disaster will lead to better outcomes than relying on disaster assistance after losses occur. Gaining a clearer idea as to the socioeconomic characteristics of homeowners who lack insurance coverage is a key to designing or evaluating public policy.

To help fill this gap, we reviewed data on the proportion of homeowners without insurance and on the characteristics of purchasers and non-purchasers. We were particularly interested in the insurance status of relatively low-income households which, as the data demonstrates, are much more likely to be uninsured. We used the American Housing Survey (AHS) data for 1998, 2000, and 2002. Our analysis is limited to owner-occupied homes. The AHS data was collected in eight large metropolitan areas in three of our four target states – Florida, New York and Texas; different cities were surveyed in different years. The data provides detailed information on insurance, housing, and homeowner characteristics.

Defining "Affordability"

There is no unique technical definition of "affordability" or "afford" in either economics or insurance-related policy analysis. We propose and use an interpretation that represents what policymakers and decision makers have had in mind, based on other uses of the term in policy discussions in the literature. In Section 11.3 we will also discuss alternative definitions of both "affordability" and "equity" that might be considered. The most common interpretation of affordability is a normative concept: a consumer expenditure on a particular good is said to be

“affordable” by a household if the expenditure buys an adequate amount of the good in question, if the household has enough income to pay for the expenditure on the particular good, and has enough money left over to buy adequate amounts (“an adequate basket”) of other goods. For example, Bramley (1991)²⁹² defines affordability of a given good as entailing a household’s having enough income to buy the quantity of the good “that meets well established (social sector) norms of adequacy” at a total cost “that leaves them with enough income to live on without falling below some poverty standard.”

While some variant of this definition (*normative*, in the sense that it depends on norms) is the basis of the most common uses of the term “affordability” or “affordable,” other definitions are possible. For example, one could define the income at which some amount of a good is affordable as that level at which more than half (or some other fraction) of otherwise similar households actually choose to obtain the item. This *behavioral* definition cannot be explored fully with the data at hand, since we do not know how purchase decisions are affected by changes in prices, but it could be implemented when information on price responsiveness of the purchase/non-purchase decision becomes available.

11.2. Why No Insurance? Concepts and Results

We explored the association between having or not having homeowners’ insurance and (1) whether the home carried a mortgage; and (2) the income of the homeowner (relative to the poverty line). We anticipate that homeowners without mortgages are more likely to be uninsured than homeowners with mortgages, because mortgage lenders typically require purchase of at least enough insurance to protect their assets at risk.

Homeowners with mortgages agree to pay for insurance because they are required to do so if they want to take out the loan that makes ownership of their home possible. Homeowners without mortgages generally ought to seek insurance as well, since damage can wipe out a very important asset that they own. However, they are not required to have insurance as a condition of retaining ownership in the home. If the mortgage balance slips to a low level relative to the value of the property, rational lenders may be less concerned about continuing insurance protection, expecting that any remaining exposure might be covered by the salvage and/or land value of the property.

Household income or wealth has a less obvious relationship to insurance coverage. For a given asset value at risk, the normative theory of insurance suggests that lower-income households are more likely to be insured, since a total loss would be a larger proportion of their wealth and therefore more devastating to them. However, it is often said that lower-income homeowners are “less able to afford” insurance (as part of housing costs). It is surely true that a given lower-income household paying an insurance premium would generally have lower levels of other consumption than if it had not purchased coverage (except when it actually experienced a loss).

²⁹² Bramley, G. (1991), *Bridging the Affordability Gap in 1990*, Birmingham, England BEC Publications.

For lower-income households without mortgages who find the insurance premium on their current home to be too burdensome, there is, in theory, an economically more attractive option to risking an uninsured loss of the asset from a disaster: sell the house, use the proceeds to buy a less expensive home and use the savings to cover the insurance premium on the new residence. This strategy works well on paper. In reality, however, sentimental attachment to a particular home, the desire to stay in a bigger house or in a nicer area, inertia, location of one's employment, the high transaction costs associated with selling and buying a new home (including the time and expenses associated with moving), lagged responses to insurance premium increases due to the appreciation in house value and higher replacement cost, and/or poor planning may make this strategy unattractive.

Analyses of American Housing Survey (AHS) Data

The AHS data indicates how these conflicting motives for purchasing insurance play out. The specific wording of the question in the AHS questionnaire was, "Does this household have homeowners insurance (HO) (household property insurance)?" Some people may have interpreted "homeowners insurance" to mean more comprehensive fire and hazard protection than what they currently have. So the fraction of people who said "No" may be an upward-biased measure of those without any financial protection for their house whatsoever.

We explore the implications of using different specifications of affordability in terms of household income. We assume that society chooses a lower boundary for adequate spending on the household's consumption of other goods and services, and therefore defines a household as unable to afford insurance if its income is below the amount needed to buy those other items as well as homeowners insurance. We explore two different levels of this "minimum adequate consumption standard": 125 percent of the federal poverty line and 200 percent of the poverty line.²⁹³

Table 11.1 shows the proportion of uninsured homeowners in the metropolitan areas in the AHS survey in Florida, New York and Texas, for the two different measures based on the federal poverty line. The proportion of homes owned by low-income households is substantial in all of the areas. It is highest in Miami and Tampa, and lowest in the two New York cities, Rochester and Buffalo, where lower-income families are more likely to rent rather than own.

²⁹³ The federal poverty line within the 48 contiguous states is \$9,800 per year for a single person and increases by \$3,400 for each additional person in the household.

TABLE 11.1. PERCENTAGE OF OWNER-OCCUPIED HOUSES IN HOUSEHOLDS WITH INCOME BELOW VARIOUS AFFORDABILITY THRESHOLDS, 1998-2002

Threshold	City and Year							
	Houston 1998	Tampa 1998	Rochester 1998	Dallas 2000	Miami 2000	Fort Worth 2000	Buffalo 2000	San Antonio 2002
200% of poverty	25.7	30.8	18.0	16.3	27.6	19.0	21.1	29.4
200% of poverty plus triple premiums	26.8	32.8	18.8	18.1	29.9	20.9	23.0	30.7
125% of poverty	15.8	17.2	9.0	6.85	12.6	8.7	7.8	14.5
125% of poverty plus triple premiums	17.3	18.7	9.7	8.4	14.7	10.8	9.0	16.8

Suppose that we utilize 200 percent of the poverty line as a measure of the affordability threshold. The data in the first row of Table 11.1 show that a significant portion of owner-occupied houses had owners with incomes *below* this line. Consider Houston, Texas. Based on the normative poverty-line definition, 26.8 percent of the homeowners in this city could not afford homeowners premiums even at their then-current level of income. What if we use 125 percent of the poverty line, a lower income level, as a threshold? Fewer homes were owned by people with such low incomes, so the proportion of Houston homes owned by families labeled unable to afford by this measure falls to 15.8 percent.

How would an increase in premiums, (e.g., from stricter adherence to risk-based pricing) affect the proportion of those who could *not* afford coverage? We simulate such an increase using data results from Table 11.1 by asking what the percentage of individuals in this category would be if the threshold premiums were raised by a substantial amount. Specifically, we assume that the premium to be paid would more than triple, and estimate this increase by adding twice the median premium to the threshold. Continuing with the Houston example, the median annual insurance premium in 1998 for those homeowners who bought homeowners insurance was approximately \$852. Homes owned by low-income homeowners generally had smaller premiums than this, but we shall use this measure in our illustration. If premiums had risen by triple the average premium, or \$1,704, the percentage of homeowners unable to afford insurance would increase, but only moderately, from 25.7 percent to 26.8 percent. That is, while the proportion of homes owned by people who cannot afford premiums is fairly high, it does not increase much if premiums increase substantially. Similar findings hold for the other seven cities as shown in Table 11.1. The findings are not changed for any of the eight cities when one uses a lower standard of affordability such as 125 percent of the poverty line. The reason these households are not able to afford insurance is because their incomes are low, not because their premiums are high.

This common normative definition of “affordability” does, however, lead to a puzzle in this regard. While many lower-income homeowners might be said to be unable to afford insurance, a very large fraction of those homeowners actually did pay for homeowners insurance. In fact, 96.6 percent of non-afforded homeowners with mortgages had insurance (data not shown). This high proportion presumably reflects lender requirements.²⁹⁴ Table 11.2 shows that, of those non-afforded homeowners who had no mortgage, a surprisingly low percentage of low-income homeowners had no insurance. The percentages without insurance ranged from a low of 6.5 percent (Buffalo, NY) to a high of 31.8 percent (San Antonio, TX). Mortgages for poor households are most common in Miami, FL; Dallas, TX; and Tampa, FL, which explains the relatively low overall uninsured percentage among low-income homeowners in these three areas. We conjecture that the very low uninsured percentages in Rochester and Buffalo are due to the fact that a much larger proportion of low-income individuals rent in these two cities than in the other six, so that almost all of those who choose to own a home can afford to pay for the insurance.

TABLE 11.2. MORTGAGE AND INSURANCE STATUS, LOW-INCOME HOUSEHOLDS, 1998-2002

	<i>City and Year</i>							
Affordability: 200% poverty	Houston 1998	Tampa 1998	Rochester 1998	Dallas 2000	Miami 2000	Fort Worth 2000	Buffalo 2000	San Antonio 2002
% without mortgage	62.6	58.6	64.1	49.0	48.9	65.6	65.8	63.0
% without mortgage and without insurance	31.6	11.6	7.7	20.1	26.8	26.9	6.5	31.8
Overall % without insurance	23.2	8.3	6.3	15.5	21.0	22.8	5.1	23.1

	<i>City and Year</i>							
Affordability: 125% poverty	Houston 1998	Tampa 1998	Rochester 1998	Dallas 2000	Miami 2000	Fort Worth 2000	Buffalo 2000	San Antonio 2002
% without mortgage	66.8	59.1	67.1	49.4	55.0	71.0	62.6	70.6
% without mortgage and without insurance	32.0	11.7	10.0	26.1	31.1	27.9	7.7	34.0
Overall % without insurance	25.0	9.0	8.3	22.2	26.1	24.8	6.9	27.2

²⁹⁴ Perhaps the few homes with mortgages but without insurance are ones in which the principal of the mortgage has fallen so low that the lender’s interest is less than the salvage value of the property, and so the lender is less strict in requiring insurance.

Aside from having a mortgage, what other variables are related to the purchase of homeowners insurance for low-income homeowners? Table 11.3 shows that for *non-afforder* homes without mortgages, insurance coverage is more likely if the home has a higher value, and if the owner is older. Since the insurance premium is almost always higher for higher house values, this finding shows that households do not necessarily drop coverage when they have to pay more for insurance. If the higher premiums reflect protection of more assets at risk, households somehow find a feasible way to protect their property.

TABLE 11.3. SAMPLE DATA ON OWNER-OCCUPIED HOUSING AMONG HOUSEHOLDS WITHOUT MORTGAGES, UNDER 200% FPL - BY HOMEOWNERS' INSURANCE STATUS

	1998 AHS			2002 AHS				2004 AHS
	Houston	Tampa	Rochester	Dallas	Miami	Fort Worth	Buffalo	San Antonio
Among Uninsured (N)	104	44	21	39	79	62	16	136
Mean Value of House (\$)	37,402	45,181	37,528	55,024	71,852	48,458	37,144	55,571
Mean Age of Householder	56.8	58.2	63.0	57.1	64.8	57.3	56.8	60.8
Among Insured (N)	249	366	273	146	232	184	252	300
Mean Value of House (\$)	77,174	65,440	77,361	102,049	136,958	83,908	83,168	83,570
Mean Age of Householder	62.8	71.4	69.0	63.0	69.2	64.5	71.7	62.7

Source: Authors' calculation; Data From American Housing Survey

11.3. Alternative Definitions of Affordability

While the definition of affordability based on income (minus premiums) relative to the poverty line is a reasonable one that is common in the literature that deals with affordability, other definitions are possible. One alternative is a definition that makes affordability dependent not on value judgment about what people can pay for, but rather on what they typically do choose to pay for. This *behavioral* definition (Bundorf and Pauly, 2006)²⁹⁵ says that a household with a given set of characteristics can afford some particular item of consumption if most households with the same set of characteristics do in fact choose to buy that item. In the present application, this definition might suggest that if most households at a given income level without mortgages owning a house of a given value do obtain homeowners insurance, those households with those characteristics who do not obtain insurance could have afforded it – but chose not to purchase it. One could then investigate what proportion of uninsured homeowners could have afforded insurance. If in almost every set of characteristics that one might construct, a majority of homeowners do buy insurance, we would conclude that almost everyone could afford insurance.

²⁹⁵ Bundorf, M.K. and M.V. Pauly (2006), "Is Health Insurance Affordable for the Uninsured?" *Journal of Health Economics*, 25(4): 650-673.

There are still some important value judgments here. For example, rather than judging something as affordable if a certain percentage of people already buy it, one could increase the criterion from 50 percent to a larger fraction, such as 75 percent or 90 percent. The set of characteristics also represents a value judgment. Presumably “uninsured” does not belong, but what about something like “says they live from paycheck to paycheck?” Very probably, a larger fraction who indicate that this behavior matches their own will be uninsured, but that kind of budgeting strategy is not imposed on people; they choose to budget in a particularly risky way (in contrast to other households similar to them on objective measures), and we would not want to let them be labeled “unafforders” just because they chose a dysfunctional pattern of family budgeting. Even measures like the value of the house or the presence or absence of a mortgage are not endogenous to households; they choose to be or not to be in one of these sets.

To estimate the proportion of uninsured homeowners who cannot afford insurance by this criterion, we would need to specify and estimate an empirical behavioral model of the decision to obtain some insurance, which we have not done. The AHS contains only some measures of household characteristics, perhaps not all that one might want. Based on the data presented above, it is very likely that most low-income people who own relatively high-value homes will have insurance, so that the minority who are uninsured would be labeled “afforders.” If uninsured households are a minority in most income and demographic categories, one would be able to conclude that most uninsured could have afforded insurance.

Another possible definition of affordability of homeowners insurance is based on definitions of affordable housing used by the U.S. Department of Housing and Urban Development (HUD). HUD usually classifies people as unable to afford housing in a given market area if the total cost of housing (including insurance) is more than 30 percent of their income *and* their income is less than half the median income in their market area. The basis for this definition is again a value judgment: such families “are considered cost burdened and may have difficulty affording necessities such as food, clothing, transportation, and medical care” (HUD, 2007).²⁹⁶ This definition differs from our earlier normative version in being based on total housing costs, and on requiring necessarily subjective judgments about what levels of spending on other necessities is affordable. While we do not apply this definition to the AHS data since it seems to go to factors other than premiums and their regulation to define social objectives, we do note that it makes the interesting point that society might be more concerned about the total cost of housing rather than any component of it. For example, if property taxes are very high in an area, a relatively low-income household might be said to be unable to afford housing even if homeowners insurance premiums were quite low.

Another alternative definition of affordability is one that was established by the Environmental Protection Agency to meet guidelines established by the 1996 Amendments to the Safe Drinking Water Act. The amendment specified that small public water systems would be allowed to use less effective pollutant control technologies when the designated technologies for satisfying treatment technique requirements were not “affordable.” EPA judged that a technology was not affordable for a small system if the associated average expense per

²⁹⁶ U.S. Department of Housing and Urban Development, “Affordable Housing,” <http://www.hud.gov/offices/cpd/affordablehousing/index.cfm> as of December 7, 2007.

household served exceeded 2 percent of the median household income in the service area.²⁹⁷ Using this definition for judging whether a household could pay for homeowners insurance, one could determine what proportion of those residing in any given region would be considered unable to afford to pay the premium. The federal poverty line for a family of 4 is nearly \$20,000 per year,²⁹⁸ which means that if the insurance premium were above \$400, it would be considered unaffordable. By this definition, a much larger percentage of homeowners in the hazard-prone areas under study would be classified as being unable to afford insurance. The qualitative conclusions of the previous section would still hold: most of the homeowners in the “unaffordability” class would still have purchased insurance.

11.4. Equitable Changes in Premiums

While measures based on ability to consume and on household choices capture static notions of affordability, there may also be a notion of equity that people have in mind that relates to the fairness in *changes* in homeowners premiums. In particular, if changes in premiums are distributed very unevenly across households, one might take the view that those subject to very large increases are not being treated fairly and justly. To be specific, suppose a population of owners of similar homes (but in different locations) with initially similar premiums unexpectedly face increases in premiums that are much larger for homes in some locations than in others. Some homeowners see their premiums jump by thousands of dollars per year, while others, perhaps most homeowners, have modest changes. While the increase in premiums might not be large enough to push the unlucky families’ consumption levels down below the poverty line, and while all households might continue to buy coverage, there might be a public policy argument that one subgroup is being inequitably singled out for substantially higher premium increases (disregarding the reasons why this huge increase happened).

Whether or not this pattern is inequitable is obviously a value judgment, and such judgments may differ across voters, policymakers, insurers or regulators. It seems plausible that views might differ depending on the reason for the premium change. If it reflects a dramatic change in relative risk estimation, views might be different than if it reflected a movement to risk-based premiums after a period of regulation-required community rating. If in the former case, insurers and homeowners alike had previously believed risk levels to be both lower and more uniform than the risk levels indicated by new risk models with new data, then it might be possible to make the case for some regulatory cushioning of large changes in market-based premiums. Note that this argument is the same as the one discussed above about the desirability of protection (insurance) against large and unexpected jumps in annual premiums. If such protection can be provided to existing homeowners in ways that do more good than harm, it should be sanctioned. But inhibiting the ability of insurers to obtain premiums reflecting risks from new or prospective homeowners can have substantial inefficiency costs in the form of distorted incentives to local housing and inhibit investment in mitigation, so in this sense it is less desirable.

²⁹⁷ For more details on this concept of affordability see Congressional Budget Office, *Future Investment in Drinking Water and Wastewater Infrastructure*, November 2002, Appendix C.
<http://www.cbo.gov/ftpdocs/39xx/doc3983/11-18-watersystems.pdf>.

²⁹⁸ As mentioned earlier, the federal poverty line within the 48 contiguous states is \$9,800 per year for a single person and increases by \$3,400 for each additional person in the household.

As suggested, an equity-based argument would seem at most to be one that applies to people who owned the homes before the risk estimate changed. Whether they remain in those homes and pay high premiums or decide to sell their homes at a lower price, they do bear an unexpected cost, and they, as well as society, might wish some protection on the basis of efficiency in risk spreading as well as equity. The only sensible standard here would seem to be what the full subset of homeowner-taxpayers might prefer as public policy, with options presented clearly and tax or premium cost differences made transparent. The tendency to imagine that insurers have the power to absorb higher expected costs should be resisted.

11.5. Implications for Policy

The results of our analysis indicate a policy puzzle. If the government wanted to make insurance more affordable to homeowners that it thought were unable to afford the premiums, and based eligibility for a specific subsidy program only on a homeowner's having a low income relative to the poverty line, it would have to subsidize a large fraction of homeowners in many areas who had already been willing to pay for insurance. For example, at the 200 percent of poverty line standard, more than a quarter of homeowners would need to be subsidized in a number of areas we studied. In all the cities we reviewed, the government would have to subsidize at least 16 percent of all homeowners.

However, no more than 27 percent of these needy households now fail to buy their own insurance even when not required to do so by a mortgage lender (San Antonio; 125 percent of poverty). The type of subsidy program that would have the highest likelihood of homeowners buying or retaining coverage (and might also be regarded as fair) would be one which subsidized *all* low-income homeowners. To direct these subsidies only to those uninsured at a given low income level at a given point in time would offer strong incentives for the majority with coverage to cancel their insurance and would deny subsidies to those owners who behaved responsibly by maintaining their coverage.²⁹⁹ However, such a globally efficient and equitable subsidy program to reduce the number of uninsured homes would direct the bulk of subsidies to homes that were already insured. If the goal was primarily to subsidize currently uninsured homes or to reduce the number of uninsured homes, such a uniform program would probably have low *target efficiency*, in the sense that the government would be paying a lot per uninsured homeowner subsidized, and therefore potentially now able to purchase insurance.

Consider Houston, where about 23 percent of low-income homeowners lack insurance (but 77 percent of low-income homeowners already have it). An across-the-board subsidy of, say, \$1,000 per house per year in Houston that caused all formerly uninsured households to buy insurance would have a subsidy cost per newly insured home of \$4,348. That is, for every uninsured household which bought insurance because it received a subsidy, there would be about three other households receiving the subsidy that had already bought homeowners insurance.

It seems that *unaffordability* by the usual normative definition and standard does **not** do a very good job of identifying households without insurance. Instead, it identifies many households that may have problems or may be strained by homeowners insurance premiums, but not to the extent that they forego coverage. This definition of affordability says that many homes are owned by families who cannot fully afford anything. Their incomes are so low that

²⁹⁹ Chapter 14 discusses how one might subsidize low-income families in a more efficient and equitable way.

they cannot afford the other components of housing expense (e.g., taxes and utility bills) for those with no mortgage. Rather than subsidize insurance *per se* by maintaining artificially low insurance prices through regulation, it might be better to provide these families with more income through such provisions as the Earned Income Tax Credit that simply transfers income to low-income households, regardless of their current consumption patterns.

More generally, these results offer little support for the view that insurance premiums (or higher insurance premiums) are a major cause of fiscal distress among homeowners. There are some families that should have chosen a less expensive house or a rental option. But when low-income households own higher-value property, and so have a stronger incentive to have coverage, they are, in fact, more likely to buy insurance. This indicates that insurance purchase is not so much related to a normative definition of affordability based on low income, as it is related to low demand because of less wealth at risk.

Even so, an increase in insurance premiums unaccompanied by an increase in house value will add to the financial problems these families already face. For a large portion of these homeowners, a premium increase will not be the proximate cause of the problem of insurance unaffordability. Rather, the cause is low income and/or high levels of other expenses, including other housing costs. By a similar argument, lowering premiums through moderate subsidies will not lead to major increases in either the probability that an uninsured household will buy insurance or that the households' overall financial picture will brighten appreciably.

These data indicate that low-income homeowners (even very low-income homeowners) largely seek to buy and retain insurance, even when they do not have to do so because of mortgage requirements. Anecdotes of uninsured homeowners may be common in media stories, but actual instances of uninsured homeowners are relatively rare, at least in the eight cities we have studied. Ideal public policy should, of course, still deal with cases where homeowners do not have insurance that they ought to have, or with cases where low-income families have a lower than desirable ability to obtain adequate amounts of all goods, but altering insurance prices across the board is much too blunt an instrument to deal with this relatively small fraction of low-income homeowners. If, nevertheless, there were a substantial alteration of relative premiums, what impact would this have? We have shown that it would not push very many additional families below the threshold of affordability.

This data cannot tell us, however, how many low-income homeowners might significantly decrease their coverage (selecting higher deductible and lower limit), or even drop coverage, if their premiums increased and the value of their property remained constant. Our preliminary analyses in this chapter show that it is possible to find variables that strongly predict a higher chance of not having coverage, so using some of those characterizing variables to target a subsidy program might make more sense than using an indiscriminate approach.

SUMMARY OF CHAPTER 11

This chapter characterizes the socioeconomic features of the insured and uninsured population of homeowners. After defining the meaning of “affordability,” we use data from the American Housing Survey (AHS) to determine the proportion of low-income households who do not have homeowners’ coverage in eight metropolitan areas of Texas, Florida and New York. At least 73 percent of low-income homeowners in these regions had purchased homeowners insurance. Almost all homes with mortgages have insurance, and coverage is more likely if the home has a higher value and the owner is older.

The chapter concludes with implications for public policy. The results offer little support for the view that higher insurance premiums are a source of financial distress among homeowners, suggesting that there may not be a large increase in uninsured homeowners if premiums are increased to reflect risk. To decrease the number of uninsured homeowners, one should find variables that strongly predict a chance of not having coverage and provide special treatment to those individuals; the poverty line is not necessarily one of these variables.

CHAPTER 12

ENHANCING THE IMPLEMENTATION OF MITIGATION MEASURES: THE NEED FOR PUBLIC-PRIVATE SECTOR COLLABORATION

KEY FINDINGS

The adoption of building codes significantly reduces damage from hurricanes. Based on a sample of over 5,600 homeowners impacted by Hurricane Charley in 2004, residences built under the wind-resistant standards that were enforced in 1996 had a claim frequency that was 60 percent lower than those that were built pre-1996. Claims for pre-1996 damaged homes resulted in an average of \$24 per square foot compared to \$14 per square foot for those constructed between 1996 and 2004.

Many homeowners do not voluntarily invest in mitigation measures. The principal reasons that homeowners do not invest in mitigation measures are that they overweight short-term cash expenditures, underestimate the risk due to excessive optimism, and do not learn enough from past experiences. Social norms can lead individuals to take steps to reduce future disaster losses. If all homeowners in your hurricane-prone neighborhood installed strong storm shutters, then you would very likely want to follow suit.

It is possible to significantly increase adoption of mitigation measures by enforcing building codes, developing economic incentive programs such as tax rebates, and adopting zoning ordinances. Collaboration between the public and private sectors is critical in this regard. For instance, tax credits can be given to property owners who purchase building supplies used to make their homes more storm resistant. Mitigation grants are available to low-income families for retrofitting their homes, and matching grants (on a dollar-for-dollar basis) can be made available to all homeowners in the state, as authorized in the South Carolina's Omnibus Coastal Property Insurance Reform Act of 2007.

CHAPTER 12

ENHANCING THE IMPLEMENTATION OF MITIGATION MEASURES: THE NEED FOR PUBLIC-PRIVATE SECTOR COLLABORATION

This chapter discusses the role that mitigation measures can play in reducing losses from natural disasters, and the positive role that insurance could play in encouraging more homeowners to adopt cost-effective protective measures. It also raises a set of challenges for encouraging the adoption of mitigation measures.

12.1. The Role of Insurance as a Bridge between Mitigation and Risk Financing

The challenge society faces today is how to promote investments in cost-effective loss reduction mechanisms while at the same time placing the burden of recovery on those who suffer losses from natural disasters.³⁰⁰ In theory, insurance is one of the most effective policy tools for achieving both objectives, because it rewards investments in cost-effective mitigation with lower premiums, and provides claims payments to policyholders should a disaster occur.

In recent years, insurance has not played this role as much as it could. Insurers generally have not fully implemented pricing adjustments which encourage the adoption of cost-effective loss prevention measures for several reasons. First, they feel that few people would voluntarily adopt these measures based on the small annual premium reductions for taking these actions compared to the upfront cost. If individuals have short time horizons, then they would have little interest in investing \$1,500 in return for a reduction in annual premiums of say, \$200.

As discussed in Part I of this report, insurance is a highly regulated industry. Rate changes and new policies generally require the approval of state insurance commissioners. If premiums are artificially low in hazard-prone areas, insurers have no economic incentive to offer premium discounts for those who adopt mitigation measures. In fact, they prefer not to offer coverage to these property owners because it is a losing proposition in the long-run.

For insurance to play a positive role in encouraging homeowners to adopt mitigation measures, it is necessary that premiums reflect risk, so that insurers will want to provide price reductions for those who adopt these measures. Furthermore, there is a need to study the decision making processes of homeowners to understand more fully why some invest in mitigation measures and others do not.

There is also a need to involve other key interested parties from the private sector, such as the construction and banking industries, so that mitigation can be seen as an attractive investment by property owners. Well-enforced building codes may play an important role in encouraging the private sector to become proactive with respect to fostering cost-effective mitigation measures.

³⁰⁰ For further discussion and recommendations as to ways to reduce future disaster losses through mitigation, see The Financial Services Roundtable (2007), *Blue Ribbon Commission on Mega-Catastrophes. A Call to Action*, Chapter 4, Washington, DC.

12.2. Mitigation Measures for Hurricane-Related Damage

Table 12.1 summarizes the level of damage associated with different categories of hurricanes along with sustained wind speed and anticipated storm surge. The actual damage will depend on the level of mitigation measures in place at the time of the disaster.

TABLE 12.1. ANTICIPATED DAMAGE TO STRUCTURE ON THE SAFFIR-SIMPSON HURRICANE SCALE

Scale Number (Category)	Sustained Winds (MPH)	Damage	Storm Surge
1	74-95	Minimal: Damage is done primarily to shrubbery and trees; unanchored mobile homes are damaged; some signs are damaged; no real damage is done to structures.	4-5 feet
2	96-110	Moderate: Some trees are toppled; some roof coverings are damaged; major damage is done to mobile homes.	6-8 feet
3	111-130	Extensive: Some structural damage is done to roofs; mobile homes are destroyed; structural damage is done to homes and utility buildings.	9-12 feet
4	131-155	Extreme: Extensive damage is done to roofs, windows, and doors; roof systems on buildings completely fail; some curtain walls fall.	13-18 feet
5	More than 155	Catastrophic: Roof damage is considerable and widespread; damage to windows and doors is severe; there are extensive glass failures; some buildings fall.	Greater than 18 feet

Source: FEMA³⁰¹

The damage to property from natural disasters falls into two categories – *structural damage* and *contents damage* (damage to the land itself can also occur, but it is generally not a major consideration). *Structural damage* refers to the damage to the foundation, frame, roof and other features – exterior and interior – of the property at risk. *Contents damage* refers to the damage to valuable items located at the property – automobiles, furniture, fixtures, appliances, electronics and other contents with a monetary or non-monetary value (the latter can include irreplaceable documents and items with sentimental value).³⁰²

³⁰¹ Federal Emergency Management Agency (FEMA) (2002), “Community Wind Shelters, Background and Research,” August.

³⁰² Structural damage can cause contents damage (for example, when a broken window allows in water from a flood or hurricane), and contents damage can cause structural damage (as when an unsecured water heater topples during an earthquake, causing fire damage to the property). Either kind of damage can cause injury or loss of life, whether from broken glass windows or the collapse of a structure destroyed by fire.

Wind Damage. Wind from hurricanes poses a major danger to the structure of the property, particularly to the roof, windows and doors. Mitigation measures to roofs include replacing old or damaged sheathing, sealing sheathing joints and installing a roof covering that can withstand high winds. Connections, where the roof meets the walls and where the walls meet the foundation, should be well anchored. Mitigation measures to windows include impact resistant window systems or storm shutters. Patio doors should be non-sliding, and high-wind-resistant garage door and track systems are recommended. Another measure homeowners can take is to ensure that objects on the property that could become debris in a windstorm, especially overhanging tree branches, are cleared.

Water Damage. To reduce water damage from floods and hurricanes, property owners can undertake a variety of flood-proofing measures that include the use of flood-resistant building materials, bracing roof trusses and gable end walls, applying wood adhesive where the roof decking and roof supports meet, installing hurricane straps or clips where the roof framing meets the top of the studs, and elevating the structure.³⁰³

12.3. Cost-Effectiveness of Mitigation Measures

The challenges associated with encouraging homeowners to mitigate against catastrophic risks lie in demonstrating (1) the effectiveness of mitigation measures: and (2) a sufficient expected return on the investment over the relevant time horizon. As the government has been allocating money to support mitigation efforts, an important question relates to the effectiveness of these governmental grants.

This was the purpose of a multi-year study undertaken by the U.S. National Institute of Building Science and released in 2005. This initiative systematically assessed the future savings from hazard mitigation activities supported by the U.S. Federal Emergency Management Agency's grants for a period of 11 years (1993-2003). The study quantified these savings for three types of hazards: wind, flood, and earthquake. Benefits were defined as losses avoided, and included reduced direct property damage, reduced direct business interruption, reduced indirect business interruption ("ripple" effects), reduced environmental damage (to wetlands, parks or historical structures), and reduced human losses (deaths, injuries, homelessness). Benefits also included the reduced cost of emergency responses, as well as reduced amount of federal funds being used for disaster assistance/recovery (including post-disaster tax revenue decreases because of tax-breaks or interruption of activities).

These findings are interesting because they demonstrate a high benefit/cost ratio of mitigation grants. The study estimates that the aforementioned benefits from FEMA mitigation grants represent \$14 billion (in 2005 dollars), compared to \$3.5 billion for grants made by FEMA on the studied programs. In other words, using a statistically representative sample of FEMA grants awarded between 1993 and 2003, it can be shown that \$1 spent on mitigating the risk of wind, flood and earthquake in the United States saves an average of \$4 (U.S. National Institute of Building Science, 2005).³⁰⁴

³⁰³ For more details on these and other measures see Laska, S.B. (1991), *Floodproof Retrofitting: Homeowner Self-Protective Behavior*, Boulder, CO: Institute of Behavioral Science, University of Colorado.

³⁰⁴ U.S. National Institute of Building Science (2005), "Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities," Multihazard Mitigation Council, Washington, DC.

On the human side, it is estimated that these mitigation measures are likely to save over 200 lives and prevent almost 4,700 injuries over 50 years. The U.S. National Institute of Building Science's Multihazard Mitigation Council (MMC) indicates that federal grants are not only cost-effective, but that they also often lead to the implementation of additional mitigation measures that are supported by other sources, especially in communities that have implemented specific mitigation programs in a systematic way. Appendix 12 highlights two examples of mitigation projects undertaken recently by the state of Florida with funding support from FEMA: the Miami-Dade Flood Control Project and the Miami Children's Hospital which recently underwent a state-of-the-art retrofit to enable it to withstand a Category 4 hurricane. The MMC recommended that:

"... the federal government should support ongoing evaluation of mitigation by developing a structured process for assessing the performance of buildings and infrastructure after all types of natural disasters and by measuring the benefits that accrue from process mitigation activities."³⁰⁵

12.4. Role of Building Codes

Building codes require property owners to meet standards on new structures, but normally do not require them to retrofit existing structures. Often, such codes are necessary, particularly when property owners are not inclined to adopt mitigation measures on their own due to their misperception of the expected benefits resulting from adopting the measure and/or their inclination to underestimate the probability of a disaster occurring.

Cohen and Noll (1981)³⁰⁶ provide an additional rationale for building codes. When a structure collapses, it may create negative externalities in the form of economic dislocations and other social costs that are beyond the financial loss suffered by the owners. For example, if a poorly designed structure collapses in a hurricane, it may cause damage to other buildings that are well designed and still standing from the storm. Knowing this, an insurer may offer a smaller premium discount than it would otherwise have given to a homeowner investing in loss reduction measures.

Two agencies that rate building codes in the U.S. are the International Code Council (ICC) and Insurance Services Office (ISO). ICC is a membership association which produces model building codes which can then be implemented or modified by individual states. Forty-seven states plus Washington, DC use the International Building Code (which focuses on nonresidential property). Forty-five states plus Washington, DC use the International Residential Code (which deals with the construction of one- and two-family dwellings and townhouses up to three stories high). Forty-two states plus Washington, DC use the International Fire Code (which addresses fire safety in new and existing buildings) (International Code Council, 2006).³⁰⁷

³⁰⁵ Ibid., Vol. 1, p. 7.

³⁰⁶ Cohen, L. and R. Noll (1981), "The Economics of Building Codes to Resist Seismic Shocks." *Public Policy* (Winter): 1-29.

³⁰⁷ International Code Council (2006); <http://www.iccsafe.org/government/adoption.html>, as of September 2007.

The Building Code Effectiveness Grading Schedule

The *Building Code Effectiveness Grading Schedule* (BCEGS) is a community-level mitigation rating system administered by the Insurance Services Office (ISO). The BCEGS assesses the building codes in effect in a particular community and how the community enforces its building codes, with special emphasis on mitigation of losses from natural hazards. The BCEGS program places particular emphasis on reducing losses caused by hurricanes, tornadoes and earthquakes. The BCEGS judges adherence to building codes, since the score is based not only on the building code in place but also on field inspector staffing and qualifications.

The BCEGS ratings received by communities are provided to insurers to use as an underwriting tool. The insurance companies we surveyed all gave the same premium discounts: 11-14 percent premium discounts for those with the best BCEGS score (“1”) dropping to 0 percent for those with the worst BCEGS score (“10”), and 0 percent or even a 1 percent surcharge for those policyholders who live in a community not graded by ISO.

According to the U.S. Government Accountability Office³⁰⁸ few insurance companies are using the BCEGS report to provide premium discounts. The one exception is Florida, where insurers are required by law to offer discounts on wind protection premiums based on a community’s BCEGS rating. Communities that do not participate in the program are assessed a 1 percent surcharge on wind protection premiums.

Figure 12.1 shows in stark detail how the stringency of building codes can translate into vastly different levels of damage (compare the upper left-hand corner of the photo with the lower right-hand corner of the photo). This photo, taken in south Florida after Hurricane Andrew shows that homes on one side of a street were completely destroyed, while homes on the other side were still standing. Later inspection determined that, in many cases, construction of the destroyed buildings was well below the standard required by the building code in effect.³⁰⁹



FIGURE 12.1. EFFECTIVENESS OF MITIGATION MEASURES IN PLACE IN FLORIDA

Source: National Oceanic and Atmospheric Administration/Department of Commerce

³⁰⁸ U.S. Government Accountability Office (GAO) (2007), *Natural Hazard Mitigation: Various Mitigation Efforts Exist but Federal Efforts Do Not Provide a Comprehensive Strategic Framework* Washington, DC, (August), pp. 39-40.

³⁰⁹ <http://www.iso.com/products/2400/prod2409.html> as of September 2007.

The Insurance Services Office (ISO) uses the BCEGS as part of the Community Rating System (CRS), a component of the National Flood Insurance Program (NFIP) which allows communities to achieve lower flood insurance rates through mitigation (ISO, 2006).³¹⁰ Depending on the level of activities that communities undertake in four areas (public information; mapping and regulatory activities; flood damage reduction; and flood preparedness), communities are rated from 1 to 10. A class 1 rating provides the largest flood insurance premium reduction (45 percent) while a community with a class 10 rating receives no premium reduction (GAO, 2007).³¹¹ Only a small number of communities (around 1,000 at risk from flooding nationwide) participate in the CRS, so it is an incomplete national indicator of code adherence. More detailed assessment of building code enforcement at the local level often takes place on an *ex post* basis, with disasters such as Hurricane Katrina serving as the impetus for such a review.

Application to Florida

Florida has several insurance mandates regarding mitigation measures and rating that make it an interesting test case. First, rating on mitigation measures, such as adherence to latest building codes, are mandatory in Florida. Florida also has a permit and inspection system that allows insurers to verify that mitigation measures are in place without the expense of independent verification. A qualified inspector is defined as a Florida licensed building inspector, building contractor, general contractor, residential contractor, structural engineer or architect.

My Safe Florida Home Program. The Florida Department of Financial Services operates this program to help Florida residents identify ways to strengthen their homes to reduce damage from hurricanes. The program offers a free home inspection to homeowners that meet income and other eligibility requirements to help them identify appropriate mitigation measures. The state provides matching grants of up to \$5,000 to make recommended mitigation improvements (GAO, 2007).³¹²

Florida Building Codes. Following Hurricane Andrew in 1992, Florida reevaluated its building code standards and their enforcement. In 1995, coastal areas of Florida began to use and enforce high wind design provisions for residential housing. Toward the end of the 1990s, the state began the process of developing and enforcing a statewide building code. The Florida Building Code (FBC) 2001 edition was adopted in mid-2002, accompanied by an extensive education and training program that included a requirement that all licensed engineers, architects and contractors take a course on the new building code.³¹³

Hurricane Charley in 2004 demonstrated the impact of the new building code. One insurance company provided the Institute for Business & Home Safety (IBHS) data on 5,636 policies in Charlotte County at the time that this hurricane made landfall on August 13, 2004. There were 2,102 reported claims from the hurricane (37 percent of all the homeowners insurance policies in Charlotte County for this insurer). Figure 12.2 reveals that homes built under the new wind-resistant standards that were enforced in 1996 had a claim frequency that was 60 percent less than those that were built prior to 1996.

³¹⁰ ISO (2006); <http://www.isomitigation.com/bcegs/0000/bcegs0001.html>

³¹¹ GAO (2007), Op. Cit.

³¹² Ibid. p. 38.

³¹³ More recent building codes were established in 2004, then in 2007. See www.FloridaBuilding.org.

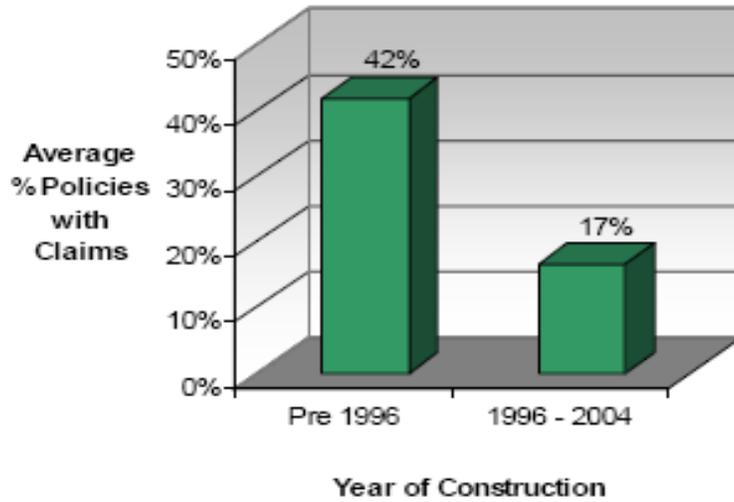


FIGURE 12.2. AVERAGE CLAIM FREQUENCY BY BUILDING CODE CATEGORY FROM HURRICANE CHARLEY
 Source: Institute for Business & Home Safety (IBHS)

Moreover, this insurer’s claims for pre-1996 homes resulted in an average claim amount of \$24 per square foot, compared to \$14 per square foot for those constructed between 1996 and 2004, as shown in Figure 12.3. For an average home of 2,000 square feet, the average damage to each of these homes would be \$48,000 and \$28,000 respectively. In other words, the average reduction in claims from Hurricane Charley to each damaged home in Charlotte County built according to the newer code was approximately \$20,000 (Institute for Business & Home Safety, 2007).³¹⁴

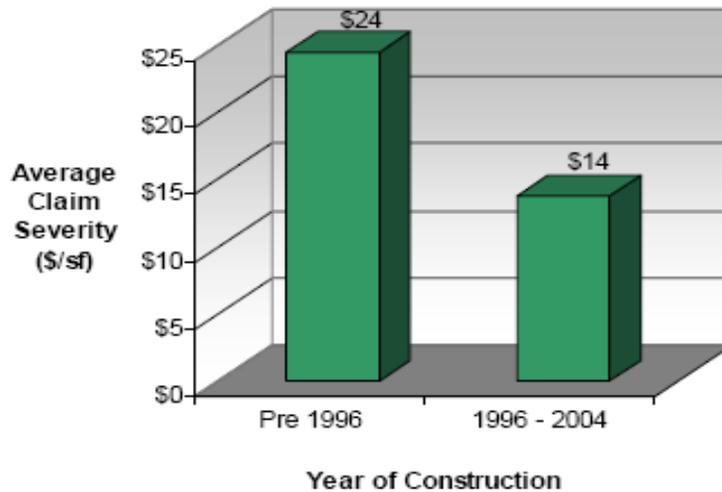


FIGURE 12.3. AVERAGE CLAIM SEVERITY BY BUILDING CODE CATEGORY FROM HURRICANE CHARLEY
 Source: Institute for Business & Home Safety (IBHS)

³¹⁴ Institute for Business & Home Safety (2007), *The Benefits of Modern Wind Resistant Building Codes on Hurricane Claim Frequency and Severity—A Summary Report*.

Rewarding Mitigation with Premium Discounts. In order to quantify the mitigation discounts that insurers give to their policyholders, we examined the rate manuals for four major homeowners insurance companies in Florida: Allstate, State Farm, Travelers and Citizens Property Insurance Corporation. What we present here is a sample of mitigation discounts.

Properties constructed prior to new building code requirements are permitted exemption until the next improvement to the home. Therefore, there are three levels of building code compliance in Florida: non-FBC (“grandfathered” structures), existing homes FBC compliant (pre-2001 constructions that are retrofitted to the latest building standard) and FBC new construction (homes built after adoption of the new building code).

All four companies have two types of mitigation discount plans: one for Florida Building Code (FBC) compliant homes (whether existing or new construction); and one for non-FBC compliant homes with verified mitigation measures. Measures that garner discounts include roof covering, roof deck attachment, roof-wall connection, roof opening protection and secondary water resistance measures. This discount generally applies to the hurricane portion of the premium (premium structures are generally split between non-hurricane and hurricane premium).

One other measure of interest is rewarding superior construction – structures that are built with mitigation features above and beyond those required by building codes. An example of this is the Fortified Home[®] seal of approval offered by the Institute for Business & Home Safety (IBHS). Of four insurers’ programs we examined in detail,³¹⁵ only one explicitly makes use of this mitigation measure, awarding policyholders a 10 percent discount on total premiums (i.e., hurricane and non-hurricane premiums). Another insurer defines a *superior construction* measure (i.e., one which can encompass other types of well-designed structures), and awards policyholders a 15 percent discount on total premiums.

12.5. Factors Influencing the Adoption of Mitigation Measures³¹⁶

A Normative Model of Choice: Cost-Benefit Analysis

Consider the Lowlands, a hypothetical family whose home was destroyed by one of the four hurricanes that hit Florida in 2004. They have decided to rebuild their property in the same location but are undecided as to whether they want to invest in a wind reduction measure (e.g., storm shutters).³¹⁷ Suppose that scientific experts have estimated that the annual chance of a severe hurricane in the area where the Lowlands live is 1 in 100. If they invested in a wind mitigation measure, they would reduce damage from this hurricane by \$40,000. In other words,

³¹⁵ Citizens Property Insurance Corporation (2006), *Homeowners Policy Program Manual General Rules*, Ed. 4/01/2006; State Farm Florida Insurance Company, Homeowners: FPL-10.509, 8/15/2006; First Floridian Auto and Home Insurance Company (Travelers of Florida), *Filing 06-05323: Homeowners Premium Section*, Rev 4/23/2006; Allstate Floridian Insurance Company, *Homeowners Manual*, 4/22/2002.

³¹⁶ This section is based on Kunreuther, H. (2006), “Disaster Mitigation and Insurance: Learning from Katrina,” *ANNALS*, American Academy of Political and Social Science, 604: 208-227. Portions of this chapter are reprinted from Kunreuther, H., R.J. Meyer, and E. Michel-Kerjan (2007), “Strategies for Better Protection against Catastrophic Risks” Invited Paper for the Conference on the Behavioral Foundations of Policy, Princeton University, October 2007.

³¹⁷ A discussion of alternative flood reduction measures can be found in Laska (1991; *ibid*) and Federal Emergency Management Agency (FEMA) (1998), *Retrofitting: Six Ways to Prevent Your Home from Flooding*, Washington, DC: Federal Emergency Management Agency, June.

the expected annual benefit from investing in such a measure would be \$400 (i.e., 1 in 100 x \$40,000). The longer the time period (T) that the Lowlands expect to live in their house, the greater the expected benefit from hurricane-proofing their house. More specifically, let (B) represent the expected net present value of the benefit of mitigation over (T).³¹⁸

Suppose the extra cost to the Lowlands of undertaking windproofing measures is $C = \$1,200$. Let (T^*) represent the minimum number of years for the loss-reduction investment to be cost-effective. In other words (T^*) is the smallest time period where $B/C > 1$. The second column in Table 12.2 depicts the expected benefit-cost ratio as a function of (T) associated with such an investment if the Lowlands' annual discount rate was 10 percent.

TABLE 12.2. EXPECTED BENEFIT/COST RATIO OF INVESTING IN MITIGATION MEASURE AS A FUNCTION OF TIME HORIZON, PERCEIVED LOSS REDUCTION AND PERCEIVED PROBABILITY (P)

Time Horizon (in years)	Loss Reduction (\$40,000)	
	$p=1/100$	$p=1/300$
1	.30	.10
2	.58	.19
3	.83	.28
4	1.06	.35
5	1.26	.42
10	2.05	.68
15	2.54	.84
20	2.83	.94
25	3.03	1.01

If the family planned to live in their home for more than 4 years they would want to windproof their house if they were risk neutral and utilized cost-benefit analysis (CBA). If the Lowlands were risk averse, then $T^* < 4$ because they would be even more concerned with the financial consequences of suffering a large loss from the next disaster and would thus find the expected benefits of mitigation more attractive than if they were risk neutral.

Behavioral Considerations

In the absence of analytic guidance such as the information provided in Table 12.2, the Lowlands will make their decision on whether or not to invest in mitigation measures by utilizing informal heuristics that have proven useful for guiding day-to-day decisions in more familiar contexts, but which are likely to be unsuccessful when applied to the kind of low-probability, high consequence event the family is now considering. In the sections below, we review the range of informal mechanisms that might be used to make mitigation decisions, and discuss how they might explain the widespread lack of investment illustrated above.

Budgeting Heuristics. The simplest explanation as to why individuals fail to mitigate in the face of transparent risks is *affordability*. If the Lowland family focuses on the upfront cost of wind-proofing their house and they have limited disposable income after purchasing necessities, there

³¹⁸ If the resale value of the house were increased due to mitigation this would be an additional benefit.

would be little point in undertaking a cost-benefit analysis regardless of its recommendations. Residents in hazard-prone areas have used this argument explicitly as to why they have limited interest in buying insurance voluntarily.

In focus group interviews to determine factors influencing decisions on whether to buy flood or earthquake coverage, one uninsured homeowner responded to the question, “How does one decide how much to pay for insurance?” by responding as follows:

“A blue-collar worker doesn’t just run up there with \$200 [the insurance premium] and buy a policy. The world knows that 90 percent of us live from payday to payday... He can’t come up with that much cash all of a sudden and turn around and meet all his other obligations.” (Kunreuther et al., 1978, p. 113).³¹⁹

The budget constraint for investing in protective measures may extend to higher-income individuals if they set up separate “mental” accounts for different expenditures (Thaler, 1999).³²⁰ Under such a heuristic, a homeowner who is uncertain about the cost-effectiveness of mitigation might simply compare the price to that which is typically paid for comparable home improvements. Hence, the \$20,000 investment may be seen as affordable by those who frame it as a large improvement similar to installing a new roof, but unaffordable to those who frame it as a repair similar to fixing a leaky faucet.

Making mitigation decisions in this manner does not conform to guidelines implied by cost-benefit analysis (CBA), but there is evidence from controlled laboratory experiments that it may not be uncommon. For example, in a study that asked individuals why they were willing to pay only a fixed amount for a dead bolt lock when the lease for their apartment was extended from 1 to 5 years, one respondent said, “\$20 is all the dollars I have in the short-run to spend on a lock. If I had more, I would spend more – maybe up to \$50.” (Kunreuther, Onculer and Slovic, 1998, p. 284).³²¹ Similarly, we suspect that some residents in coastal zones are discouraged from buying and installing storm shutters because the cost exceeds that of the window itself – a logical benchmark expenditure.

Biases in Temporal Planning. While individuals’ decisions about mitigation are undoubtedly constrained by considerations of affordability, tradeoffs between costs and benefits invariably arise at some level. How skilled are people at performing intuitive cost-benefit analysis? The empirical evidence on how individuals make inter-temporal judgments is not encouraging. Although decisions often follow the directional advice of normative theory (such as by giving less value to temporally distant events than immediate ones), they frequently depart from those prescribed by rational theories of inter-temporal choice. Moreover, they depart in a way that collectively discourages far-sighted investments in mitigation. In particular, homeowners are likely to overweight short-term cash expenditures, have distorted beliefs about probabilities, and value common outcomes differently over time. The implications of these biases for mitigation decisions will be reviewed in turn.

³¹⁹ Kunreuther, H. et al., (1978), *Disaster Insurance Protection: Public Policy Lessons*. New York: John Wiley & Sons.

³²⁰ Thaler, R. (1999), “Mental Accounting Matters,” *Journal of Behavioral Decision Making*, 12: 183-206

³²¹ Kunreuther, H., A. Onculer, and P. Slovic (1998), “Time Insensitivity for Protective Measures,” *Journal of Risk and Uncertainty*, 16: 279-299.

Underweighting the Future. A fundamental feature of human cognition is that we are influenced more by cues that are concrete and immediate than by those that are abstract and delayed. To some extent, of course, rational inter-temporal choice theory prescribes that we *should* give less weight to distant future outcomes. There is extensive experimental evidence, however, showing that human temporal discounting tends to be *hyperbolic*, where temporally distant events are disproportionately discounted relative to immediate ones. As an example, people are willing to pay more to have the timing of the receipt of a cash prize accelerated from tomorrow to today, than from two days from now to tomorrow (Loewenstein and Prelec, 1991).³²² The implication of hyperbolic discounting for mitigation decisions is that we are asking residents to invest a tangible fixed sum now to achieve a benefit later that we instinctively undervalue — and one that we, paradoxically, hope never to see at all.

The effect of placing too much weight on immediate considerations is that the upfront costs of mitigation will loom disproportionately large relative to the delayed expected benefits in losses over time. A homeowner might recognize the need for mitigation, and see it as a worthwhile investment when it is framed as something to be undertaken a few years from now when both upfront costs and delayed benefits are equally discounted. However, when the time arrives to actually make the investment, a homeowner subject to hyperbolic discounting might well get cold feet.

We should add that other, less formal, psychological mechanisms could also produce perpetual postponements of investments in mitigation. The most salient is the observed tendency for individuals to defer ambiguous choices. The less certain one is about a correct course of positive action, the more likely one is to choose inaction (Tversky and Shafir, 1992).³²³ This ambiguity would seem particularly acute in the context of mitigation decisions where the question of whether it is optimal to mitigate is often unknowable for a single household, and there is infinite flexibility as to *when* one can undertake the investment.

Underestimation of Risk Due to Excessive Optimism. In addition to overweighting immediate costs, underweighting future benefits of mitigation, and procrastination, another factor that could suppress investments in mitigation is excessive optimism by underestimating the likelihood of the hurricane occurring. Although underestimation of risk is perhaps the simplest explanation as to why people fail to mitigate, the empirical evidence in the domain of natural hazards is far from complete.

On the one hand, we do know that decisions about mitigation are rarely based on formal beliefs about probabilities. Magat, Viscusi and Huber (1987)³²⁴ and Camerer and Kunreuther (1989)³²⁵ for example, provide considerable empirical evidence that individuals do not seek out

³²² Loewenstein, G. and D. Prelec (1991), "Negative Time Preference," *American Economic Review*, 81(2): 347-52, May.

³²³ Tversky, A., and E. Shafir (1992), "Choice under conflict: The dynamics of deferred decision," *Psychological Science*, 3(6): 358-361.

³²⁴ Magat, W., K.W. Viscusi, and J. Huber (1987), "Risk-dollar Tradeoffs, Risk Perceptions, and Consumer Behavior," in W. Viscusi and W. Magat (eds.), *Learning About Risk* (p. 83-97). Cambridge, MA: Harvard University Press.

³²⁵ Camerer, C. and H. Kunreuther (1989), "Decision Processes for Low Probability Events: Policy Implications," *Journal of Policy Analysis and Management*, 8: 565-592.

information on probabilities in making their decisions. Huber, Wider and Huber (1997)³²⁶ showed that only 22 percent of subjects sought out probability information when evaluating risk managerial decisions. When consumers are asked to justify their decisions on purchasing warranties for products that may need repair, they rarely use probability as a rationale for purchasing this protection (Hogarth and Kunreuther, 1995).³²⁷

This evidence, that individuals do not find statistical probability to be a useful construct in making risky decisions, does not, of course, imply that decisions are not based on subjective beliefs about relative risk. To the contrary – when asked, individuals have no problem expressing beliefs about the relative riskiness of hazards (e.g., Lerner et al., 2003).³²⁸ But these beliefs are not well-calibrated. When directly asked to express an opinion about the odds of being personally affected by different hazards, people consistently respond with numbers that, perhaps surprisingly, are far *too high* relative to actuarial base rates. For example, in a study of risk perception Lerner et al., (2003)³²⁹ found that when people were asked to provide an estimate of the probability that they will be the victim of a violent crime over the coming year, the mean estimate was 43 percent – an estimate that was far too high compared to actuarial base rates, and comparable to that which they expressed when asked to estimate the odds of getting the flu (47 percent). If these estimates actually reflected heightened fears about being exposed to hazards, it would strongly argue against the idea that people fail to mitigate simply because they assume that they will be immune. But these results may be speaking more to individuals' lack of familiarity with statistical constructs than real evidence that people are pessimistic.

On the other hand, there is also evidence that people tend to ignore risks whose subjective odds are seen as falling below some threshold. Many homeowners residing in communities that are potential sites for nuclear waste facilities have a tendency to dismiss the risk as negligible (Oberholzer-Gee, 1998).³³⁰ Prior to the Bhopal chemical accident in 1984, firms in the industry estimated the chances of such an accident as sufficiently low that it was not on their radar screen. Similarly, even experts in risk disregard some hazards. For instance, after the first terrorist attack against the World Trade Center in 1993, terrorism risk continued to be included as an unnamed peril in commercial insurance policies, so insurers were liable for losses from a terrorist attack without their ever receiving a penny for this coverage. Because U.S. insurers had not integrated the threat into their portfolio management, the September 11, 2001 attacks obligated them to pay over \$35 billion in claims (Kunreuther and Pauly 2006).³³¹ If the Lowland family exhibits similar threshold-based behavior, they would not have any interest in investing in a loss mitigation measure no matter how large the savings would be.

³²⁶ Huber, O., R. Wider, and O. Huber (1997), "Active Information Search and Complete Information Presentation in Naturalistic Risky Decision Tasks," *Acta Psychologica*, 95: 15-29.

³²⁷ Hogarth, R. and H. Kunreuther (1995), "Decision Making Under Ignorance: Arguing with Yourself," *Journal of Risk and Uncertainty*, 10: 15-36.

³²⁸ Lerner, J., R. Gonzalez, D. Small, and B. Fischhoff (2003), "Effects of Fear and Anger on Perceived Risks of Terrorism: A National Field Experiment," *Psychological Science*, 14(2): 144-150.

³²⁹ Op. Cit.

³³⁰ Oberholzer-Gee, F. (1998), "Learning to Bear the Unbearable: Towards and Explanation of Risk Ignorance," Mimeo, Wharton School, University of Pennsylvania.

³³¹ Kunreuther, H. and M. Pauly (2005), "Terrorism Losses and All-perils Insurance," *Journal of Insurance Regulation*, 23(4): 3.

Furthermore, levees or other flood control projects are likely to have given residents a false sense of security with respect to suffering damage from floods or hurricanes. In fact, Gilbert White pointed out many years ago that when these projects are constructed, individuals believe that they are fully protected against future disasters and hence there is increased development in these “protected” areas. Should a catastrophic disaster occur so that residents of the area are flooded, the damage is likely to be considerably greater than before the flood-control project was initiated. This behavior and its resulting consequences have been termed the *levee effect*.

Learning Failures. The above discussion makes a clear argument that if individuals make mitigation decisions by performing intuitive cost-benefit analysis, they will likely underinvest by focusing too much on upfront costs, undervaluing long-term benefits and/or underestimating the likelihood that the disaster will happen to them. While an individual (or institution) making a one-time mitigation decision might err by underinvesting, such errors would appear to be transient. Once the consequences of under-mitigation are observed, intuition suggests that there would be a natural tendency to correct the biases that led to the initial error. Indeed, there is some evidence that mitigation errors are naturally correcting; early Mayans learned (no doubt by experience) that it was safer to build cities inland than on the hurricane-prone coasts of the Yucatan, the loss of 6,000 lives in Galveston in 1900 taught the city that it needed a seawall to protect against future storms, and it took the disaster of Hurricane Katrina for New Orleans to finally put in place a comprehensive evacuation plan (Brinkley, 2006).³³²

The problem, however, is not that we do not learn, but rather that we do not seem to learn *enough* from the experiences of disaster. As an illustration, when Hurricane Wilma hit south Florida in October of 2005, thousands of residents failed to take such simple preparatory measures as securing bottled water and filling their cars up with gas – oversights that greatly added to the challenges of recovery. What was surprising about this lack of preparation was that the region had ample warning of the storm’s approach (the impact was forecast up to four days in advance), and it came at the end of the most destructive hurricane season on record, one where the news media were constantly filled with graphic illustrations of the destructive power of such storms (such as the flooding in New Orleans). Other familiar examples exist as well – such as the tendency to re-settle in floodplains after major floods, and to become increasingly lax in earthquake preparedness as the time since the last quake lengthens.

What explains the seeming lack of learning by residents? The reason, we suggest, is that we instinctively learn to protect ourselves against hazards by relying on the same trial-and-error heuristics that have proven successful in other walks of life – heuristics that encourage us to repeat those behaviors that yield positive rewards and avoid those behaviors that yield negative outcomes. But while reinforcement learning is a highly efficient way to learn multiplication tables and how to play tennis, it is particularly ill-suited for learning how best to respond to low-probability, high-consequence hazards. The reason is simple: most protective behaviors will be negatively reinforced far more often than they will be positively reinforced.

³³² Brinkley, D. (2006), *The Great Deluge: Hurricane Katrina, New Orleans, and the Mississippi Gulf Coast*, New York: Harper Collins.

As an example, when Hurricane Wilma approached south Florida in 2005, the vivid news depictions of suffering Katrina survivors were counterbalanced by a different and more salient source of information: residents' recollections of the seven false-alarms that the area had received during the previous two years. For many, the hurricane warnings posted for Wilma triggered memories of rushing to secure supplies of water and gas before a storm, only later to find out that their efforts were unnecessary. For everyone else, it was memories of how gambling paid off; their decisions *not* to prepare for all the *previous* storms had turned out to be the right ones (in hindsight).

A second major impediment to learning is the inherent ambiguity of feedback about what constitutes optimal mitigation. In the course of disasters, one can rarely observe the counterfactuals critical to learning: what damage would have occurred had certain mitigation steps been taken (or not taken). As noted by Meyer (2006),³³³ one consequence of this feedback property is that it supports the persistence of superstitious beliefs about mitigation strategies. A good example is the old adage that one should open windows in advance of a tornado so as to equalize pressure. It took structural engineers years to discover that open windows were more likely to be the *cause* of building failures than the cure (entering wind exerts upward pressure on roofs), yet the myth is still widely held. The reason, of course, is that it is impossible to infer from observing a destroyed house whether it would still be standing had the windows been closed—or indeed whether they were open or closed to begin with.

We should emphasize that it is not the rarity of hazardous events *per se* that limits learning. While individuals may encounter a major earthquake or hurricane only once in their lives (or, more likely, never), there are ample opportunities to learn by observing the experiences of others. Indeed, the plethora of books describing great disasters of the past (from Noah's flood onward) and the intense new attention that is given to disasters suggests that we have deeply-ingrained instincts (however morbid) for trying to learn from others' misfortunes. There is suggestive evidence, however, that people often learn much less from vicarious feedback than one might hope. As an example, in a laboratory study designed to measure peoples' abilities to learn optimal levels of investment to protect against hurricanes, Meyer (2006)³³⁴ found that decisions to increase investment were driven almost exclusively by whether the decision maker personally suffered losses in the previous period; in contrast, losses suffered by others did not have such a triggering effect.

Social Norms and Interdependencies. Suppose the Lowland family was considering elevating their house on piles so as to reduce flood losses from a future hurricane. If none of their neighbors have taken this action, their house would look like an oddity in a sea of homes at ground level. Should the Lowlands choose to move, they would be concerned that the resale value of their home would be lower because the house was different from all the others. Given that there is a tendency not to think about a disaster until after it happens, the Lowlands may reason that it would be difficult to convince potential buyers that elevating their house should increase its property value.

³³³ Meyer, R.J. (2006), "Why We Under-Prepare for Hazards," in R.J. Daniels, D.F. Kettl, and H. Kunreuther (eds), *On Risk and Disaster: Lessons from Hurricane Katrina*, University of Pennsylvania Press, pp. 153-174.

³³⁴ *Ibid.*

The question as to how actions of others impact one's own decisions relates to the broader question of social norms and interdependencies. With respect to social norms, if all homes in the neighborhood had installed strong storm shutters, then the Lowlands would very likely want to follow suit; if none of them had taken this step, then they would not have an interest in doing so. The problem of interdependencies arises if there is the possibility that unprotected homes can cause damage to a home that has adopted mitigation measures. If the Lowlands decide to install storm shutters but their neighbors have not taken this action, then during the next hurricane, flying debris from one of these non-protected houses could cause damage to the Lowlands' home which would otherwise have been spared.

It is conceivable that if a few leaders in the community protect their houses, then others will do the same. This type of tipping behavior is common in many situations and has been studied extensively by Schelling (1978)³³⁵ and popularized by Gladwell (2000).³³⁶ Heal and Kunreuther (2005)³³⁷ provide a game theoretic treatment of the topic and indicate that there is a wide range of problems that come under this rubric. They suggest ways to coordinate actions of those at risk ranging from subsidization or taxation to induce tipping or cascading to rules and regulations such as well-enforced building codes.

12.6. The Need for Public-Private Sector Collaboration to Encourage Mitigation

The Natural Disaster Syndrome

Recent extreme events have highlighted the challenges associated with reducing losses from hurricanes and other natural hazards due to the *natural disaster syndrome* (Kunreuther 1996).³³⁸ Before a disaster, many homeowners, private businesses and the public sector do not voluntarily adopt cost-effective loss-reduction measures. Hence, the area is highly vulnerable and unprepared should a severe hurricane or other natural disaster occur. The magnitude of the destruction following a catastrophe often leads public sector agencies to provide disaster relief to victims even if the government claimed it had no intention of doing so prior to the event. This combination of underinvestment in protection prior to the event leading to large disaster losses, together with the general taxpayer financing some of the recovery can be critiqued on both efficiency and equity grounds.

One of the reasons for the natural disaster syndrome relates to the decision processes of individuals with respect to events such as a Category 3 or 4 hurricane or a major earthquake. Prior to a disaster, many individuals perceive its likelihood as sufficiently low that they argue, "It will not happen to me." As a result, they do not feel the need to invest voluntarily in protective measures, such as strengthening their house or buying insurance. It is only after the disaster occurs that these same individuals claim they were sorry they didn't undertake protective measures.

³³⁵ Schelling, T. (1978), *Micromotives and Macrobehavior*, New York: Norton.

³³⁶ Gladwell, M. (2000), *The Tipping Point*, New York: Little Brown.

³³⁷ Heal, G. and H. Kunreuther (2005), "You Can Only Die Once: Interdependent Security in an Uncertain World," in H.W. Richardson, P. Gordon and J.E. Moore II, (eds.), *The Economic Impacts of Terrorist Attacks*, Cheltenham, UK: Edward Elgar.

³³⁸ Kunreuther, H. (1996), "Mitigating disaster losses through insurance," *Journal of Risk and Uncertainty*, 12: 171-187.

Kydland and Prescott (1977)³³⁹ in their Nobel Prize winning contribution, show that a discretionary policy, which may be optimal given the current situation, may not necessarily result in a socially optimal policy in the longer run. As a specific example of this general proposition, the authors note that unless individuals are initially prohibited from locating in a floodplain, it will be very difficult politically to force these people to leave their homes. In making their decisions to locate there, Kydland and Prescott indicate that these individuals believe that the Corps of Engineers will subsequently build dams and levees if enough people choose to build homes there. A large number of homeowners then decide to locate in these high-hazard areas for that reason, and the Corps of Engineers is forced to invest in flood control projects.

Kunreuther and Pauly (2006)³⁴⁰ extend the Kydland-Prescott argument by introducing behavioral considerations into the picture. They contend that because individuals underestimate the likelihood of a future disaster, it may be important to require homeowners to purchase insurance and have well-enforced rules such as land-use regulations and building codes to avoid the large public sector expenditures following these events. To support this point, they provide empirical evidence that many individuals do not even think about the consequences of a disaster until after a catastrophe occurs, and hence do not invest in protective measures in advance of a disaster. After a large-scale flood, earthquake or hurricane, the government provides some financial assistance to aid the recovery of the unprotected victims.

There is extensive evidence that residents in hazard-prone areas do not undertake loss prevention measures voluntarily. A 1974 survey of more than 1,000 California homeowners in earthquake-prone areas revealed that only 12 percent of the respondents had adopted any protective measures (Kunreuther et al., 1978).³⁴¹ Fifteen years later, there was little change despite the increased public awareness of the earthquake hazard. In a 1989 survey of 3,500 homeowners in four California counties at risk from earthquakes, only 5 to 9 percent of the respondents in these areas reported adopting any loss reduction measures. Palm et al. (1990),³⁴² Burby et al. (1988)³⁴³ and Laska (1991)³⁴⁴ have found a similar reluctance by residents in flood-prone areas to invest in mitigation measures.

In the case of flood damage, Burby (2006)³⁴⁵ provides compelling evidence that actions taken by the federal government, such as building levees, make residents feel safe when, in fact, they are still vulnerable to catastrophes should the levee be breached or overtopped. This

³³⁹ Kydland, F. and E. Prescott (1977), "Rules Rather Than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy*, 85: 473-91.

³⁴⁰ Kunreuther, H. and M. Pauly (2006), "Rules Rather Than Discretion: Lessons from Hurricane Katrina," *Journal of Risk and Uncertainty*, (33): 1-2, September.

³⁴¹ Kunreuther, H. et al. (1978), *Disaster Insurance Protection: Public Policy Lessons*. New York: John Wiley & Sons.

³⁴² Palm, R., M. Hodgson, R.D. Blanchard and D. Lyons (1990), *Earthquake Insurance in California: Environmental Policy and Individual Decision Making*. Boulder, CO: Westview Press.

³⁴³ Burby, R.J., S. Bollens, E.J. Kaiser, D. Mullan and J.R. Sheaffer (1988), *Cities Under Water: A Comparative Evaluation of Ten Cities' Efforts to Manage Floodplain Land Use*. Boulder, CO: Institute of Behavioral Science, University of Colorado.

³⁴⁴ Laska, S.B. (1991), *Floodproof Retrofitting: Homeowner Self-Protective Behavior*. Boulder, CO: Institute of Behavioral Science, University of Colorado.

³⁴⁵ Burby, R. (2006), "Hurricane Katrina and the Paradoxes of Government Disaster Policy: Bringing About Wise Governmental Decisions for Hazardous Areas" *The Annals of the American Academy of Political and Social Science*, 604: 171-191.

problem is reinforced by local public officials who do not enforce building codes and/or impose land-use regulations to restrict development in high hazard areas. If developers do not design homes so that they are resistant to disasters, and individuals do not voluntarily adopt mitigation measures, one can expect large-scale losses following a disaster, as evidenced by the property damage to New Orleans caused by Hurricane Katrina.

Even after the devastating 2004 and 2005 hurricane seasons, a large number of residents had still not invested in relatively inexpensive loss reduction measures with respect to their property, nor had they undertaken emergency preparedness measures. A survey of 1,100 adults living along the Atlantic and Gulf Coasts undertaken in May 2006 revealed that 83 percent of the respondents had taken no steps to fortify their home, 68 percent had no hurricane survival kit, and 60 percent had no family disaster plan (Goodnough, 2006).³⁴⁶

The Politician's Dilemma

The fact that politicians can benefit from their generous actions following a disaster raises basic questions as to the capacity of elected representatives at the local, state and federal levels to induce people to adopt protection measures before the next disaster. The difficulty in enforcing these mitigation measures has been characterized as the *politician's dilemma* (Michel-Kerjan, in press).³⁴⁷

Consider an elected representative at the city or state level. Should s/he push for people and firms in this city or state to invest in cost-effective mitigation measures to prevent or limit the occurrence of a disaster? From a long-term perspective, the answer should be yes. But given short-term re-election considerations, the representative is likely to vote for measures that allocate taxpayers' money elsewhere that yield more political capital. It is another example where little consideration is given to supporting mitigation measures prior to a disaster (*ex ante*) because they believe that their constituents are not worried about these events occurring, but where there is likely to be a groundswell of support for generous assistance to victims from the public sector after a disaster (*ex post*) to aid their recovery. The one silver lining to this behavior is that following a natural disaster when residents and the media focus on the magnitude of the losses, politicians will respond by favoring stronger building codes and other loss reduction measures, but only when there is a consensus among her/his constituents that this is a good thing to do.

Tax Incentives

One way for communities to encourage residents to pursue mitigation measures is to provide them with tax incentives. For example, if a homeowner reduces the chances of damage from a hurricane by installing a mitigation measure, then this taxpayer would get a rebate on state taxes to reflect the lower costs for disaster relief. As part of South Carolina's Omnibus Coastal Property Insurance Reform Act of 2007, tax credits are given to property owners who purchase building supplies used to make their homes more storm resistant. Mitigation grants of up to \$5,000 are available for low-income families, and matching grants (on a dollar-for-dollar basis) of up to \$5,000 are available for all homeowners in the state.

³⁴⁶ Goodnough, A. (2006), "As Hurricane Season Looms, State Aim to Scare," *The New York Times*, May 31.

³⁴⁷ Michel-Kerjan, E. (in press), "Disasters and Public Policy: Can Market Lessons Help Address Government Failures," proceedings of the 99th National Tax Association Conference, Boston, MA, *National Tax Journal*.

The city of Berkeley in California has instituted a transfer tax rebate to encourage homebuyers to retrofit newly purchased homes to reduce the damage should an earthquake occur in the area. The city has a 1.5 percent tax levied on property transfer transactions; up to one-third of this amount can be applied to seismic upgrades during the sale of property. Qualifying upgrades include foundation repairs or replacement, wall bracing in basements, shear wall installation, water heater anchoring, and securing of chimneys. The Berkeley program has been a great success. According to Arrietta Chakos, the assistant city manager, about 40 percent of Berkeley's homes have been improved using this tax incentive.³⁴⁸

Better Zoning Ordinances

One of more vexing problems facing policy makers after major catastrophes is whether to permit rebuilding in areas that have been damaged. As demonstrated by the response after Hurricane Katrina, there is usually strong political support for wanting to rebuild. Indeed, not to do so seems somehow unpatriotic. But in some cases, common sense should take precedence. In areas that have suffered multiple catastrophes – say, three or more – nature may be telling us something: that these locations are naturally much more likely to be damaged than others. In effect, this is recognized in FEMA's flood maps, which the agency is in the process of updating.

Ideally, local authorities would adopt zoning policies that prohibit rebuilding in hazard-prone locations. But this is unlikely, since much of the pressure to permit, if not encourage, such rebuilding exists at the local level. This pressure is unlikely to be as intense at the state level, and thus one way of addressing the problem is for states to adopt policies that prevent or discourage localities from allowing rebuilding in areas that have been subjected to multiple natural catastrophes (at least three, over some reasonable time period, for example two decades).

An even bolder suggestion is to have the federal government encourage state governments to take this step. This could be done through positive incentives. Alternatively, the federal government could use penalties to accomplish the same objective – withholding federal highway monies, as one example, unless the state adopted this zoning policy.

Future Challenges for Encouraging Mitigation Measures

A U.S. GAO (2007)³⁴⁹ report noted a number of opportunities for private-public collaboration with respect to encouraging adoption of cost-effective mitigation measures. They pointed out that in Florida where the population continues to grow rapidly, most of the new residents were unfamiliar with the state's hazard risks and mitigation options. The report calls for public education and outreach programs that can take many forms including distributing literature to individuals, organizing community events that discuss mitigation options and incorporating hazard information into school curriculums.

Local governments may be reluctant to take actions to mitigate natural hazards because community goals such as building housing and promoting economic development may be higher priorities than formulating mitigation regulations which may include more restrictive

³⁴⁸ Personal communication.

³⁴⁹ U.S. Government Accountability Office (GAO) (2007), *Natural Hazard Mitigation: Various Mitigation Efforts Exist but Federal Efforts Do Not Provide a Comprehensive Strategic Framework*, Washington, DC, (August) p. 40-41.

development regulations and more stringent building codes. Local communities may also encounter difficulties in implementing and maintaining mitigation-related policies due to cost concerns such as the expenses in hazard mapping, land-use planning and local ordinances to address natural hazard risks.

Officials from the National Homebuilders Association told the GAO that the economic cost of mitigation should be considered because every \$1,000 increase in median home prices can force about 240,000 homebuyers out of the market. Similarly, private property owners may be reluctant to pay for the additional cost of features that exceed local building codes, such as reinforced concrete walls and flood proofing materials.

In Chapter 14, we will discuss innovations for dealing with catastrophic risks, such as long-term homeowners insurance. Unless there are economic incentives provided to property owners to adopt cost-effective mitigation measures coupled with well enforced regulations and standards, it will be extremely difficult to make headway in having these measures adopted for reasons outlined above.

12.7. Conclusions

The 2005 hurricane season has provided empirical evidence that many victims suffered severe losses from flooding because they had not mitigated their home and did not have flood insurance to cover the resulting damage. As a result, there is an unprecedented level of federal disaster assistance promised to aid these victims. But the amount of disaster relief will never cover all the losses that could have been avoided by the implementation of effective protection measures.

There are many reasons why those in harm's way have not protected themselves against natural disasters. The principal reasons are budgeting or affordability constraints, underestimating the likelihood of the event occurring, underweighting the future, myopia, and failure to learn from the past. These beliefs, coupled with artificially low insurance rates in high-risk areas, have led to increased development in areas subject to natural disasters. At the local level, government representatives might also prefer to allocate taxpayers' money where they can gain more political capital in the short term; investing in mitigation might not be their first priority until a disaster occurs.

If we as a society are to commit ourselves to reducing future losses from natural disasters and limit government assistance after this event, then we have to engage the private and public sectors in a creative partnership which would include well-enforced building codes and land-use regulations coupled with insurance protection. In order to develop these measures we need to examine the economic welfare of homeowners and their ability to afford protective measures.

SUMMARY OF CHAPTER 12

This chapter analyzes mitigation measures for reducing the physical consequences of specific types of catastrophes (wind, flood, and earthquake). Many of these measures have proven to be cost-effective. Data collected by the Institute for Business & Home Safety following Hurricane Charley in 2004 illustrates that poorly designed homes sustained greater damage relative to homes built under building codes.

Homeowners do not seem to use cost-benefit analyses when deciding about whether to invest in mitigation measures. Instead, individuals may decide not to adopt cost-effective measures because they utilize budgeting heuristics, are somewhat myopic in their planning, underestimate the risk due an optimism bias, and/or fail to learn from past experience. Social norms and interdependencies also affect homeowners' decision processes. Given the reluctance of individuals to invest in cost-effective mitigation measures voluntarily, and politicians' reluctance to push for cost effective mitigation measures unless a disaster has recently occurred, there is a need to develop innovative strategies that involve creative public-private sector collaboration. The chapter concludes by providing examples of tax incentives coupled with zoning ordinances which would better protect residents in hazard-prone areas against future disasters.

APPENDIX 12. BEST PRACTICES IN FLORIDA³⁵⁰**The C-4 Basin Project: Moving Water to Prevent Flooding**

The Miami-Dade Flood Control Project, or C-4 Basin Project (2002), built on the existing canal system, was created to address the county's extensive flooding problem and to relocate excess water from one area to another so it could be absorbed into the groundwater or held in reserve. At the heart of the C-4 basin is the Tamiami Canal, which begins in the Everglades National Park and traverses the Miccosukee Indian reservation, the critical Pensuco Wetlands, and several municipalities before flowing into the environmentally-sensitive Biscayne Bay. The driving force of the C-4 Project is the forward pump station at the mouth of the canal, which is designed to push waterflow downstream against the tide. A second station, at the mouth of the Miami River Canal in the C-6 basin, was built to offset the flow from the C-4 canal and prevent flooding upriver. There are three pumps in each station that can process approximately 4,500 gallons of water per second.

For occasions when the canals cannot handle the water volume necessary to prevent flooding, an emergency detention basin, comprised of two reservoirs, was created to receive and store the excess water. In addition, a separate supply canal was built to divert excess water from the C-4 canal to and from the detention basin which allows water to be shifted from area to area, not only in times of heavy rainfall or potential flooding, but also during instances when a need for water in other areas arises, such as when droughts occur.

The cost of the project totaled \$70 million. The State of Florida was awarded \$52.5 million from FEMA's Hazard Mitigation Grant Program. The Quality Neighborhood Improvement Program, along with the South Florida Water Management District and Miami-Dade County, contributed remaining funds.

Miami Children's Hospital

Beginning in 2001, the Miami Children's Hospital (MCH) underwent a state-of-the-art retrofit to enable it to withstand a Category 4 hurricane. The hospital serves seven counties in southern Florida, including populous Miami-Dade County, and is the region's only specialty hospital for children. The 268-bed medical facility has expertise in all aspects of pediatric medicine and is an important community resource. An assessment of the facility's exterior construction, built in the mid-1980s, found that it was unsafe at wind speeds associated with a Category 2 hurricane, which is a common occurrence in southern Florida. Hospital administrators had to solve a two-fold problem: how to fund the renovation project, and how to conduct the retrofit and renovations without disrupting medical services.

MCH received \$5 million through FEMA's Hazard Mitigation Grant Program, administered by the Florida Department of Community Affairs, to help pay for the \$11.3 million project. The retrofit involved strengthening the building by encapsulating the three-story structure in pre-molded panels of concrete reinforced with glass fibers. The panel system, anchored into the building's existing support structure, forms a protective cocoon around the hospital and, along with impact-resistant windows and a strengthened roof, enables the building to withstand winds of up to 200 miles per hour.

The project was completed in the spring of 2004 and proved to be effective in the following months: Young patients and their families did not need to evacuate from the hospital when Hurricanes Frances and Jeanne struck. In addition, MCH welcomed over 60 children who live at home but depend on ventilators or other powered medical equipment.

During Hurricane Frances, MCH was the refuge for nearly 1,000 staff members and their families. The hospital hosted medical evacuees and families during Hurricanes Katrina and Wilma (2005). MCH has proven to be a safe haven for sheltering sick children and those who care for them.

³⁵⁰ A more detailed description of these two examples can be found on FEMA's website, http://www.fema.gov/plan/prevent/bestpractices/kat_fl.shtm.

CHAPTER 13

POLICY ANALYSIS OF ALTERNATIVE PROGRAMS: COMPARING THE STATUS QUO WITH A TRUE COMPETITIVE INSURANCE MARKET

KEY FINDINGS

The proportion of losses covered by private insurers for a 100-year hurricane under current insurance programs in place (*status quo*) differs widely among the four states studied. Using a hurricane with a return period of 100 years as our base case, we find that should this event occur in South Carolina, private insurers would cover 80 percent of the loss, compared to about 70 percent in New York and 50 percent in Texas. In Florida, private insurers would cover 25 percent of the loss, and the state-operated insurer, Citizens, 10 percent. Private reinsurance covers less than 10 percent of the losses in New York and South Carolina and over 17 percent of the loss in Texas. In Florida, private reinsurance would cover 20 percent of the losses and the Florida Hurricane Catastrophe Fund over 30 percent. The actual dollar amounts of loss to residential properties from a 100-year hurricane are much lower in South Carolina and New York than in Texas and Florida. We provide similar loss-sharing analyses for 250-year and 500-year hurricanes for each state.

If a hurricane with a return period of 100 years were to occur in 2008, the deficits to the Florida Hurricane Catastrophe Fund (FHCF), Citizens Property Insurance Corporation (Citizens) and the Texas Windstorm Insurance Association (TWIA) would be \$21.2 billion, \$5.7 billion and \$3.6 billion respectively. If there were no hurricanes for three years after that, Citizens could collect enough funds from premiums to recover its losses from the event. The FHCF would have to have 16 hurricane-free years of operation for future premiums to sum up to the total losses from that single event. If Citizens and the FHCF can assess insurers in Florida *ex post* to recoup funds to cover the claims from a hurricane that they cannot meet from their reserves, all residential and commercial policyholders in the state are likely to pay a significant portion of the losses.

Mitigation has the potential to provide significant cost savings in all four states. In our analysis of the impact of mitigation, we consider two extreme cases – one in which no one has invested in mitigation, the other in which everyone has invested in predefined mitigation measures. For a 100-year hurricane, mitigation would reduce the potential losses by 61 percent in Florida, 44 percent in South Carolina, 39 percent in New York, and 34 percent for Texas. In Florida alone, the use of mitigation leads to a \$51 billion savings for a 100-year event, and \$83 billion for a 500-year event. Should a 500-year event occur tomorrow, full mitigation would save the Miami-Dade area \$58 billion and the Houston area \$34 billion. These findings are important given the costly capital needed to cover the tail of the distribution of extreme events. Enforcing mitigation significantly reduces, if not eliminates, this tail.

-over-

KEY FINDINGS, cont.

Under a scenario where insurers are permitted to charge premiums reflecting risk, the private sector will be able to cover most (if not all) losses from severe hurricanes if homeowners mitigate their property and private reinsurance is in place. In this case, if insurers were to devote 10 percent of their surplus to provide coverage against a 100-year hurricane in a given state, they would be able to cover 100 percent of the market in all four states. For a 500-year event, they would continue to cover 100 percent of the market in New York and South Carolina, 94 percent of the market in Texas, and 66 percent in Florida.

Except for Florida, which constitutes a peak zone for catastrophe exposure, insurers would need to allocate only a small portion of their surplus to provide the market with full coverage under a competitive market if adequate mitigation and private reinsurance were in place. If all single-family dwellings in the state were mitigated, and if private reinsurance and alternative risk transfer mechanisms were in place, based on the *status quo*, the percentage of insurers' surplus necessary to insure all homes against a 100-year hurricane is 1.1 percent in South Carolina, 1.4 percent in New York, 6.7 percent in Texas, and 15.4 percent in Florida.

If one determines premiums based on loss costs and adds a 50 percent loading factor to reflect additional expenses (administrative, marketing and claim assessment costs, and cost of capital), coastal communities that have the highest risk of wind damage from hurricanes in each of the four states we study will pay significantly more for insurance than other regions in these states. This is particularly true in Texas, where Calhoun, Aransas and Galveston Counties would be charged over nine times the average for the entire state. The ratios for the most hazard-prone counties in the other three states are on the order of four to five times the average premium across the state.

CHAPTER 13

POLICY ANALYSIS OF ALTERNATIVE PROGRAMS: COMPARING THE STATUS QUO WITH A TRUE COMPETITIVE INSURANCE MARKET

13.1. Introduction

This chapter provides a series of empirical analyses on how residential losses to homeowners due to hurricanes will be shared among the affected stakeholders under different market environments. The stakeholders we consider are uninsured homeowners, insured homeowners, all insurance policyholders, private insurers, private reinsurers, state insurers and reinsurers along with general taxpayers. We also examine the significant role that mitigation can play in reducing such losses. There are four principal objectives in undertaking these analyses:

- Determine the economic impact of a series of major hurricanes on the key stakeholders under the *current* disaster insurance programs in each of the four target states (Florida, New York, South Carolina and Texas). We denote this as the **status quo** analysis.
- Examine the ability of the insurance industry to provide coverage against hurricanes in each of these four states, if they were able to charge risk-based premiums and adopt a maximum-exposure strategy. We denote this as the **competitive market** analysis.
- Analyze the impact of mitigation measures on the reduction of aggregate damage to homes and contents (ground-up losses) and insured losses from severe hurricanes in each of the four states.
- Characterize the relative magnitude of damage from hurricanes to the four metropolitan areas in relation to the state in which they are located: Miami, FL area (Miami-Dade County), New York City, NY area (Bronx, New York, Queens, Kings, and Richmond Counties); Charleston, SC area (Charleston, Berkeley, Colleton, and Dorchester Counties); and Houston, TX area (Galveston, Harris, Fort Bend, Montgomery, Brazoria, Liberty, Waller, Chambers, Austin, and San Jacinto Counties).³⁵¹

The maps in Figures 13.1-A through 13.1-D depict the four states and the metropolitan areas (circled) on which these analyses are based.

³⁵¹ The metropolitan areas were defined by Risk Management Solutions (RMS) according to their exposure at risk. Using Miami-Dade County as a benchmark, all the metropolitan areas were selected to have comparable exposures at risk when compared to one another.

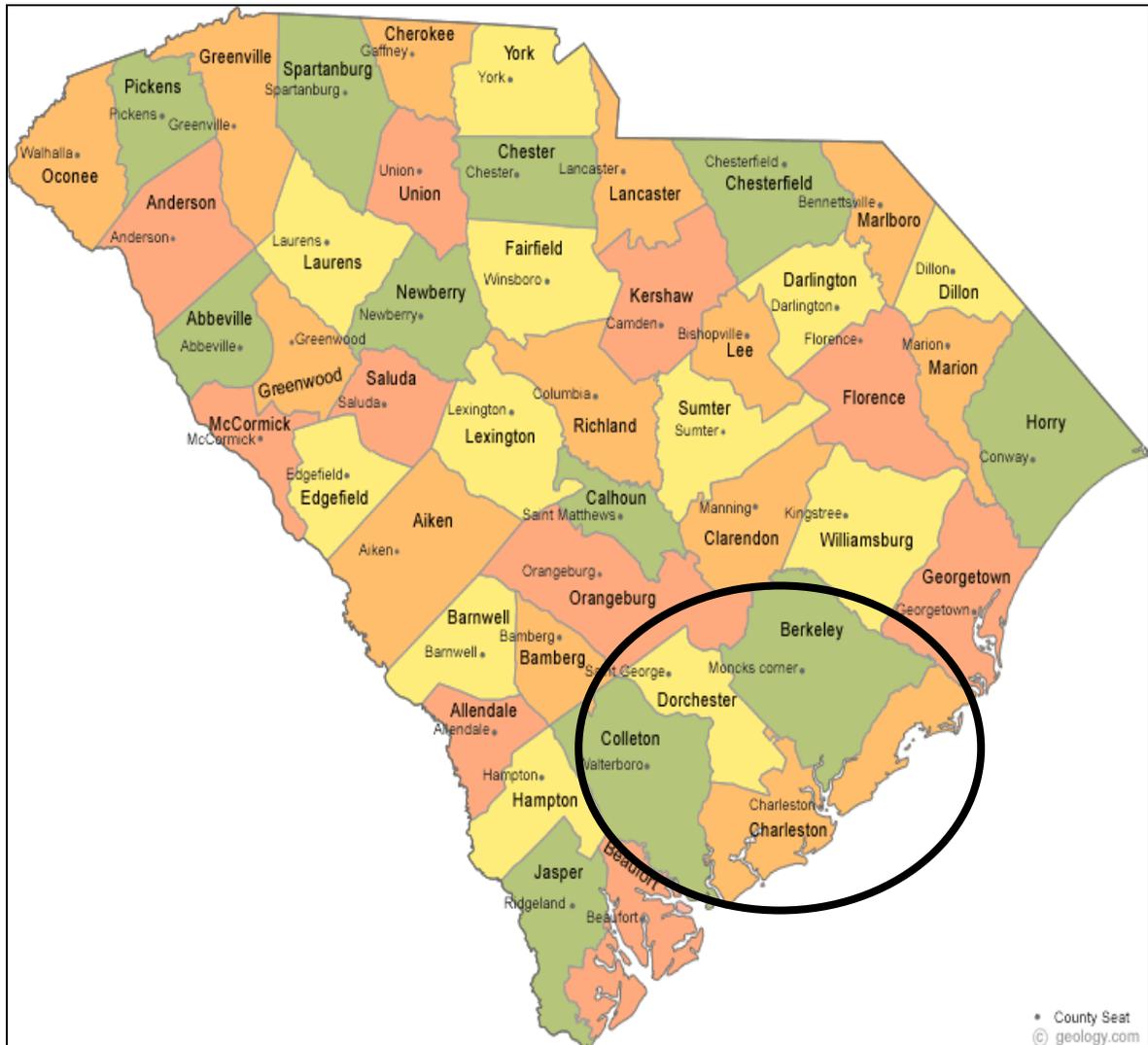


FIGURE 13.1-C. MAP OF COUNTIES AND MAIN CITIES IN SOUTH CAROLINA

Source: Geology.com

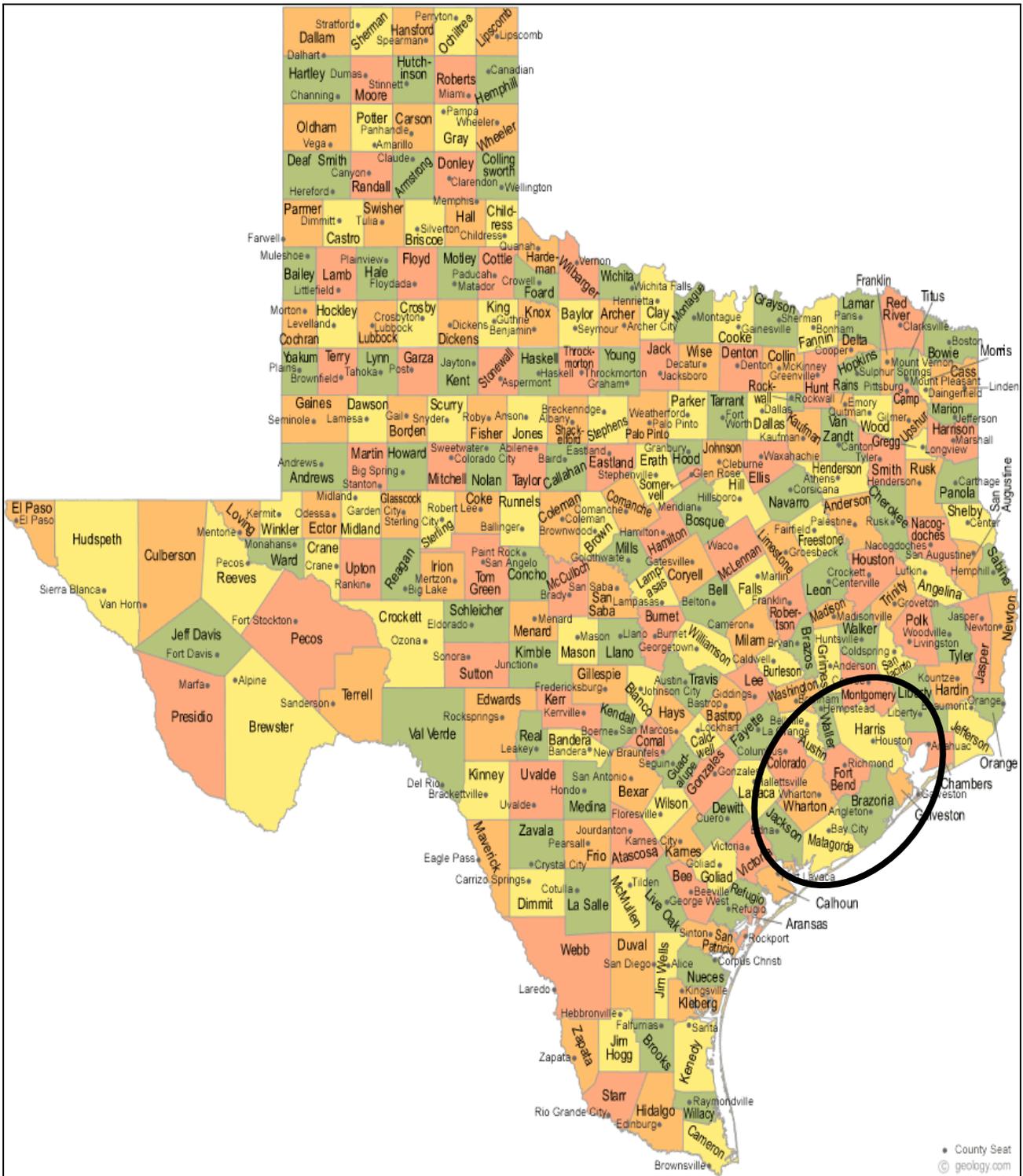


FIGURE 13.1-D. MAP OF COUNTIES AND MAIN CITIES IN TEXAS

Source: Geology.com

13.2. Data Sources

In order to undertake the above analyses, we obtained data from several complementary sources: the catastrophe modeling firm Risk Management Solutions (RMS), the rating agency A.M. Best, the state insurance regulatory offices and state funds in Florida (Florida Hurricane Catastrophe Fund and Citizens Property Insurance Corporation) and Texas (Texas Wind Insurance Association).

State Exposure Data: Residential

Data on states’ residential-only exposure to hurricane risk was provided by Risk Management Solutions (RMS). Losses are comprised of damage caused by wind to buildings and contents, as well as victims’ additional living expenses (ALE). RMS used its proprietary U.S. Hurricane Industry Exposure Database (IED), which contains residential exposures at the postal zone level of resolution using a standard occupancy (e.g., single-family dwelling or multi-family dwelling) and construction (e.g., wood-frame or masonry) class. These data provide information about the total insured values of residential structures in the four target states.

Our analyses in New York, South Carolina and Texas were performed looking at both the wind and storm surge peril using RMS’s Hurricane Industry Exposure Database. This database analyzes insured wind damage as well as the portion of storm surge damage due to wind that would be covered by private insurance. In Florida, RMS’s residential exposure data came from the publicly available Florida Hurricane Catastrophe Fund (FHCF) through Paragon Strategic Solutions (Paragon), the FHCF Administrator. The RMS analyses in Florida did *not* include storm surge damage, because the FHCF only insures damage caused directly by wind. This means that the Florida figures underestimate the damage relative to the other three states.

The RMS model focuses on multiple types of residential exposure, including among others, single-family dwellings, mobile homes, condos, and rental properties. We used damage multipliers for each of the four states to isolate this “single-family dwelling” component from total damage to dwellings and focused on this component in our analyses. By comparing the total insured value (TIV) of residences and single-family homes to the TIV of all dwelling types, one obtains the damage multiplier (i.e., $TIV_{Residential}/TIV_{Total}$).

Table 13.1 details the TIV for all dwellings and computes the TIV for residential and single-family homes in each of the four states using the relevant damage multiplier.

TABLE 13.1. TOTAL INSURED VALUE OF ALL DWELLING TYPES AND RESIDENTIAL/SINGLE-FAMILY HOMES FOR FLORIDA, NEW YORK, SOUTH CAROLINA AND TEXAS, AND DAMAGE MULTIPLIERS

State	TIV: All Dwelling Types (in \$ Billion)	TIV: Residential and Single-Family Homes (in \$ Billion)	Damage Multiplier
FL	\$1,769	\$1,504	0.850
NY	\$2,063	\$1,749	0.847
SC	\$362	\$321	0.888
TX	\$2,053	\$1,857	0.904

In addition to exposure data, the catastrophe model allows us to measure the following elements at a postal zone level for each for the four states:

- Average Annual Loss (AAL) from wind-related damage due to hurricanes³⁵²
- Standard deviation of AAL

Data on Insurance Companies

The rating agency A.M. Best provided us with data on the 2006 statutory annual statements of individual insurance and reinsurance groups that included their total surplus and direct insurance premiums written, as well as the amount of homeowners multi-peril reinsurance coverage they assumed from both affiliates and non-affiliates. A.M. Best also provided aggregate data on the gross and net probable maximum losses (PMLs) for hurricane events with a 100-, 250- and 500-year return period for each of these groups. PML data came from the 2005 Supplemental Rating Questionnaires (SRQs) which are completed by the insurers. We used the PML data to estimate the amount of reinsurance and other risk transfer instruments available under the *status quo* program.

Note that the data from A.M. Best is comprised of group data and unaffiliated single companies. An unaffiliated single company is a stand-alone company that is not part of a group. A.M. Best provided us with the total surplus for each group of companies. This means that companies and their affiliates' surpluses were aggregated under one umbrella insurance group. One assumption inherent in this analysis is that the umbrella insurance group relies on its total surplus to determine how much insurance and reinsurance it will want to provide, should it have the freedom to charge risk-based rates as assumed under the *competitive market* program.

Florida Office of Insurance Regulation (FLOIR) Data

Insurers doing business in Florida are required by law to report statistical information to the Florida Office of Insurance Regulation (FLOIR). We used these data from their Quarterly Supplement Report (QUASR) to determine the insurer exposure in Florida. As our analysis is undertaken using 2005 data from RMS, we also used the 2005 data from QUASR. Because we restricted our analysis of losses to single-family dwellings, we focused on the homeowners' exposure (including tenants and condo owners) from the QUASR dataset. We used this exposure to develop individual insurer market shares to calculate the FHCF payouts on an individualized basis (see FHCF discussion below).

Data on State Funds

Given recent changes in the operation of state funds in Florida and Texas, we used the most recent information on their operation. The Florida Hurricane Catastrophe Fund (FHCF) provided us with 2007 information about its operations and surplus estimates. The data were compiled by Paragon, which also develops the reimbursement premium formula and the rates used in determining the FHCF's annual reimbursement premium. The FHCF annual reimbursement premiums are those paid by an insurer for its mandatory coverage. It does not

³⁵² By definition, the average annual loss (AAL) is the sum over all possible events of the expected losses associated with each of these individual events in a given state or postal zone, and for a given year.

include premiums of optional coverage above and below the standard coverage limit, Temporary Emergency Additional Coverage Options (TEACO) and Temporary Increase in Coverage Limit (TICL). The FHCF structure is described in more detail in the “Operation of Florida State Funds” subsection of Section 13.3.

Data on *Citizens Property Insurance Corporation*, the Florida-state run insurance company, was obtained from the same data sources used for other private insurers. We also obtained market share estimates for Citizens from news reports. A May 13, 2007 article in the *South Florida Sun-Sentinel* reported that Citizens’ board chairman estimated their market share to be about 30 percent.³⁵³ We recognize that this market share may increase substantially in the near future, but use this figure for this analysis. Data on the *Texas Windstorm Insurance Association* (TWIA), the state-run insurance company in the state of Texas, came from publicly available 2007 data as well as from the Insurance Information Institute.

American Housing Survey

Other housing statistical information came from the U.S. Census American Housing Survey (AHS). The AHS is the largest, regular national housing sample survey in the United States. The U.S. Census Bureau conducts the AHS to obtain up-to-date housing statistics for the Department of Housing and Urban Development (HUD). The national sample covers an average 55,000 housing units. Each metropolitan area sample covers 4,100 or more housing units. National data are collected in odd numbered years, and data for each of 47 selected metropolitan areas are collected every six years (note that not all metropolitan areas are collected at the same time). We used data from the following five metropolitan areas to project losses to uninsured homes: Tampa, FL (1998); Miami/Fort Lauderdale, FL (2002); Houston, TX (1998); Dallas, TX (2002) and Fort Worth/Arlington, TX (2002).

13.3. Assumptions for the Status Quo Analysis

Our analysis of the *status quo* estimates how much insurance and reinsurance is provided by the public and private sectors in each of the four states that we are studying. We then examine the effects of hurricanes of different magnitudes and intensities in each of these states and four metropolitan areas based on the *current insurance programs* in place. Should a hurricane occur tomorrow, this analysis would specify *who pays* for the damage. We also discuss the nature and length of the ultimate loss sharing in Florida and Texas, should their state-run funds have insufficient reserves to cover all the homeowners’ losses from the disaster.

³⁵³ Bushouse, K. "Citizens’ growth called risky: All Floridians could pay if major storm hits." *Sun-Sentinel*, Fort Lauderdale, FL, (May 13, 2007). This figure is consistent with other estimates; see for instance Holborn (2007), *Florida 2007 Update: Law Changes and Market Responses*, June 1.

Losses, Insurance Coverage, Take-up Rate, Uninsured Projections, Reinsurance and Mitigation Assumptions

To undertake a systematic analysis of insurance programs currently in place using data from the above sources, we made a set of assumptions that are detailed in this subsection.

Losses. Insurers' losses from hurricanes that occur in a given state are determined by multiplying their market shares in the state by the total insured losses from specific hurricanes. This assumption implies that each insurer's portfolio of homeowners' risks is distributed in the same manner across the entire state. While we recognize that this is a simplifying assumption, there is no systematic data collection publicly available on market share at a finer grain (e.g., postal zone level).

Take-Up Rate (TUR). Take-up rate (TUR) or market penetration refers to the percentage of homeowners in a given state or metropolitan area who have purchased insurance against wind damage in Florida, and wind and storm surge damage in the other states. The take-up rate enables one to derive the amount of losses to uninsured structures. We used data from the American Housing Survey (AHS) to estimate the take-up rate for Tampa, Miami/Fort Lauderdale, Houston, Dallas and Fort Worth/Arlington as shown in Table 13.2.

TABLE 13.2. TAKE-UP RATES FOR SELECTED AHS CITIES

City	Year	Take-Up Rate
Tampa, FL	1998	93%
Miami/Fort Lauderdale, FL	2002	87%
Houston, TX	1998	89%
Dallas, TX	2002	95%
Fort Worth/Arlington, TX	2002	92%
Average		91%

Based on this analysis, we estimated the take-up rate for all four states to be 90 percent.

Insurance Coverage. The data that RMS provided us assumed that all homeowners who purchased insurance against wind damage to their homes from hurricanes have full insurance coverage with the exception of their deductibles.

Mitigation. RMS provided data on the ground up (total) and gross (insured portion only) losses assuming full mitigation on all of the insured structures. The mitigation measures were based on the assumption that all structures met the building codes defined by "*The Fortified... for Safer Living*" program for Florida or the 2002 building codes for New York, South Carolina, and Texas.

Uninsured Losses Projection. The take-up rate (TUR) enables us to obtain an approximation of the residential uninsured losses. Our data from RMS included the ground up losses for *insured* structures only, as well as the gross losses, which is the portion of the ground up losses covered by insurers. In order to determine the ground up losses to uninsured structures, we had to extrapolate using the TUR.

We divided the ground up losses by the TUR to determine the total ground up losses assuming all of the structures were valued the same. Next, we subtracted the original value of ground up losses to remove the insured structures from our new total figure. Finally, we recognized that uninsured homes are worth less than insured homes. We used the ratio of the average uninsured home value (UHV) over the average insured home value (IHV) to estimate the value of the uninsured homes using the following formula:

$$(\text{Insured Ground Up Losses}/\text{Take-Up Rate} - \text{Insured Ground Up Losses}) \cdot \text{UHV}/\text{IHV}$$

We assumed that UHV/IHV = 60 percent based on the mean home values for insured and uninsured people from the AHS data on the five metropolitan areas in Florida and Texas, as shown in Table 13.3.

TABLE 13.3. RATIO OF INSURED TO UNINSURED HOME VALUES

Metropolitan Area	UHV/IHV
Tampa, FL	62%
Miami/Fort Lauderdale, FL	73%
Houston, TX	53%
Dallas, TX	60%
Fort Worth/ Arlington, TX	46%
Average	59%

The following example shows how we incorporate uninsured losses to obtain total losses from a hurricane. If the ground up losses are \$9 billion and the take-up rate is 90 percent, then we divide \$9 billion by 90 percent to get total losses of \$10 billion. But the additional \$1 billion must be diminished because it represents uninsured structures, which are worth less than the insured structures we used to estimate the loss. We multiply this figure by 60 percent since we assume these homes are valued at 60 percent of the insured homes. This yields an uninsured value of \$0.6 billion. This adjustment in value yields total losses of \$9.6 billion. \$9 billion is the original value of ground up loss while \$0.6 billion is our loss projection for the uninsured.

Reinsurance Assumptions and Calculations. The RMS data specifies the gross losses to insurers from any hurricane without taking into account reinsurance and other risk transfer instruments. Note that hereafter, when we refer to *reinsurance* we mean all types of alternative risk transfer (ART) instruments such as industry loss warranties, cat bonds and sidecars (see Chapter 8 for a more detailed discussion of these insurance-linked securities).

To estimate the aggregate amount of reinsurance we rely on probable maximum loss (PML) data from A.M. Best. We use the national pre-tax per-occurrence hurricane gross and net PMLs for the 100-, 250- and 500-year return periods for 90 groups categorized within the personal lines and homeowners’ segments using 2005 data. The 90 groups included in the analysis represent companies that submitted a Supplemental Rating Questionnaire (SRQ) to A.M. Best. Groups that provided the PML information verbally or in a group presentation are not included in the study.

Although some groups were omitted from the analysis, we believe this is an accurate portrayal of the industry. Furthermore, we used PML ratios, not the absolute value. These ratios from our sample should be generally applicable to the entire industry. The gross PML is the total projected loss from a catastrophic event for an insurer, while the net PML is the total projected loss from this event after subtracting reinsurance and other alternative risk transfer payments. The percentage of losses paid by reinsurance is derived using the following formula:

$$\% \text{ Reinsurance} = 1 - (\text{net PML}/\text{gross PML})$$

To illustrate, suppose that for a 100-year return period, an insurer had a gross PML from hurricanes in Florida of \$500 million and a net PML of \$300 million. Then equation (13.1) implies that the percent Reinsurance = $1 - (\$300/\$500) = 40$ percent. A.M. Best estimated gross and net PMLs for the insurance industry from hurricanes using data at the group level for the 100-, 250- and 500-year return periods. This enabled us to estimate the percent of reinsurance that insurers had purchased for these catastrophic losses as shown in Table 13.4.

TABLE 13.4. ESTIMATING REINSURANCE PERCENTAGES USING PML DATA ON HOMEOWNERS’ LOSSES FROM HURRICANES

Return Period	Gross PML	Net PML	Net/Gross	Reinsurance (incl. ART)
100	21.3	8.5	39.7%	60.3%
250	33.3	16.1	48.3%	51.7%
500	44.7	25.4	56.9%	43.1%

Source: Data from A.M. Best; Authors’ calculations

Because these reinsurance percentages are based on aggregate group PMLs, we feel they are accurate only for Florida hurricanes with no mitigation in place, since the losses from these disasters comprise most of the nation’s PML. Furthermore, reinsurance is linked to damage amounts instead of return periods. Using the Florida RMS data for no mitigation, we find that gross losses for the insurance industry are \$76 billion for the 100-year return period, \$113 billion for the 250-year return period, and \$141 billion for the 500-year return period. The gross losses for the other three states are somewhat lower. Based on PML analysis and on discussions with several reinsurers, we developed the following assumptions for reinsurance percentages for the spectrum of gross loss amounts, as shown in Table 13.5.

TABLE 13.5. PERCENTAGES OF REINSURANCE AS A FUNCTION OF CATASTROPHIC LOSS

Gross Loss	Reinsurance
\$0-10 billion	10%
\$10-20 billion	20%
\$20-30 billion	30%
\$30-50 billion	40%
\$50-90 billion	60.3%
\$90-120 billion	51.7%
\$120-145 billion	43.1%

The amount of reinsurance in place for any hurricane in New York, South Carolina and Texas is estimated by multiplying the gross losses by the relevant percentage in the above table. In Florida, the Florida Hurricane Catastrophe Fund (FHCF) provides significant amounts of reinsurance to many insurers, so sometimes the total payout from the FHCF will reflect the total amount of reinsurance for the insurer. More specifically, we assume that the FHCF is the first tier reinsurer and that the amount of private reinsurance (second tier) is determined by:

$$\text{Private Reinsurance} = \text{Max} (0; \text{Total Reinsurance} - \text{Reinsurance by FHCF})^{354}$$

Operation of Florida State Funds

Florida currently plays a significant role in providing insurance and reinsurance to homeowners through Citizens and the FHCF respectively. A detailed description of these two entities is provided in Chapter 2 of this report, so here we focus only on key assumptions regarding the operation of these state Funds.

Citizens. Citizens provides insurance to homeowners in high-risk areas and others who cannot obtain coverage in the open, private insurance market. For our analysis, we assumed Citizens had a market share of 30 percent for the base case scenario. Note that this represents a significant increase compared to its market share just a few years ago. Citizens, which was supposed to be the insurer of last resort, has recently become the largest provider of residential coverage against wind in Florida.

If Citizens does not have enough money to pay its claims, we assume that it will recoup its entire deficit over time against all policyholders in the state. Specifically, Citizens assesses insurers, who then collect a surcharge from all their policyholders that is remitted to Citizens. The assessment is an obligation of the policyholders, not the insurers. If a policyholder fails to pay the assessment, the policyholder loses his coverage. The assessment base to pay for Citizens deficits has been expanded from homeowners coverage to include auto and other lines of insurance, with the exception of medical malpractice and workers' compensation. These policyholders are now required to help pay for Citizens' 2005 deficit through a surcharge averaging 2 percent of their annual premium. In 2006, the state legislature allocated \$715 million to reduce the amount of assessments policyholders would be required to pay. The remainder of the deficit, about \$887 million, will be collected over a ten year period.³⁵⁵

³⁵⁴ Sometimes the FHCF payout is larger than the total reinsurance projected in Table 13.5. This is because the FHCF offers more generous levels of reinsurance coverage until it hits its cap. In cases when the FHCF payout exceeds our total reinsurance calculation, the total reinsurance is assumed to be equal to the FHCF payout.

³⁵⁵ Insurance Information Institute (2007), "Issues Update: Residual Markets," August 2007.

Florida Hurricane Catastrophe Fund (FHCF). The FHCF was established to supplement private reinsurance and reimburse all insurers in Florida for a portion of their losses from catastrophic hurricanes. During the January 2007 special Florida legislative session, the capacity of the FHCF was expanded to \$27.75 billion in reinsurance.

Post Disaster Assessment. Since the FHCF has far less reserves than potential liabilities, the additional capacity that might be needed to meet all its claims following a severe hurricane would be funded by bonds supported by the FHCF's emergency assessment authority, which will assess all property and casualty lines of business including surplus lines but excluding workers' compensation, accident and health, medical malpractice, and flood. Here again, all Floridians who purchased these types of insurance coverage will have to pay over the years when the FHCF runs a deficit. The assessment is limited to 6 percent annually for losses realized in any one year, and 10 percent annually in the aggregate for all assessments for losses in all years.

FHCF Payout Calculation. We obtained 2005 data on the exposure of different insurers at the county level from the Florida Office of Insurance Regulation (FLOIR). These data are reported by insurers to the FLOIR under the QUASR system. 138 of these companies had homeowners exposure in Florida, and we estimated the market share of each insurer i to be:

$$\text{MarketShare}_i = \text{Exposure}_i / \text{TotalExposure}$$

We then use the gross losses provided by RMS to estimate the gross loss by insurer i as follows:

$$\text{Loss}_i = \text{MarketShare}_i \cdot \text{TotalGrossLosses}$$

Under the current arrangement between the FHCF and insurers in Florida, the FHCF will reimburse a fixed percentage of a participating insurer's losses from each covered event in excess of a per event retention and subject to a maximum aggregate limit for all events. The percentage of proportional reinsurance covered by the FHCF can be 45 percent, 75 percent, or 90 percent at the option of the insurer. The event retentions and limits vary by insurer according to a formula based on FHCF premiums. In order to calculate the payout from the FHCF to each insurer, we accessed data on the FHCF. Knowing the retention cap, the choice of proportional reinsurance rate (45 percent, 75 percent or 90 percent) and the FHCF decision to pay an additional 5 percent of the calculated reimbursement figure for loss adjustment expenses, the FHCF payout to insurer i is determined by the following formula:

$$\text{FHCF Payout}_i = \text{Max} [0; (\text{Loss}_i - \text{Retention}_i)] \cdot (\text{ReinsuranceRate}_i) \cdot (1.05)$$

To illustrate the FHCF payout, consider an insurer with a \$50 million retention who selected the 90 percent proportional reinsurance rate. If that insurer suffers \$500 million losses, then the FHCF will be responsible for \$405 million (90 percent above the \$50 million retention).

We sum all the individual payouts to insurers to obtain the total FHCF payout:

$$FHCF \text{ Payout} = \sum_i \{ \text{Max} [0; (\text{Loss}_i - \text{Retention}_i)] \cdot (\text{ReinsuranceRate}_i) \cdot (1.05) \}$$

If the total payout is greater than \$27.75 billion, we cap the aggregate payout at \$27.75 billion because that is the FHCF defined maximum.³⁵⁶ Then we multiply the payout by the damages multiplier to remove the non-residential structures from the analysis, so we can isolate the portion of the payout going toward residential structures.³⁵⁷

Funding Arrangements. The current 2007-2008 FHCF funding arrangement is displayed in Figure 13.2. The \$6.1 billion industry retention is the aggregate retention (deductibles) of insurers covered by the FHCF. Insurers are assumed to have a 90 percent proportional reinsurance rate so that they are only responsible for 10 percent of the insurance wind losses from a hurricane above the \$6.1 billion retention. The FHCF structure utilizes a buy-down option below the aggregate industry retention level, Temporary Emergency Additional Coverage Options (TEACO), which lowers the retention (deductible) of an insurer.³⁵⁸ The FHCF offers an additional buy-up option above the FHCF limit, Temporary Increase in Coverage Limit (TICL), which can be chosen by the insurer to increase its coverage against catastrophic wind losses from hurricanes. TICL coverage applies when hurricane losses exceeds claims paying capacity.

The FHCF claims paying capacity is the Fund’s balance as of December 31st of a contract year. The 2007-2008 FHCF funding structure is used to analyze the FHCF deficit should a severe hurricane occur. Table 13.6 compares the “potential coverage” as stated in the legislation to the “actual coverage” based on availability and insurer selections. We have estimated actual coverage using 2006 premiums.

TABLE 13.6. FHCF FUNDING STRUCTURE FOR PAYING HURRICANE CLAIMS

	Potential Coverage	Actual Coverage based on Selections
TICL Layer	\$12.000 billion	\$11.373 billion
SBA Optional Limit	\$4.000 billion	\$0
Mandatory Layer Bonds	\$13.430 billion	\$13.430 billion
\$10 million Coverage Option	\$0.600 billion	\$0.537 billion
TEACO	\$6.000 billion	\$ 0
Cash Balance	\$2.415 billion	\$2.415 billion
TOTALS	\$38.445 billion	\$27.755 billion

³⁵⁶ The \$27.75 billion represents the full coverage and includes the 5 percent for loss adjustment expenses. The losses would be \$26.43 billion (\$27.75/1.05) and the loss adjustment expense would be \$1.32 billion (\$26.43 billion x 5 percent).

³⁵⁷ We thank Jack Nicholson, president of the Florida Hurricane Catastrophe Fund, for many insightful discussions on the operation of the Fund.

³⁵⁸ In 2007, no insurers selected this coverage.

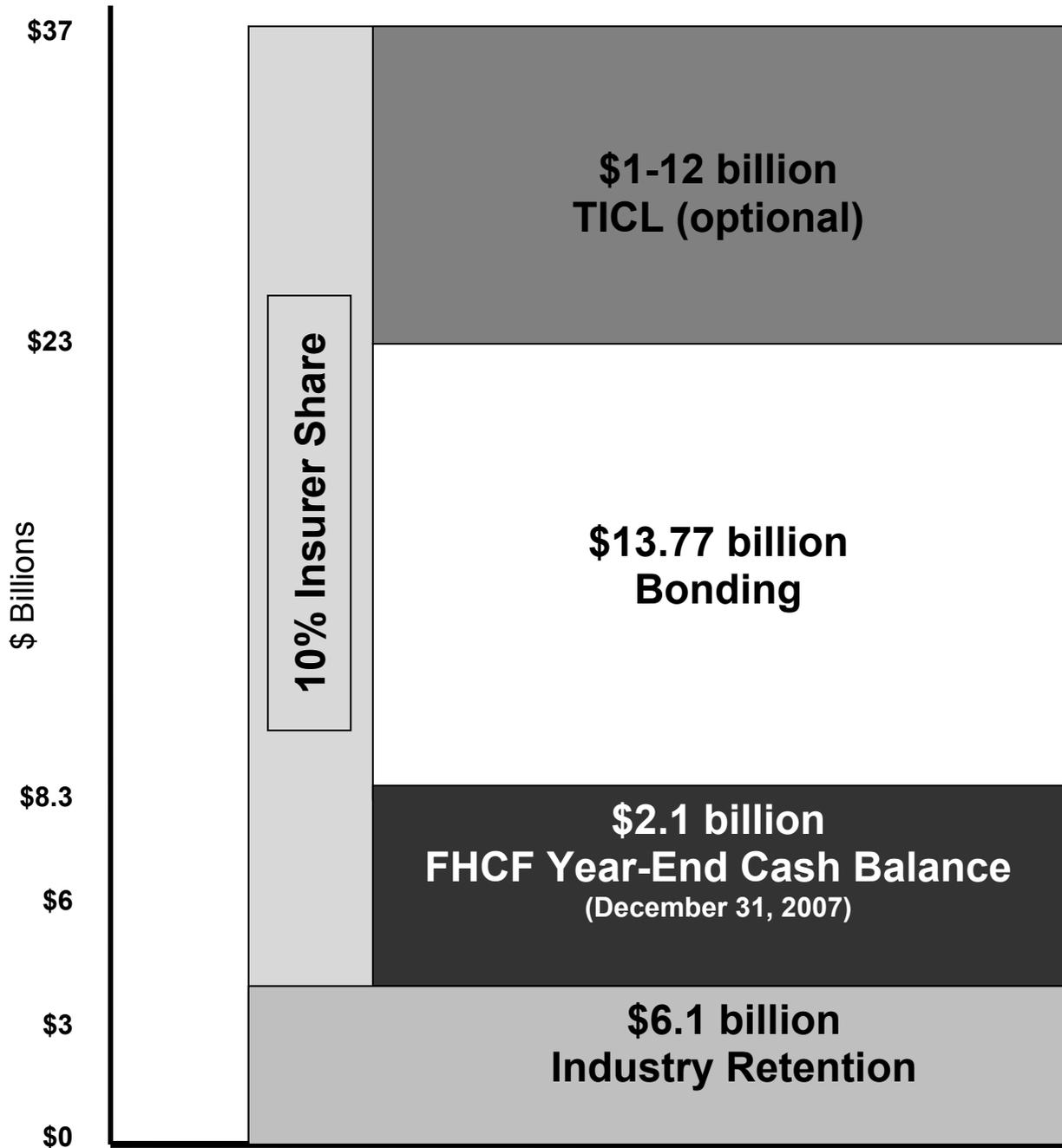


FIGURE 13.2. 2007-2008 FHCF EVENT FUNDING STRUCTURE

The State Board of Administration (SBA) may make available an additional \$4 billion of capacity but this optional coverage is not currently offered to insurers. Mandatory Layer Bonds are the bonds taken out by the FHCF to pay for the regular (mandatory) coverage. The \$10 million coverage option is available to certain limited apportionment companies and companies that participated in the Insurance Capital Build-Up Incentive Program. No insurer actually purchased TEACO since it is designed to be a last resort coverage; private reinsurance was used as a substitute for TEACO. As a result, the total actual coverage of \$27.75 billion is about \$10.7 billion less than its potential coverage.³⁵⁹ For our analyses of hurricane damage to homeowners, FHCF coverage is \$23.59 billion – the portion of the state fund that would be available for covering insurers’ hurricane wind claims to residences. That represents the maximum level of claims the Fund will be responsible for in our analysis; we discuss below how the FHCF can finance such a level of claims (using future reinsurance premiums collected against insurers or *ex post* assessment against all policyholders in the state), given that its current reserve is only \$2 billion.

Operation of the Texas Windstorm Insurance Association (TWIA)³⁶⁰

In 1970, Hurricane Celia caused an estimated \$310 million in insured losses in Texas (\$1.55 billion in 2005 dollars). Many insurers sustained significant losses and discontinued coverage in the state’s exposed coastal communities. As a result, in 1971, the state created the Texas Catastrophe Property Insurance Association which later became the Texas Windstorm Insurance Association (TWIA). The TWIA provides wind and hail coverage for Texas Gulf Coast property owners as an insurer of last resort. As such, the TWIA writes higher risk policies than other carriers.

The TWIA writes policies in only the following 15 counties, all of which are on the coast, as shown in Figure 13.3.

Aransas	Galveston	Matagorda
Brazoria	Harris County (partial)*	Nueces
Calhoun	Jefferson	Refugio
Cameron	Kenedy	San Patricio
Chambers	Kleberg	Willacy

*Although not on the map, the following portions of Harris County, located inside the city limits and east of Highway 146 are also included: LaPort, Morgan’s Point, Pasadena, Seabrook and Sore Acres.

³⁵⁹ More details can be found at <http://www.sbafla.com/fhcf/> as of December 2007.

³⁶⁰ We thank Jim Oliver and Jim Murphy of the Texas Windstorm Insurance Association for discussions we had on the nature of the Association’s operations.

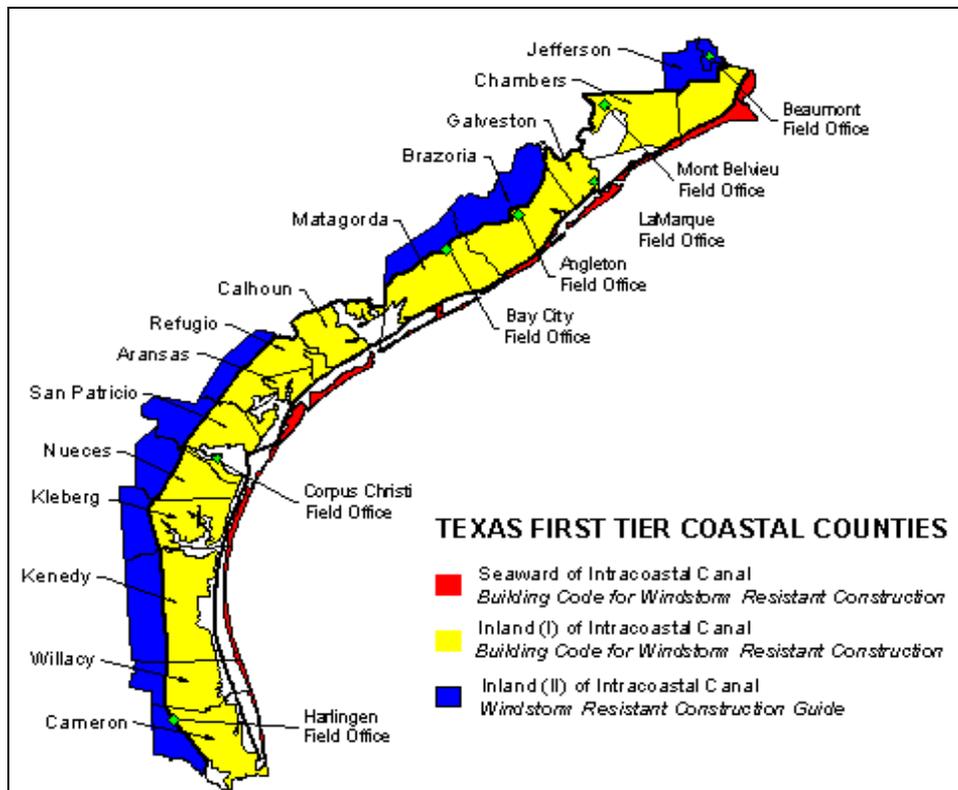


FIGURE 13.3. LOCATION OF COASTAL COUNTIES WHERE COVERAGE IS PROVIDED BY TWIA

Insured Property. The number of structures insured by TWIA has been growing dramatically in the past few years. In 2001, the Association had 68,756 policyholders; as of July 31, 2007, 190,468 policies were in place. In 1992, TWIA had about \$5 billion exposure in these counties. At the end of July 2007, its exposure was approximately \$51.5 billion, not including loss of business coverage and additional living expense coverage. This represents a \$13.2 billion increase since January 1, 2007. When business interruption and additional living expense coverage are included, the total TWIA exposure rises to over \$56.1 billion.

Residential and commercial policyholders can purchase TWIA coverage up to the following statutory limits:

- **Residential:** Dwelling Building and Contents: \$1.5 million
- **Apartment, Condo, Townhouse:** Contents Only: \$163,000
- **Mobile Home:** Building and Contents: \$84,000
- **Commercial:** Commercial Building and Contents: \$1.9 million

How the TWIA Operates. All companies that are licensed to write property insurance in the state of Texas are required to contribute to the TWIA as pool members. Any excess and surplus lines carriers that are affiliated with a member company are also included. TWIA is governed by a nine-member board of directors, comprised of five insurance company representatives, two agent representatives and two consumer representatives. While our analysis focuses on residential property only, the TWIA covers residential and commercial structures as well as miscellaneous items such as signs, fences, flagpoles and swimming pools.

The TWIA operates similarly to a standard insurance company. It issues policies, collects premiums, and pays claims. Any profits accrued are deposited annually into the Catastrophe Reserve Trust Fund (CRTF), which provides one source of funding in the event of a catastrophic loss or series of losses, as detailed in the funding arrangement section below.

Market Share. The TWIA estimates that, as of July 31, 2007 its share of the coastal residential market where they are authorized to do business has increased to 51.4 percent. Using the RMS data, we determined the average annual losses (AAL) of the coastal areas where TWIA does business relative to the total AAL in Texas. It ranges from 53.6 percent if there is no mitigation in place, to 46.7 percent if there is mitigation in place. Given the 51.4 percent market share for TWIA in these coastal areas, this translates to a 24 percent to 28 percent overall market share (with mitigation and without mitigation, respectively) in Texas.

Funding Arrangements. The current funding structure for TWIA is shown in Figure 13.4. Texas statute requires that losses to the TWIA be paid from the following sources in this order:

- 1) \$100 million assessed against members of TWIA
- 2) Up to \$400 million, depending on the current reserve in the Catastrophe Reserve Trust Fund, which acts as the TWIA surplus
- 3) \$1 billion in reinsurance
- 4) \$200 million assessed against members of the Association, non-reimbursable
- 5) Unlimited additional assessments against members of the Association, reimbursable via premium tax credits over five or more years

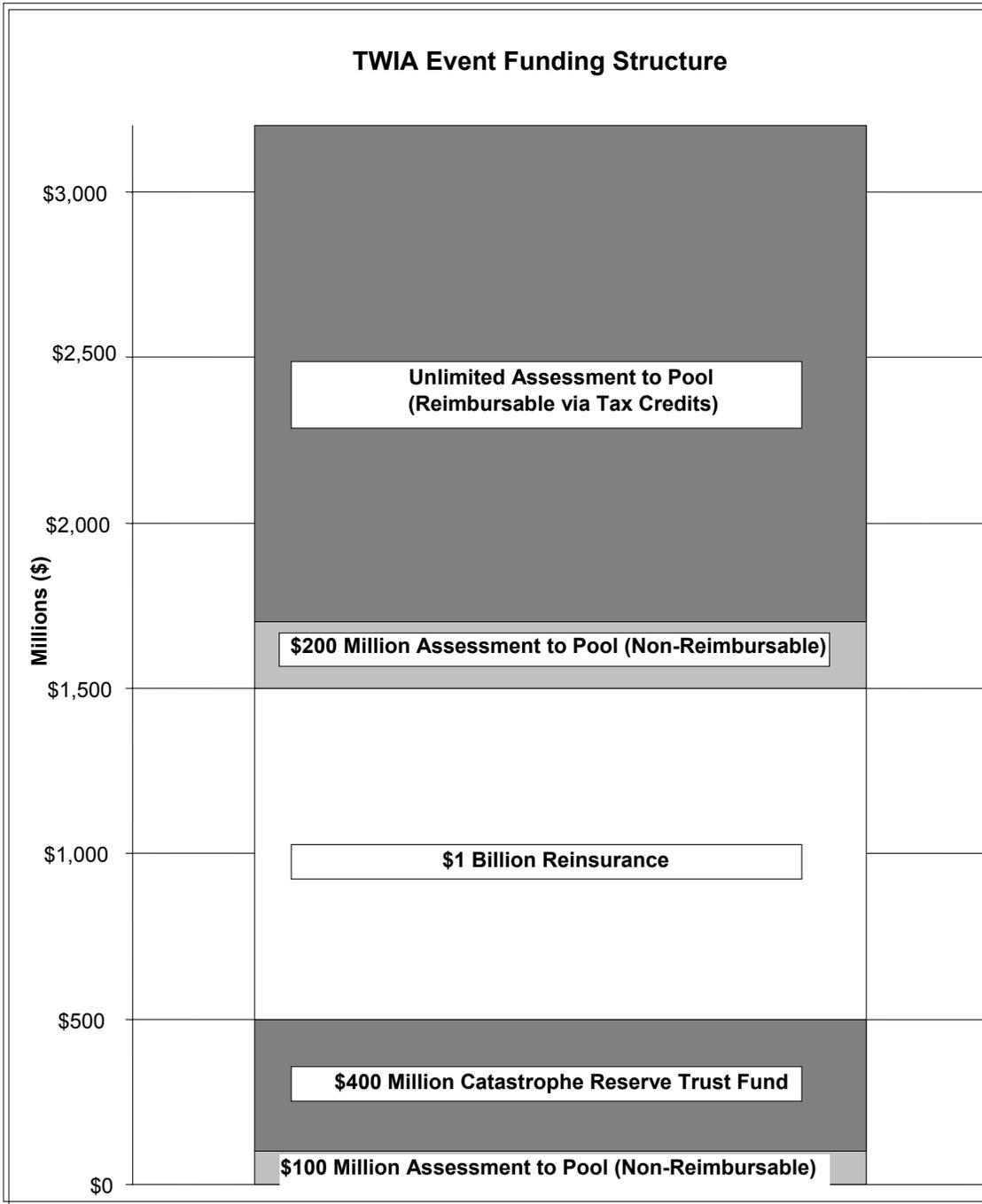


FIGURE 13.4. FUNDING ARRANGEMENTS FOR THE TWIA (TEXAS)

The amount of reinsurance recoverable by the TWIA is contractual. For the 2007 storm season, \$1 billion in reinsurance coverage has been purchased by the TWIA. The amount paid from the Catastrophe Reserve Trust Fund (CRTF) is based on the actual fund balance, which was \$382 million as of September 2007. Given current premiums and reinsurance expenses, average non-catastrophic losses, and no catastrophic losses, the TWIA expects to be able to contribute an average of \$50 million annually to the CRTF. Unexpected growth, changes in reinsurance costs, non-catastrophic losses significantly above or below historic averages, or any catastrophes could materially impact the amount of any contribution to the CRTF.

The premium tax credit provision in the TWIA statute has never been executed because losses have never exceeded the relevant threshold. In the event of an assessment in this layer, TWIA member companies would claim up to 20 percent of their assessment annually as a credit against their Texas premium taxes for five or more years.³⁶¹ In discussions with TWIA representatives, they indicated that the Texas Windstorm Insurance Association was seeking solutions to pay losses and avoid compromising the Texas General Revenue fund should a major hurricane make landfall in a coastal area of the state. In 2006, TWIA paid \$160 million in losses as a result of losses caused by Hurricane Rita. Claims could have been much higher had the storm hit Galveston.

Mitigation

In undertaking our series of analyses, we assume two extreme cases regarding mitigation in place: either no mitigation or full mitigation on all residential homes. As our analysis reveals, mitigation plays a critical role in reducing losses associated with the different major hurricanes we analyze.

New York, Texas, and South Carolina. In these states, we assumed that **all** houses and buildings conformed to the most recent standard (2002 standards or later ones) to measure the effects of full mitigation. Every structure was assumed to be mitigated in accordance with the latest building codes without determining whether or not it would be cost effective to do so.

Florida. Mitigation in this state assumes that the relevant homes met the standards of the “*Fortified...for Safer Living*” program.³⁶² This program offers solutions to reduce a residential structure’s vulnerability to natural hazards such as hurricanes. Strategies include mitigation measures such additions of roof anchors in the building process. As the “*Fortified...for Safer Living*” program is directed only at wood-frame or masonry dwellings, this program was only applicable to 80 percent of the structures in the FHCF portfolio (the remaining structures were manufactured homes). Every structure was mitigated in accordance with the program without examining whether these measures would be cost effective.

³⁶¹ If a company's potential tax credit were greater than its tax liability, it could carry over the additional credit to future years. In this case, a company with a small tax liability and/or a large assessment might require significantly more than five years to fully recoup its assessment. Under no circumstance would a company be able to recoup its assessment in less than five years, as the maximum annual credit is 20 percent of the assessment.

³⁶² Information on this program is available on the website of the Institute for Business & Home Safety at http://www.ibhs.org/property_protection/default.asp?id=8 as of September 2007.

13.4. Status Quo Analyses

Comparisons Across the Four States

We utilized the following *base case assumptions* for our analyses of current insurance programs in place:

Hurricane Return Period	100 years
Insurance Take-Up Rate	90%
Mitigation	None
Reinsurance	Linked to Losses (see Table 13.5)
Reserves	FHCF (FL) = \$2.4 billion Citizens (FL) = \$2.1 billion TWIA (TX) = \$0.4 billion
State Insurer Market Share	Citizens (FL) = 30% TWIA (TX) = 27.55%

Table 13.7 provides a *dollar comparison* of the impact of a 100-year hurricane on the different stakeholders for each of the four states. An explanation of each column of this table is described below:

- **Losses to Uninsured Homes:** Losses to homeowners who do not have insurance.
- **Losses to Insured Homes:** Losses to homeowners who have insurance after claims reimbursements. These residual losses include deductibles and payments above the coverage limit.
- **State Insurer:** Losses to Citizens in Florida (this amount is the level of claims that Citizens will be responsible for under different scenarios; later we discuss how Citizens will meet its claims if they are higher than its current reserves) and the TWIA in Texas, after reinsurance reimbursements.
- **State Assessment to Insurers:** Losses paid by TWIA pool members (private insurers in Texas).
- **Private Insurers:** Losses to private insurers after reinsurance reimbursement.
- **Private Insurers Reimbursable Tax Credits:** Losses paid by TWIA pool members (private insurers in Texas), that can be recouped via future tax credits (see TWIA section above).
- **State Reinsurer:** Losses to the FHCF in Florida only (that amount is the level of claims the FHCF will be responsible for under different scenarios; later we discuss how the fund will meet its claims if they are higher than its current reserves).
- **Private Reinsurance:** Losses to private reinsurers.

TABLE 13.7. STATE COMPARISON: 100-YEAR RETURN PERIOD – HURRICANE WITHOUT MITIGATION (\$ BILLION)

State	Details	Total Loss	Homeowner Losses		Insurer Losses				Reinsurer Losses	
			Losses to Uninsured Homes	Losses to Insured Homes (below deductible and above limit)	State Insurer (FL=Citizens TX= TWIA)	State Assessment to Insurers (TWIA only)	Private Insurers	Private Insurers Reimbursable Tax Credits Portion (TWIA only)	State Reinsurer (FHCF only)	Private Reinsurance
FL	Return Period: 100 Take-Up Rate: 90% Mitigation: No Reinsurance: 60.3% CitizensMktShare: 30% Citizens Reserve: \$2.1 B FHCF Reserve: \$2.4B	\$75.73	\$4.73	\$6.18	\$7.72	-	\$18.01	-	\$23.59	\$15.49
TX	Return Period: 100 Take-Up Rate: 90% Mitigation: No Reinsurance: 20% TWIA Reserve: \$400M	\$16.6	\$1.04	\$1.08	\$0.4	\$0.3	\$8.59	\$2.29	-	\$2.90
NY	Return Period: 100 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$5.41	\$0.34	\$0.82	-	-	\$3.82	-	-	\$0.42
SC	Return Period: 100 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$4.13	\$0.26	\$0.21	-	-	\$3.29	-	-	\$0.37

Table 13.8 provides a *percentage comparison* of the impact of a 100-year hurricane on the different stakeholders for each of the four states. Several observations are relevant regarding the distribution of losses between the affected parties.

Differences in Losses between States. Florida is by far the most exposed of the four states we studied. A 100-year hurricane is estimated to produce total losses of \$75.7 billion in Florida, losses of \$16.6 billion in Texas, \$5.4 billion in New York and \$4.1 billion in South Carolina. As shown in Appendix 13-A, a 250-year event would inflict total losses of \$114.2 billion in Florida, \$26.1 billion in Texas, \$11.4 in New York and \$6.5 billion in South Carolina. A 500-year event would inflict total losses of \$144.9 billion in Florida, \$35.5 billion in Texas, \$17.4 billion in New York and \$8.7 billion in South Carolina.

Homeowners' Losses. Due to the nature of our analysis, the losses to homeowners are derived from the take-up rate, the RMS data for ground up losses for each hurricane scenario based on the assumption that uninsured home values are 60 percent of the insured homes in any given state. These assumptions result in uninsured homeowners in all states paying for 6 percent of the total loss in a 100-year return event. Insured homeowners are relatively well protected against large catastrophes, generally suffering less than 5 to 8 percent of the total losses except in New York, where it is 15 percent of the loss. The RMS data indicate that New York is more likely to have less severe hurricanes than other states, so that many homeowners incur relatively small losses which are only partially covered by insurance due to the deductibles on homeowners' policies which normally range from \$500 to \$2,000.

State Fund Losses. In Florida, Citizens will incur only 10 percent of total losses even though it is assumed to have a market share of 30 percent. Citizens is heavily reinsured by the FHCF for a 100-year event. TWIA would be responsible for only 2 percent of the losses in Texas, so that private insurers in that state would incur a much higher percentage of the losses from a hurricane with a 100-year return period than those marketing policies in Texas.

Figure 13.5 details the losses sustained by homeowners, insurers, and reinsurers in each of the four states for events with 50-, 100-, 250- and 500-year return periods when there are no mitigation measures in place. Private insurers in New York and South Carolina pay for a significant portion of the total losses, but the actual dollar amounts are much lower than in the other states in our analysis, Florida and Texas.

TABLE 13.8. STATES COMPARISON (PERCENTAGE): 100-YEAR RETURN PERIOD – HURRICANE WITHOUT MITIGATION (\$ BILLION)

State	Details	Total Loss	Homeowner Losses		Insurer Losses				Reinsurer Losses	
			Losses to Uninsured Homes	Losses to Insured Homes	State Insurer (FL=Citizens TX= TWIA)	State Assessment to Insurers (TWIA only)	Private Insurers	Private Insurers Reimbursable Tax Credits Portion (TWIA only)	State Reinsurer (FHCF only)	Private Reinsurance
FL	Return Period: 100 Take-Up Rate: 90% Mitigation: No Reinsurance: 60.3% CitizensMktShare: 30% Citizens Reserve: \$2B FHCF Reserve: \$2B	\$75.73	6%	8%	10%	-	24%	-	31%	20%
TX	Return Period: 100 Take-Up Rate: 90% Mitigation: No Reinsurance: 20% TWIA Reserve: \$400M	\$16.6	6%	7%	2%	2%	52%	14%	-	17%
NY	Return Period: 100 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$5.41	6%	15%	-	-	71%	-	-	8%
SC	Return Period: 100 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$4.13	6%	5%	-	-	80%	-	-	9%

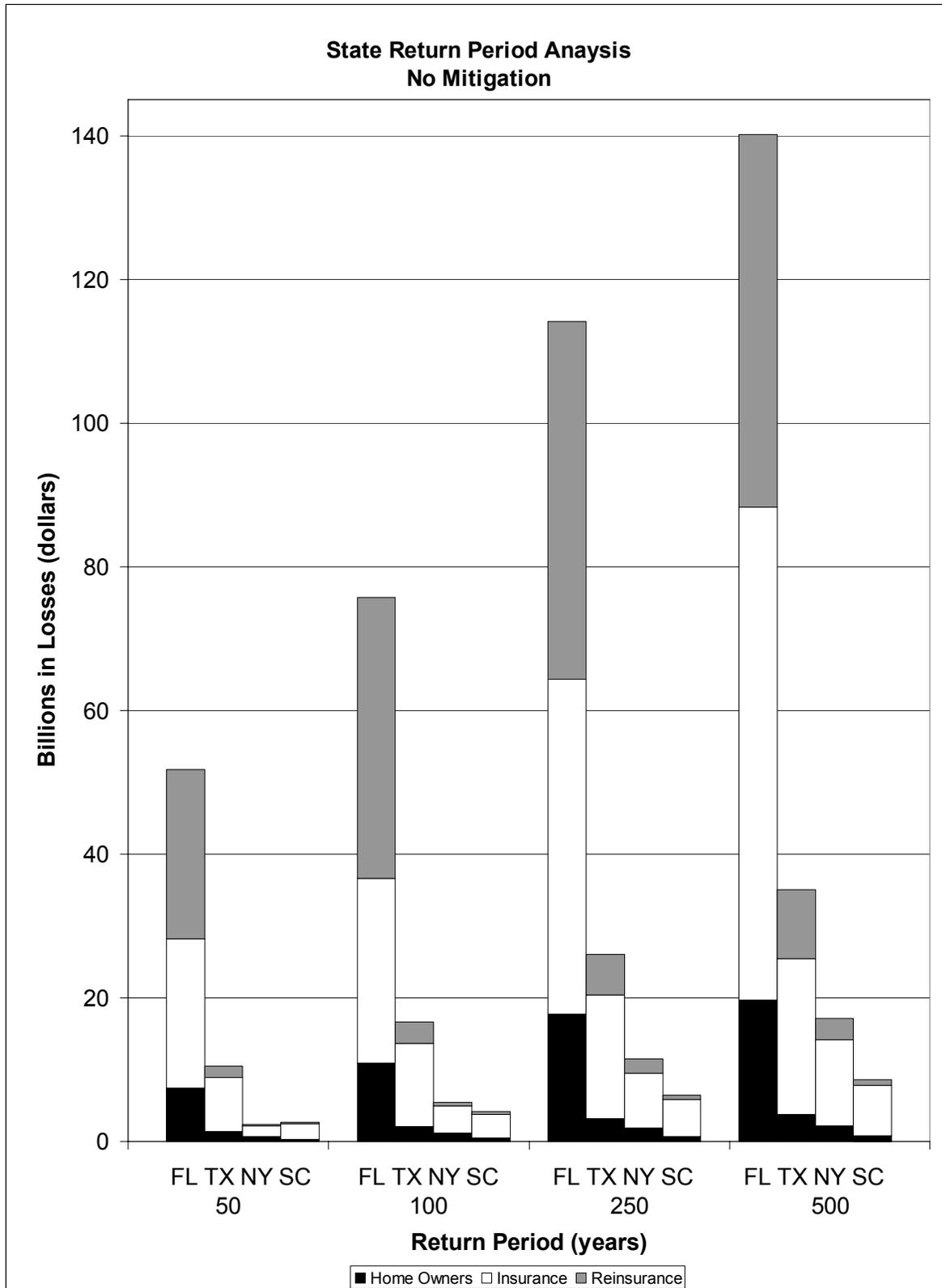


FIGURE 13.5. HOMEOWNER, INSURER AND REINSURER LOSSES (INITIAL CLAIMS) FROM HURRICANES WITH 50- TO 500-YEAR RETURN PERIODS FOR FLORIDA, TEXAS, NEW YORK AND SOUTH CAROLINA

Deficit from TWIA, Citizens and FHCF

We now analyze the residential losses that would be sustained by TWIA, Citizens, and the FHCF from a 100-year hurricane, and determine who will ultimately pay for these losses. In Texas, the TWIA will be liable for nearly \$4 billion in claims. The deficit amount sustained by the TWIA is the amount of money that the TWIA assesses to pool members (see TWIA funding section). This includes the first \$100 million tier, the \$200 million tier after TWIA reserves and reinsurance, and the highest tier (unlimited assessment to pool members).

In Florida, Citizens will be responsible for \$7.7 billion in claims from its policyholders and the FHCF will be responsible for \$23.6 billion in claims from the insurers it covers with respect to residential damage.³⁶³ The major challenge is that, as of today, each of these two entities has only about \$2 billion in reserve. There are at least two possible ways this deficit can be absorbed: *ex post* assessment (recoupment process) or use of future premiums.

Ex post assessment (recoupment process). The first possibility is for Citizens and the FHCF to assess the entire deficit against all insurers, who in turn can assess it back to their policyholders. Here, the figures are \$5.72 billion for Citizens (claims minus reserves of \$7.72 billion - \$2 billion); and \$21.59 billion for the FHCF (claims minus reserves of \$23.59 billion - \$2 billion).³⁶⁴ Table 13.9 compares the original claims distribution to all stakeholders in Florida under a 100-year hurricane scenario with the loss-sharing arrangements if Citizens and the FHCF decide to finance 100 percent of the claims above their reserves through *ex post* assessments. We assume that the recoupment is assessed only to insured residential homeowners.³⁶⁵ Policyholders will now pay a total of **\$33.49 billion** (the \$6.18 billion plus \$5.72 billion assessed to recoup Citizens' deficit, and \$21.59 billion assessed to recoup FHCF's deficit).

Use of Future Premiums. The second possibility is for these entities to issue some type of bond and/or access other types of debt so they can repay the debt over time using future premiums collected in the state. How long would it take Citizens, the FHCF and TWIA to repay entirely claims above their current reserves if they followed this strategy?

To address this question we assumed a growth in claims paying capacity by the state funds, through premiums collected over time but no increase in residential losses. Furthermore, we assumed there was no hurricane during the intervening years. The growth in FHCF capacity was estimated by using a 4 percent increase in its premiums per year.³⁶⁶ Investment income on the premium or the balance carried forward is not considered. Table 13.10 shows the claims paying capacity for the three state funds from 2007 through 2016.

³⁶³ The actual figure, including commercial coverage, would be higher.

³⁶⁴ The figures on claims for Citizens and FHCF come from Table 13.7.

³⁶⁵ In reality, the recoupment will be made against both residential and commercial policyholders in the state.

³⁶⁶ This estimate was provided to us by the FHCF as a conservative growth factor.

**TABLE 13.9. ORIGINAL CLAIM DISTRIBUTION AND ULTIMATE LOSS-SHARING AFTER 100% POST-DISASTER ASSESSMENT
100-YEAR RETURN PERIOD WITHOUT MITIGATION IN FLORIDA (IN \$ BILLION)**

Details	Total Loss	Homeowner Losses		Insurer Losses		Reinsurer Losses	
		Losses to Uninsured Homes	Losses to Insured Homes (below deductible and above limit)	Citizens	Private Insurers	FHCF	Private Reinsurance
Return Period: 100 Take-Up Rate: 90% Mitigation: No Reinsurance: 60.3% Citizens Mkt Share: 30% Citizens Reserve: \$2B FHCF Reserve: \$2B	Original Claims						
	\$75.73	\$4.73	\$6.18	\$7.72	\$18.01	\$23.59	\$15.49
	Ultimate Loss Distribution						
	\$75.73	\$4.73	\$33.49³⁶⁷	\$2.00	\$18.01	\$2.00	\$15.49

TABLE 13.10. CLAIMS PAYING CAPACITY GROWTH ESTIMATES FOR FHCF, CITIZENS, AND TWIA

Year	FHCF			Citizens		TWIA	
	Premiums @ 4% Growth per Year	TICL and TEACO	Actual Claims Paying Capacity	Premiums @ 4% Growth per Year	Actual Claims Paying Capacity	Premiums @ 4% Growth per Year	Actual Claims Paying Capacity
2007	\$0.98	\$0.25	\$2.41	\$2.05	\$ 2.05	\$0	\$0.38
2008	\$1.02	\$0.26	\$3.69	\$2.14	\$ 4.19	\$0.05	\$0.43
2009	\$1.06	\$0.27	\$5.03	\$2.22	\$ 6.41	\$0.05	\$0.48
2010	\$1.10	\$ 0	\$6.13	\$2.31	\$ 8.72	\$0.05	\$0.53
2011	\$1.15	\$ 0	\$7.28	\$2.40	\$11.13	\$0.05	\$0.58
2012	\$1.19	\$ 0	\$8.47	\$2.50	\$13.63	\$0.05	\$0.63
2013	\$1.24	\$ 0	\$9.71	\$2.60	\$16.23	\$0.05	\$0.68
2014	\$1.29	\$ 0	\$11.00	\$2.70	\$18.93	\$0.05	\$0.73
2015	\$1.34	\$ 0	\$12.34	\$2.81	\$21.74	\$0.05	\$0.78
2016	\$1.40	\$ 0	\$13.74	\$2.92	\$24.66	\$0.05	\$0.83

³⁶⁷ The increase here assumes that the entire deficit of Citizens and the FHCF is recouped only against homeowners who have wind coverage; in reality, as described above, the deficit would be recouped against all lines of insurance, with the exception of medical malpractice and workers' compensation.

To determine whether or not the different state funds experience a deficit, their claims paying capacity is subtracted from the base case losses from a 100-year hurricane occurring in a particular year, assuming there were no damaging hurricanes during the previous years. A deficit occurs if the losses from such a hurricane exceed the aggregate claims paying capacity of the FHCF, Citizens or TWIA. The results from this analysis are detailed in Table 13.11.

TABLE 13.11. DEFICIT ESTIMATE: BASE CASE LOSSES – ESTIMATED CLAIMS PAYING CAPACITY OVER TIME

Remaining Deficit (\$ Billion)			
Year	FHCF	Citizens	TWIA
2007	\$21.18	\$5.67	\$3.61
2008	\$19.90	\$3.53	\$3.56
2009	\$18.57	\$1.31	\$3.51
2010	\$17.47	\$0	\$3.46
2011	\$16.32	\$0	\$3.41
2012	\$15.13	\$0	\$3.36
2013	\$13.89	\$0	\$3.31
2014	\$12.60	\$0	\$3.26
2015	\$11.25	\$0	\$3.21
2016	\$9.86	\$0	\$3.16
2017	\$8.41	\$0	\$3.11
2018	\$6.90	\$0	\$3.06
2019	\$5.33	\$0	\$3.01
2020	\$3.70	\$0	\$2.96
2021	\$2.00	\$0	\$2.91
2022	\$0.23	\$0	\$2.86
2023	\$0	\$0	\$2.81

If Citizens is assumed to maintain a stable 30 percent market share of homeowners insurance in Florida, there would have to be **no** damaging hurricanes in 2008-2010 for its claims paying capacity to cover losses without any recoupment. If Citizens’ market share in Florida increased to 50 percent and 70 percent, then the period of no hurricane damage would have to increase to 5 years and 7 years, respectively for the state insurer to be able to pay claims from a 100-year event without sustaining a deficit. With respect to the FHCF, there would have to be no damaging hurricanes until the year 2023 for this state fund to pay all its claims from a 100-year hurricane. The decrease in the deficit over time for Citizens and FHCF is depicted in Figure 13.6.

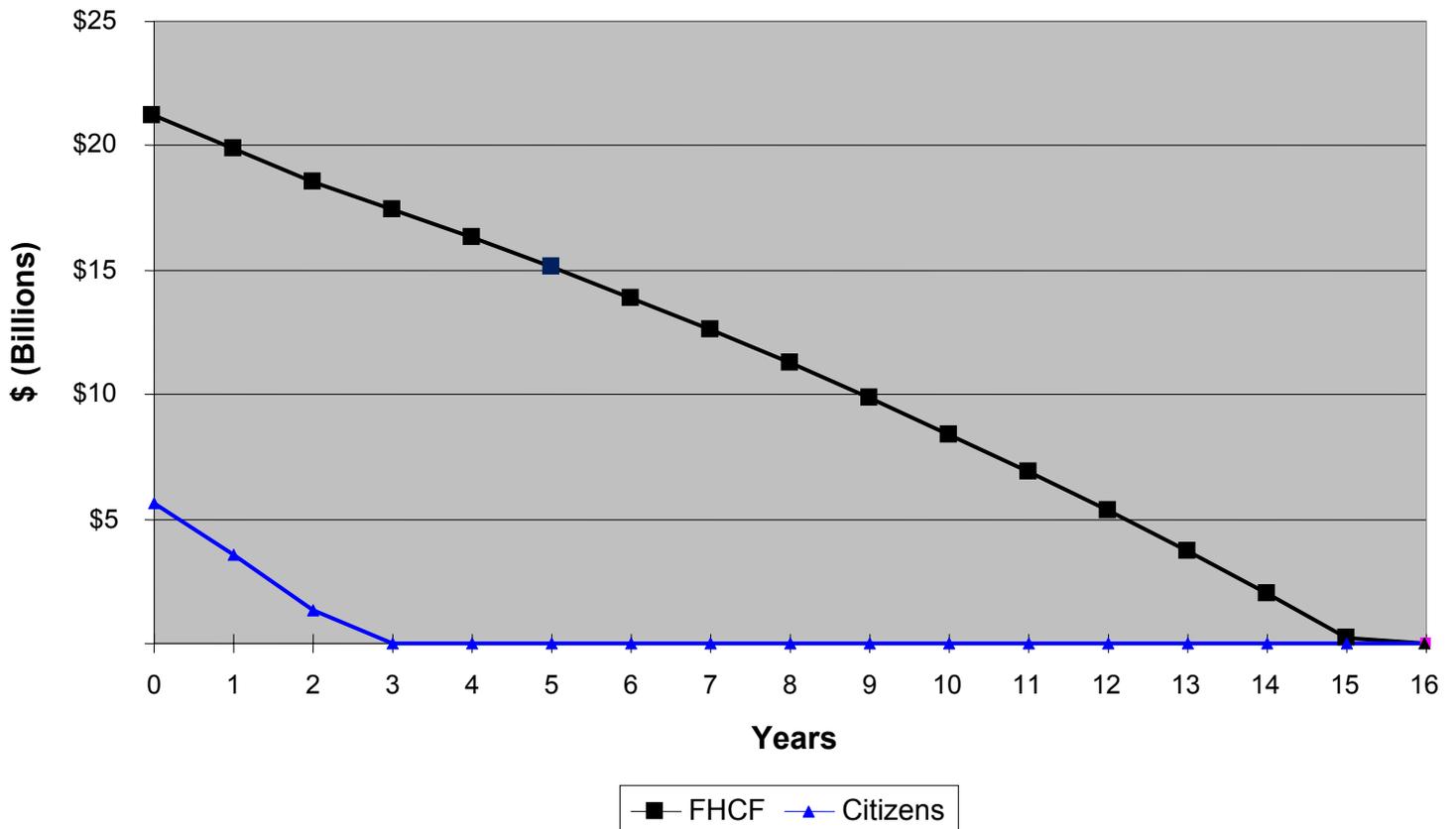


FIGURE 13.6. NUMBER OF YEARS FOR THE FHCF AND CITIZENS TO RECOUP CLAIMS FROM A 100-YEAR HURRICANE ABOVE THEIR CURRENT RESERVE USING FUTURE PREMIUMS (PAYING CAPACITY ASSUMING NO EVENT DURING THE RECOUPMENT PERIOD)

Impact of Mitigation

The above analyses were undertaken with the assumption that no mitigation measures were in place to protect homes. Now, we assume that all of the residential structures are fully mitigated pursuant to relevant building codes. Table 13.12 indicates the differences in losses for hurricanes with return periods of 100, 250 and 500 years for each of the four states we are studying when these loss-reduction measures are in place.

TABLE 13.12. MONEY SAVED FROM FULL MITIGATION FOR DIFFERENT RETURN PERIODS

State	100-Year Event			250-Year Event			500-Year Event		
	Unmitigated Losses	Savings from Mitigation (\$)	Savings from Mitigation (%)	Unmitigated Losses	Savings from Mitigation (\$)	Savings from Mitigation (%)	Unmitigated Losses	Savings from Mitigation (\$)	Savings from Mitigation (%)
FL	\$84 billion	\$51 billion	61%	\$126 billion	\$69 billion	55%	\$160 billion	\$83 billion	52%
NY	\$6 billion	\$2 billion	39%	\$13 billion	\$5 billion	37%	\$19 billion	\$7 billion	35%
SC	\$4 Billion	\$2 billion	44%	\$7 billion	\$3 billion	41%	\$9 billion	\$4 billion	39%
TX	\$17 billion	\$6 billion	34%	\$27 billion	\$9 billion	32%	\$37 billion	\$12 billion	31%

The analyses reveal that mitigation has the potential to provide very significant cost savings in all four states, ranging from 61 percent in Florida for a 100-year hurricane to 31 percent in New York for a 500-year event. Appendix 13-b depicts these differences graphically. Note that mitigation for homes in Florida was based on different building codes than in the other three states.

Focus on Metropolitan Areas in the Four States

The total insured value (TIV) for each state is assumed to be equivalent to the total amount at risk in the state. Miami-Dade County represents 9 percent of Florida’s \$1.8 trillion TIV. The New York City area counties comprise 3 percent of New York’s \$2.1 trillion TIV. The Charleston area counties represent 15 percent of South Carolina’s \$0.36 trillion TIV and the Houston area counties comprise 26 percent of Texas’s \$2.1 trillion TIV. Table 13.13 shows that the four metropolitan areas we selected comprise a much larger proportion of the ground up losses than would be implied by looking at their percentage of the TIV in each of their respective states (without mitigation).

These regions are subject to a disproportionate hurricane risk than other parts of their states. This was not a surprise, as we intentionally chose the riskiest counties for this segment of our analysis.

TABLE 13.13. METROPOLITAN AREA REGIONS’ SHARE OF STATE GROUND UP LOSSES FOR DIFFERENT RETURN PERIODS WITHOUT MITIGATION

Region	100-Year Event			250-Year Event			500-Year Event		
	State Loss	Region Loss	Percent of State Loss	State Loss	Region Loss	Percent of State Loss	State Loss	Region Loss	Percent of State Loss
Miami-Dade	\$84bn	\$18bn	21%	\$126bn	\$37bn	29%	\$160bn	\$58bn	36%
NYC Area	\$6bn	\$1.4bn	24%	\$13bn	\$4bn	28%	\$19bn	\$6bn	30%
Charleston Area	\$4bn	\$2.4bn	56%	\$7bn	\$4bn	60%	\$9bn	\$6bn	60%
Houston Area	\$17bn	\$15bn	89%	\$27bn	\$25bn	92%	\$37bn	\$34bn	93%

13.5. Assumptions and Methodology for the Competitive Market Analysis

Databases

The *competitive market* analysis relied on two different datasets.

RMS Data. We used the RMS data from the status quo analysis to develop projections of gross losses (with and without mitigation) for different locations and return periods. Gross losses are the total losses to insured structures covered by insurance. We used the gross losses instead of the ground up losses because we have assumed full coverage in the status quo, meaning the additional losses contained in the ground up figures reflect the deductibles.

A.M. Best Data. A.M. Best provided us with publicly available data on 1,379 insurance and reinsurance groups. From this dataset, we had the direct premiums written (DPW) for homeowners multi-peril insurance in each of the four states. We were then able to derive a market share for each group i in each state using the following formula:

$$\text{MarketShare}_i = \text{DPW}_i / \text{TotalDPW}$$

There are 75 groups with DPW in Florida, 100 groups with DPW in New York, 62 groups with DPW in South Carolina, and 68 groups with DPW in Texas. The A.M. Best data also included the total surpluses of each of the groups, which we used to determine the amount of coverage they would offer in the competitive market.

Note that we use the DPW to estimate market share in the competitive market analysis while we used exposure to estimate market share in calculating the FHCF payout in the status quo analysis. This is because we had exact exposure data from the FLOIR which allowed us to calculate a more precise estimate of the FHCF payout. These data did not extend to the other three states and it was not relevant to our competitive market analysis since it assumes there no state funds in existence. Insurance is provided only by private insurers and reinsurance is provided only by reinsurers or other alternative risk transfer instruments.

General Assumptions

In undertaking the analyses of a competitive insurance market, we made the following general assumptions:

- Total insurance is based on the amount of surplus each group is willing to put at risk in the studied state for the relevant hurricane return period.
- Insurers allocate their surplus to each state independently.
- Total surplus used by companies is equal to total surplus for the entire group.³⁶⁸
- Reinsurance and other risk transfer amounts are the same as in the status quo. This assumption can be justified given that reinsurers are not restricted by state regulators under the status quo.

³⁶⁸ State Farm, which groups its companies differently, is the exception. See next footnote for a full explanation of how we handled this special case.

Insurance Calculation

To determine the amount of insurance coverage offered in the competitive market, we focused on the surpluses of the top 25 insurers by market share in each state. The data for these 25 insurers in each of the four states are in Appendix 13-c. These 25 companies typically represent more than 90 percent of the private market for homeowners coverage. Note that this surplus data came from A.M. Best for every company except for State Farm,³⁶⁹ which is unique in that it has separate entities for different lines of insurance. We took the sum of the surpluses from their five property companies instead of using the A.M. Best figure. To determine how much capacity insurers are willing to provide to cover hurricane risk under a competitive market, we assumed that each insurance group would risk 10 percent of its surplus³⁷⁰ to provide coverage for a 100-year, 250-year, or 500-year event. More specifically, we have:

$$\text{Insurance Offered by Insurer } i = 0.10 * (\text{Total Surplus of Insurer } i)$$

By aggregating the amount of coverage provided by each insurer in the state, we obtained the *amount of coverage* available to cover losses from hurricanes. For example, there was about \$150 billion of surplus available amongst the top 25 private insurers operating in Florida. We thus assumed that \$15 billion would be available for coverage against hurricane wind damage in the competitive market in Florida.³⁷¹ We derived the percentage of the residential market covered in each of the states when no reinsurance was in place by using the following formula:

$$\text{Percent of Market Covered in State } Y = \frac{\text{Insurance Offered in State } Y}{\text{Gross Loss in State } Y}$$

In a complementary series of analyses we also calculated the percent of total insurers' surplus that would have to be allocated against insured losses from hurricanes in each state so that all residential structures would be provided with full coverage. These figures were determined by the following formula:

$$\text{Necessary Percent of Surplus for Full Coverage in State } Y = \frac{\text{Gross Loss in State } Y}{\text{Total Surplus}}$$

³⁶⁹ State Farm is a parent company that has an atypical structure, in that it divides its sub-units by line of business. Other companies do not separate their surpluses at all or they do it based on state-level companies which still handle all of the different types of insurance. The A.M. Best data gave the total surpluses for entire conglomerate companies. Typically, this entire surplus is available for property insurance since the companies are not separate entities. However, State Farm does separate property insurance so their A.M. Best figure is too high. In order to rectify this, we used the sum of the surpluses for State Farm's five property insurance subsidiaries: State Farm Fire and Casualty: \$8.95 billion; State Farm General (CA): \$1.85 billion; State Farm Florida: \$0.72 billion; Texas Lloyds: \$1.29 billion; Total: \$12.81 billion.

³⁷⁰ This 10 percent figure was confirmed by the insurers and rating agencies with whom we spoke as a reasonable assumption for these analyses. In reality, of course, the determination by each insurer as to how much surplus it is willing to assign to a specific risk (e.g., wind damage) in a given state depends on its financial characteristics and the distribution of its portfolio in other states and countries. The capacity insurers are willing to offer also is likely to vary with the return period of the catastrophic event under consideration and the price they can charge for providing coverage.

³⁷¹ In the other three states, storm surge damage is also included as part of the hurricane loss borne by insurers.

We conducted this analysis of competitive market insurance for the 100-year, 250-year, and 500-year return periods both with and without mitigation in place. A separate analysis was undertaken to account for the impact of reinsurance and other risk transfer instruments on insurers’ ability to provide coverage.

Insurer Surplus Assumption

We used the surplus from the top 25 insurers within each state for undertaking our base case analyses. We also examined other amounts of total surplus by the top insurers writing coverage that comprise 95 percent of the market and all insurers writing coverage in the state (i.e., 100 percent of the market). The increase in coverage as we expanded the pool of insurers is not large as shown in Table 13.14.

Note on Competitive Market Insurer Surpluses

The competitive market insurer surplus allocations may differ from how these companies actually allocate their surpluses. This is a theoretical analysis of what these companies are capable of doing based on their total conglomerate surplus reported in the A.M. Best dataset. However, in practice they may make their capital allocation decisions differently.

TABLE 13.14. INDUSTRY SURPLUS ANALYSIS FOR TOP 25 INSURERS, AND INSURERS COMPRISING 95 PERCENT TO 100 PERCENT OF THE MARKET (FLORIDA, NEW YORK, SOUTH CAROLINA AND TEXAS)

	Top 25 Companies			95% of the Market			100% of the Market		
State	Number of Companies	Market Share	Surplus (\$ Billions)	Number of Companies	Market Share	Surplus (\$ Billions)	Number of Companies	Market Share	Surplus (\$ Billions)
FL	25	91.7%	154.4	32	94.9%	164.3	75	100.0%	205.2
NY	25	93.2%	167.8	29	95.0%	168.7	100	100.0%	225.6
SC	25	95.2%	175.0	25	95.2%	175.0	62	100.0%	203.7
TX	25	95.3%	139.2	25	95.3%	139.2	68	100.0%	195.7

13.6. Competitive Market Analysis

Our specific interest in undertaking this analysis is to determine how much coverage insurers could provide against damage from hurricanes in each of the four states. We focus on damage from the 100- 250- and 500-year hurricanes and vary assumptions regarding mitigation in place and availability of reinsurance (whether it is provided by traditional reinsurance or alternative risk transfer instruments). We study two cases: first, insurers do not have any way to reinsure part of their exposure; second, we introduce additional capacity to insurers provided by reinsurance.

Case 1. No Reinsurance

We first examine the case where none of the homes had adopted mitigation measures and insurers could **not** rely on reinsurance to protect themselves against future damage. Even when insurers are entirely on their own, our analysis shows that using the strategy of *allocating 10 percent of surplus*, they will have enough capacity to be able to provide protection to all homeowners in the state of New York and South Carolina for the 100- 250- and 500-year hurricanes, as shown in Table 13.15. The hurricane damage even for a 500-year storm in New York and South Carolina will be sufficiently small that insurers would not have to commit a large percentage of their surplus to be able to provide full protection against all residential structures in the area. For example, insurers providing wind coverage in the state of New York would have to commit only 2.5 percent of their surplus to cover total losses to homes (except for the deductible portions of the policy) from a 100-year hurricane. This percentage would increase to 8.9 percent for a hurricane with a 500-year return period. The percentage of surplus required in South Carolina to cover hurricanes with these return periods would be even smaller than in New York.

Private insurers in Florida and Texas would need financial back-up to cover all the wind losses from a severe hurricane if homeowners have not undertaken mitigation measures. Even for a 100-year hurricane in Florida, the total amount of insurance in place would only cover 23.8 percent of the loss. Insurers providing wind coverage in Florida would have to allocate 42 percent of their surplus to provide full coverage to homeowners against this event. In Texas, the hurricane damage would be less severe than in Florida, so that insurers would be able to offer close to full protection (96.2 percent) against a 100-year event, but not against hurricanes with either a 250- or 500-year return period (Table 13.15).

The situation improves considerably in these two states if all homes are required to adopt costs-effective mitigation measures as shown in the bottom portion of Table 13.15. In the case of Florida, insurers would now be able to cover 65.1 percent of the losses from a 100-year hurricane when mitigation was in place, without having to rely on reinsurance or alternative risk transfer (ART) instruments. A similar story emerges for homes in Texas, where full coverage will be provided for a 100-year hurricane if all residential structures had adopted mitigation measures specified in current building codes.

TABLE 13.15. PERCENTAGE OF LOSS COVERED AND REQUIRED SURPLUS FOR FULL COVERAGE BY INSURERS WITH NO REINSURANCE (\$ BILLION)

No Mitigation of Current Homes

State	Surplus	Return Period	Gross Losses	Amount of Coverage (10% of Surplus)	Percent of Market Covered	Percent of Surplus Necessary for Full Coverage
FL	154.4	100	64.8	15.4	23.8%	42.0%
		250	96.4	15.4	16.0%	62.5%
		500	120.5	15.4	12.8%	78.1%
NY	167.8	100	4.2	16.8	100.0%	2.5%
		250	9.6	16.8	100.0%	5.7%
		500	14.9	16.8	100.0%	8.9%
SC	175.0	100	3.7	17.5	100.0%	2.1%
		250	5.8	17.5	100.0%	3.3%
		500	7.7	17.5	100.0%	4.4%
TX	139.2	100	14.5	13.9	96.2%	10.4%
		250	22.9	13.9	60.7%	16.5%
		500	31.4	13.9	44.4%	22.5%

Full Mitigation of Current Homes

State	Surplus	Return Period	Gross Losses	Amount of Coverage (10% of Surplus)	Percent of Market Covered	Percent of Surplus Necessary for Full Coverage
FL	154.4	100	23.7	15.4	65.1%	15.4%
		250	42.9	15.4	36.0%	27.8%
		500	58.9	15.4	26.2%	38.2%
NY	167.8	100	2.4	16.8	100.0%	1.4%
		250	5.8	16.8	100.0%	3.5%
		500	9.4	16.8	100.0%	5.6%
SC	175.0	100	2.0	17.5	100.0%	1.1%
		250	3.3	17.5	100.0%	1.9%
		500	4.7	17.5	100.0%	2.7%
TX	139.2	100	9.4	13.9	100.0%	6.7%
		250	15.2	13.9	91.4%	10.9%
		500	21.1	13.9	65.9%	15.2%

Case 2. Reinsurance In Place

With reinsurance in place, we made the same assumption as in Case 1 regarding allocation of insurer surplus to homeowners insurance, but used different estimates of insured losses. We subtracted the Total Reinsurance obtained from the *status quo* analysis so insurers had to cover only their Unreinsured Losses instead of their Total Gross Losses.

TABLE 13.16. PERCENTAGE OF LOSSES COVERED AND REQUIRED SURPLUS FOR FULL COVERAGE BY INSURERS WITH REINSURANCE IN PLACE (\$ BILLION)

No Mitigation of Current Homes

State	Surplus	Return Period	Gross Losses	Reinsurance Coverage	Unreinsured Losses	Amount of Coverage (10% of Surplus)	Percent of Market Covered	Percent of Surplus Necessary for Full Coverage
FL	154.4	100	64.8	39.1	25.7	15.4	60.0%	16.7%
		250	96.4	49.8	46.6	15.4	33.1%	30.2%
		500	120.5	51.9	68.6	15.4	22.5%	44.4%
NY	167.8	100	4.2	0.4	3.8	16.8	100.0%	2.3%
		250	9.6	1.9	7.7	16.8	100.0%	4.6%
		500	14.9	3.0	11.9	16.8	100.0%	7.1%
SC	175.0	100	3.7	0.4	3.3	17.5	100.0%	1.9%
		250	5.8	0.6	5.2	17.5	100.0%	3.0%
		500	7.7	0.8	7.0	17.5	100.0%	4.0%
TX	139.2	100	14.5	2.9	11.6	13.9	100.0%	8.3%
		250	22.9	6.9	16.1	13.9	86.7%	11.5%
		500	31.4	12.5	18.8	13.9	74.0%	13.5%

Full Mitigation of Current Homes

State	Surplus	Return Period	Gross Losses	Reinsurance Coverage	Unreinsured Losses	Amount of Coverage (10% of Surplus)	Percent of Market Covered	Percent of Surplus Necessary for Full Coverage
FL	154.4	100	23.7	20.8	2.9	15.4	100.0%	1.9%
		250	42.9	23.6	19.3	15.4	80.1%	12.5%
		500	58.9	35.5	23.4	15.4	66.0%	15.1%
NY	167.8	100	2.4	0.2	2.1	16.8	100.0%	1.3%
		250	5.8	0.6	5.2	16.8	100.0%	3.1%
		500	9.4	1.9	7.5	16.8	100.0%	4.5%
SC	175.0	100	2.0	0.2	1.8	17.5	100.0%	1.0%
		250	3.3	0.3	3.0	17.5	100.0%	1.7%
		500	4.7	0.5	4.2	17.5	100.0%	2.4%
TX	139.2	100	9.4	1.9	7.5	13.9	100.0%	5.4%
		250	15.2	3.0	12.2	13.9	100.0%	8.8%
		500	21.1	6.3	14.8	13.9	94.2%	10.6%

As shown in Table 13.16, when reinsurance is available, the private insurance market is able to cover all the losses in Texas from a 100-year hurricane, 86.7 percent of the losses for a 250-year hurricane, and 74 percent of the losses for a hurricane with a 500-year return period even if homes had not undertaken mitigation measures. In Florida, 60.0 percent of the losses will be covered from a 100-year hurricane, but the majority of the losses will still be uninsured for 250-year and 500-year hurricanes if mitigation measures had not been adopted by homeowners. Should all homes be mitigated, then there will be less than full coverage in Texas for a 500-year hurricane, and in Florida for 250-year and 500-year hurricanes.

13.7. Insurance Premiums Reflecting Risk and the Cost of Capital

We conclude this series of analyses by determining the loss cost for Florida, New York, South Carolina, and Texas and counties in these states as a basis for determining premiums that reflect risk for covering wind damage. To determine these premiums one needs to augment the expected average annual loss by utilizing a positive loading factor to reflect marketing and claims processing expenses, as well as the cost of capital. RMS provided us with the data for the average annual loss (AAL) from hurricane wind damage for each postal zone in Florida, New York, South Carolina, and Texas. We also utilized data on the total insured value (TIV) for each postal zone in order to obtain loss costs.

Assumptions for the Analysis

Loss Cost per \$1,000. In order to do our analysis at the county level, we summed the average annual loss (AAL) and total insured value (TIV) from the relevant postal zones to obtain the appropriate figures for each county. The loss cost per \$1,000 of coverage for each county i was determined by the following formula:

$$\text{Loss cost}_i = \text{AAL}_i / (\text{TIV}_i) \cdot \$1,000$$

To illustrate, suppose a particular county has an AAL = \$1 million and TIV= \$20 million. This implies that a loss cost for homes in this county would be \$50 per \$1,000 of coverage.

Loading Factor. In addition to the loss cost, we assume insurers incorporate a loading factor (λ) into their pricing to cover administrative, marketing and claims processing costs and the cost of capital. As discussed in Chapter 6, each policy the insurer sells imposes its own capital burden. If an additional policy were sold without adding to the insurer's overall capital, there would normally be a small increase in the likelihood that the insurer could default. Just how much of a change would depend on the riskiness of the policy and its covariance with other policies and assets held by the insurer. The appropriate allocation of capital to a policy would be that required to maintain the insurer's credit status; i.e., the addition of the policy and the accompanying capital would leave the insurer with the same credit status as before. We thus define a fair price for insurance as a premium that provides a fair rate of return on invested equity.

Let k be the ratio of capital to expected losses for the insurer to maintain its credit rating. Here we will use $k=1$, a value utilized by many property liability insurers for their combined book of business (Doherty, 2000).³⁷²

In addition to paying claims, the insurer is assumed to set aside capital for covering additional expenses (X) in the form of commissions to agents and brokers, and underwriting and claims assessment expenses. For this example suppose $X = \$200$. Given the risk characteristics of the portfolio, we assume that investors in insurance companies require a return on equity (ROE) of 15 percent to compensate for risk. The insurer invests its funds in lower-risk vehicles that yield an expected return r of 5 percent. What premium π would the insurer have to charge its policyholders to cover them against hurricane and to secure a return of 15 percent for its investors? The formula is given by:

$$\pi = \frac{E(L) + X(1+r)}{(1+r) - k(ROE - r)}$$

which yields a value of $\pi = \$1,274$ for this hypothetical example. We can think of this premium now as the expected loss of \$1,000 plus a proportionate loading, λ , of 0.274.

Thus the premium is:

$$(1 + \lambda)E(L) = (1 + 0.274)\$1,000 = \$1,274$$

This calculation is very sensitive to the ratio of capital to expected liability, k , needed to preserve credit. In the above example, the ratio was one dollar of capital for one dollar of expected liability. This ratio is in the ballpark for the combined books of business of many property liability insurers. However, for catastrophic risk, with its very large tail risk (which severely affects the insurer's credit risk), the capital to liability ratio needs to be higher. Indeed, the capital to liability ratio depends on volatility of the catastrophe liability and its correlation with the insurer's remaining portfolio. For the catastrophe risk premium for individual homeowners, this may translate into a loading λ in the range of 0.5 to 1. Thus the premium would be 150 percent to 200 percent of the expected loss. This does not reflect undue profitability, but simply that insurers need considerable costly capital to supply this insurance, and the cost of that capital is included in the premium.

In the analysis which follows we will use a value of $\lambda = .5$ (i.e. a 50 percent loading). This is a conservative estimate, as it does not take into account other costs that insurer incurs in modeling catastrophic risk by either purchasing commercial models and/or using their own in-house modeling capability, nor does it include state and federal taxes which the insurer has to pay as any other business.

Statewide Prices. Prices for the entire state were determined using the same procedure as for the individual counties, except the postal zone data was aggregated for the entire state.

³⁷² Doherty, N. (2000), *Integrated Risk Management*, New York; McGraw-Hill.

Determination of Loss Cost and Insurance Premiums

Tables 13.17 specify the loss costs and premiums with a 50 percent loading factor for hurricane wind damage for the ten counties which have the highest risk within each state, as well as any counties from the metropolitan areas we studied that were not among the top ten. The loss costs and premiums for the entire state are specified at the bottom of the table for Florida, New York, South Carolina, and Texas. We also specify ratios of the *county premium/state premium* so one can appreciate how much more (or less) insurers would have to charge in areas that have a significant hurricane risk relative to other parts of the state in order to cover their expected claims payments. The counties from our designated metropolitan areas in each of the four states are bolded in Table 13.17. Appendix 13-D presents tables that include all the counties in the four states that we studied.

The data reveal that coastal counties which are subject to hurricane wind damage will pay significantly higher premiums than other portions of the state. This is particularly true in Texas, where Calhoun, Aransas and Galveston Counties are charged over nine times the average for the entire state. For the other three states, the differences are less extreme. In the case of Florida, the risk-based premiums do not include any losses from storm surge, so they are likely to be somewhat higher when this cause of damage is incorporated. It is important to remember that premiums based on loss costs are likely to be somewhat lower than homeowners insurance premiums, since a standard policy covers losses from other causes, such as fire and theft.

TABLES 13.17. LOSS COSTS AND INSURANCE PREMIUMS FOR HURRICANE WIND INSURED DAMAGE IN COUNTIES WITH HIGHEST RISK (FL, NY, SC, AND TX)

FLORIDA				
Price Rank	County	Loss Cost per \$1,000	Premium with 50% Loading	County/State Premium Ratio
1	MONROE	\$16.22	\$24.32	4.62
2	FRANKLIN	\$6.84	\$10.26	1.95
3	MARTIN	\$6.69	\$10.03	1.90
4	MIAMI-DADE	\$6.48	\$9.73	1.85
5	PALM BEACH	\$6.47	\$9.71	1.84
6	INDIAN RIVER	\$5.67	\$8.51	1.62
7	BROWARD	\$5.64	\$8.46	1.61
8	COLLIER	\$5.04	\$7.56	1.44
9	SAINT LUCIE	\$4.68	\$7.02	1.33
10	SANTA ROSA	\$4.46	\$6.69	1.27
	ENTIRE STATE	\$3.50	\$5.25	

NEW YORK				
Price Rank	County	Loss Cost per \$1,000	Premium with 50% Loading	County/State Premium Ratio
1	SUFFOLK	\$0.38	\$0.56	4.10
2	NASSAU	\$0.17	\$0.25	1.85
3	RICHMOND	\$0.12	\$0.17	1.26
4	QUEENS	\$0.10	\$0.15	1.10
5	KINGS	\$0.08	\$0.12	.89
6	WESTCHESTER	\$0.08	\$0.12	.88
7	ROCKLAND	\$0.07	\$0.11	.78
8	BRONX	\$0.07	\$0.10	.71
9	PUTNAM	\$0.06	\$0.09	.69
10	DUTCHESS	\$0.04	\$0.06	.43
14	NEW YORK	\$0.02	\$0.04	.27
	ENTIRE STATE	\$0.09	\$0.14	

SOUTH CAROLINA				
Price Rank	County	Loss Cost per \$1,000	Premium with 50% Loading	County/State Premium Ratio
1	GEORGETOWN	\$2.69	\$4.04	4.74
2	CHARLESTON	\$2.62	\$3.93	4.61
3	HORRY	\$2.11	\$3.17	3.72
4	BEAUFORT	\$2.10	\$3.15	3.70
5	COLLETON	\$1.37	\$2.05	2.41
6	BERKELEY	\$1.20	\$1.80	2.12
7	JASPER	\$0.92	\$1.38	1.62
8	DORCHESTER	\$0.85	\$1.27	1.49
9	WILLIAMSBURG	\$0.81	\$1.21	1.42
10	MARION	\$0.65	\$0.97	1.14
	ENTIRE STATE	\$0.57	\$0.85	

TEXAS				
Price Rank	County	Loss Cost per \$1,000	Premiums with 50% Loading	County/State Premium Ratio
1	CALHOUN	\$4.60	\$6.89	10.53
2	ARANSAS	\$4.56	\$6.84	10.45
3	GALVESTON	\$3.95	\$5.92	9.05
4	MATAGORDA	\$3.19	\$4.79	7.32
5	CHAMBERS	\$2.59	\$3.88	5.93
6	BRAZORIA	\$2.44	\$3.65	5.59
7	NUECES	\$2.32	\$3.48	5.32
8	SAN PATRICIO	\$2.27	\$3.40	5.19
9	CAMERON	\$2.08	\$3.12	4.77
10	JACKSON	\$2.04	\$3.07	4.69
17	FORT BEND	\$1.07	\$1.61	2.46
19	LIBERTY	\$1.02	\$1.53	2.34
22	HARRIS	\$0.81	\$1.22	1.86
28	WALLER	\$0.57	\$0.85	1.39
29	AUSTIN	\$0.50	\$0.75	1.14
34	SAN JACINTO	\$0.38	\$0.56	.86
36	MONTGOMERY	\$0.32	\$0.48	.74
	ENTIRE STATE	\$0.44	\$0.65	

SUMMARY OF CHAPTER 13

This chapter provides a series of analyses to evaluate how losses from major hurricanes would be shared between different stakeholders under the status quo using data provided by Risk Management Solutions (RMS) on the exposure risk from hurricanes, A.M. Best data on insurance groups, and data from the state Funds in Florida and Texas. We estimate the distribution of losses to homeowners, insurers and reinsurers for hurricanes with return periods of 100, 250, and 500 years for Florida, New York, South Carolina and Texas and metropolitan areas in each of these states with and without mitigation in place (***status quo analysis***).

We also determine the ability of the private market to offer insurance protection if companies are permitted to charge rates that reflect risk (***competitive market analysis***). The analysis reveals that insurers would not need reinsurance in order to be able to provide protection to most homeowners in New York, South Carolina and Texas, but would have to rely on private reinsurance and/or other alternative risk transfer instruments to provide coverage to the majority of homes in Florida. If all single-family residences were required to adopt mitigation measures specified in their states' building codes, the private sector should be able to provide full insurance protection in all four states without having to allocate a significant portion of its surplus to the hurricane risk. The chapter concludes with an analysis of loss costs and premiums reflecting risks and the cost of capital in the counties most subject to hurricane damage in each of the four states. These premiums are compared with the state average to show the degree of variation in the hurricane risk.

APPENDIX 13-A. 250- AND 500-YEAR RETURN STATE COMPARISONS

STATE COMPARISONS

EVENT: 250-YEAR RETURN PERIOD WITHOUT MITIGATION (\$ BILLION)

State	Details	Total Loss	Homeowner Losses		Insurer Losses				Reinsurer Losses	
			Losses to Uninsured Homes	Losses to Insured Homes	State Insurer (FL=Citizens TX= TWIA)	State Assessment to Insurers (TWIA only)	Private Insurers	Private Insurers Reimbursable Tax Credits Portion (TWIA only)	State Reinsurer (FHCF only)	Private Reinsurance
FL	Return Period: 250 Take-Up Rate: 90% Mitigation: No Reinsurance: 60.3% CitizensMktShare: 30% Citizens Reserve: \$2B FHCF Reserve: \$2B	\$114.2	\$7.1	\$10.6	\$14.0	-	\$32.6	-	\$23.6	\$26.2
TX	Return Period: 250 Take-Up Rate: 90% Mitigation: No Reinsurance: 20% TWIA Reserve: \$400M	\$26.1	\$1.6	\$1.5	\$0.4	\$0.3	\$11.9	\$4.6	-	\$5.7
NY	Return Period: 250 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$11.4	\$0.7	\$1.1	-	-	\$7.7	-	-	\$1.9
SC	Return Period: 250 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$6.5	\$0.4	\$0.3	-	-	\$5.2	-	-	\$0.6

**PERCENTAGE STATE COMPARISONS
EVENT: 250-YEAR RETURN PERIOD WITHOUT MITIGATION (\$ BILLIONS)**

State	Details	Total Loss	Homeowner Losses		Insurer Losses				Reinsurer Losses	
			Losses to Uninsured Homes	Losses to Insured Homes	State Insurer (FL=Citizens TX= TWIA)	State Assessment to Insurers (TWIA only)	Private Insurers	Private Insurers Reimbursable Tax Credits Portion (TWIA only)	State Reinsurer (FHCF only)	Private Reinsurance
FL	Return Period: 250 Take-Up Rate: 90% Mitigation: No Reinsurance: 60.3% CitizensMktShare: 30% Citizens Reserve: \$2B FHCF Reserve: \$2B	\$114.2	6%	9%	12%	-	29%	-	21%	23%
TX	Return Period: 250 Take-Up Rate: 90% Mitigation: No Reinsurance: 20% TWIA Reserve: \$400M	\$26.08	6%	6%	2%	1%	46%	18%	-	22%
NY	Return Period: 250 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$11.44	6%	10%	-	-	67%	-	-	17%
SC	Return Period: 250 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$6.46	6%	4%	-	-	80%	-	-	9%

STATE COMPARISONS
EVENT: 500-YEAR RETURN PERIOD WITHOUT MITIGATION (\$ BILLION)

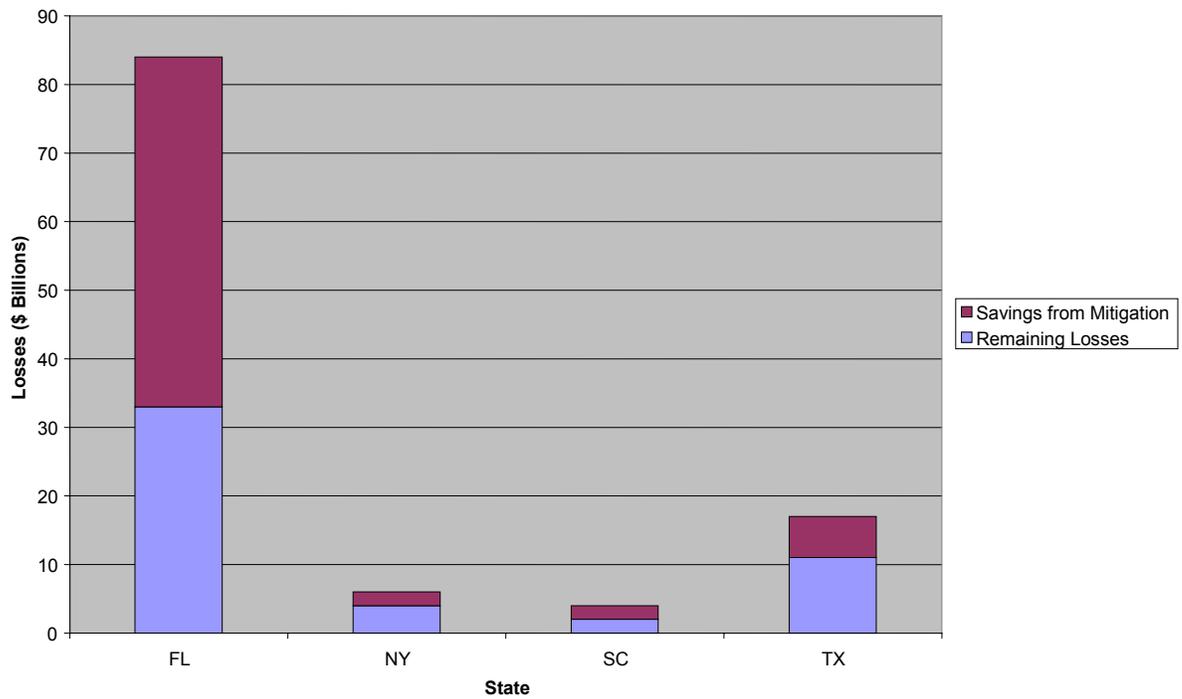
State	Details	Total Loss	Homeowner Losses		Insurer Losses				Reinsurer Losses	
			Losses to Uninsured Homes	Losses to Insured Homes	State Insurer (FL=Citizens TX= TWIA)	State Assessment to Insurers (TWIA only)	Private Insurers	Private Insurers Reimbursable Tax Credits Portion (TWIA only)	State Reinsurer (FHCF only)	Private Reinsurance
FL	Return Period: 500 Take-Up Rate: 90% Mitigation: No Reinsurance: 60.3% CitizensMktShare: 30% Citizens Reserve: \$2B FHCF Reserve: \$2B	\$144.9	\$9.1	\$15.3	\$20.6	-	\$48.0	-	\$23.6	\$28.3
TX	Return Period: 500 Take-Up Rate: 90% Mitigation: No Reinsurance: 20% TWIA Reserve: \$400M	\$35.5	\$2.2	\$1.9	\$0.4	\$0.3	\$14.0	\$6.9	-	\$9.7
NY	Return Period: 500 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$17.4	\$1.1	\$1.3	-	-	\$11.9	-	-	\$3.0
SC	Return Period: 500 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$8.7	\$0.5	\$0.4	-	-	\$7.0	-	-	\$0.8

**PERCENTAGE STATE COMPARISONS
EVENT: 500-YEAR RETURN PERIOD WITHOUT MITIGATION (\$ BILLIONS)**

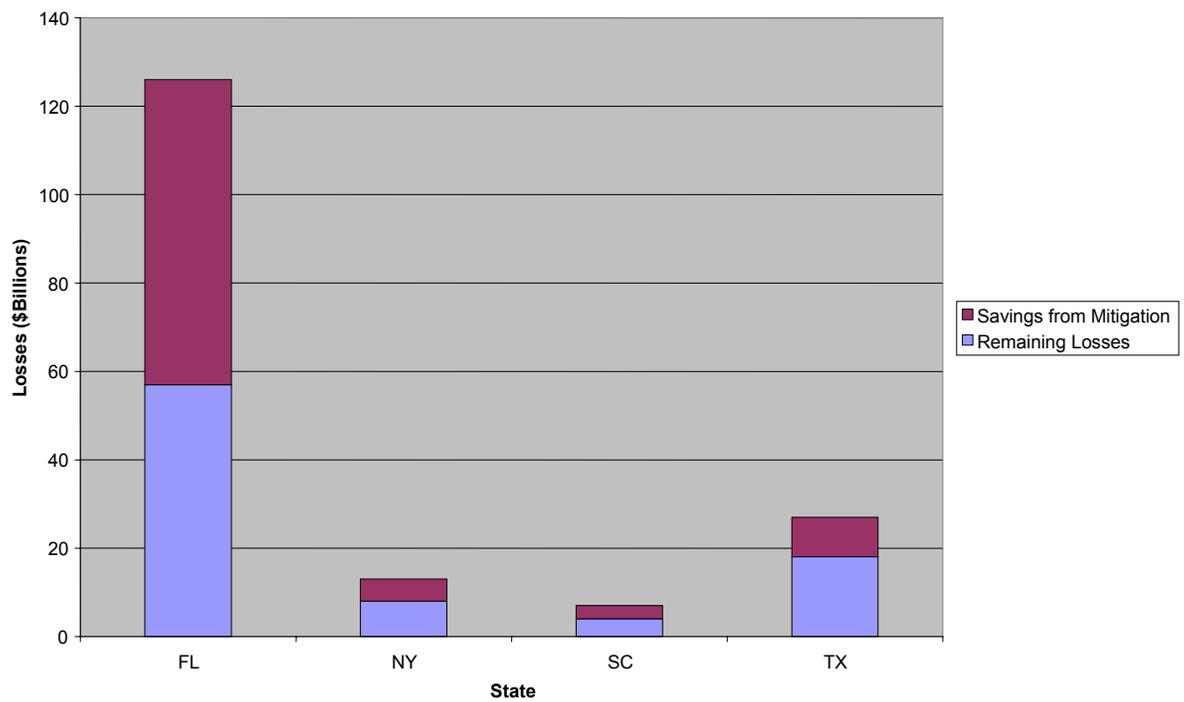
State	Details	Total Loss	Homeowner Losses		Insurer Losses				Reinsurer Losses	
			Losses to Uninsured Homes	Losses to Insured Homes	State Insurer (FL=Citizens TX= TWIA)	State Assessment to Insurers (TWIA only)	Private Insurers	Private Insurers Reimbursable Tax Credits Portion (TWIA only)	State Reinsurer (FHCF only)	Private Reinsurance
FL	Return Period: 500 Take-Up Rate: 90% Mitigation: No Reinsurance: 60.3% CitizensMktShare: 30% Citizens Reserve: \$2B FHCF Reserve: \$2B	\$144.9	6%	11%	14%	-	33%	-	16%	20%
TX	Return Period: 500 Take-Up Rate: 90% Mitigation: No Reinsurance: 20% TWIA Reserve: \$400M	\$35.46	6%	5%	1%	1%	40%	20%	-	27%
NY	Return Period: 500 Take-Up Rate: 90% Mitigation: No Reinsurance: 10%	\$17.36	6%	8%	-	-	69%	-	-	17%
SC	Return Period: 500 Take-Up Rate: 90% Mitigation: No Reinsurance: ---10%	\$8.66	6%	4%	-	-	81%	-	-	9%

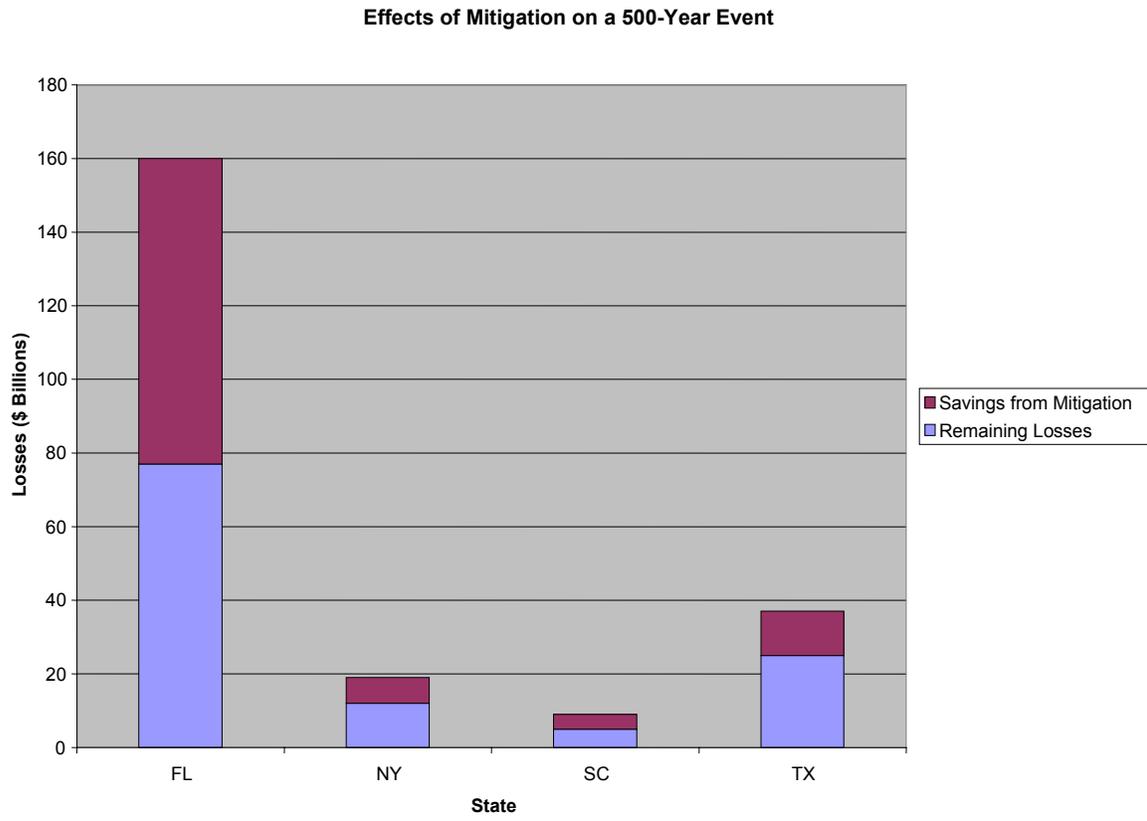
APPENDIX 13-B. EFFECTS OF MITIGATION FOR HURRICANES

Effects of Mitigation for a 100-Year Event



Effects of Mitigation for a 250-Year Event





**APPENDIX 13-C. MARKET SHARE ANALYSIS FOR THE TOP 25 INSURERS
IN FLORIDA, NEW YORK, SOUTH CAROLINA AND TEXAS**

FLORIDA					
Rank	Company Name	Company Surplus (Billions)	DPW Market Share	Surplus Market Share	DPW Market Share (Excluding Citizens)
1	State Farm Group	12.8	19.7%	8.3%	23.9%
2	Citizens Property Insurance Corporation	0.0	17.7%	0.0%	0.0%
3	Allstate Insurance Group	19.2	7.2%	12.5%	8.7%
4	Tower Hill Group	0.1	4.7%	0.0%	5.7%
5	Universal P & C Ins. Co.	0.1	4.6%	0.0%	5.6%
6	USAA Group	11.7	4.3%	7.6%	5.2%
7	Nationwide Group	12.8	4.1%	8.3%	4.9%
8	Liberty Mutual Insurance Companies	12.1	3.0%	7.9%	3.7%
9	American Strategic Insurance Companies	0.2	3.0%	0.1%	3.6%
10	Universal Insurance Group of Puerto Rico	0.2	2.5%	0.1%	3.1%
11	American International Group Inc	27.0	2.2%	17.5%	2.7%
12	Chubb Group of Insurance Companies	11.3	2.1%	7.3%	2.6%
13	United Property & Casualty Ins. Co., Inc.	0.1	1.9%	0.0%	2.3%
14	Hartford Insurance Group	14.5	1.9%	9.4%	2.3%
15	Travelers Insurance Companies	20.2	1.8%	13.1%	2.2%
16	Gulfstream Property and Casualty Ins. Co.	0.0	1.6%	0.0%	2.0%
17	GeoVera Insurance Group	0.1	1.5%	0.1%	1.8%
18	Southern Farm Bureau Group	1.8	1.2%	1.2%	1.5%
19	Sunshine State Insurance Company	0.0	1.2%	0.0%	1.5%
20	Cypress Holdings Group	0.0	1.2%	0.0%	1.5%
21	Farmers Insurance Group	5.3	1.1%	3.4%	1.3%
22	Florida Family Insurance Company	0.0	1.0%	0.0%	1.2%
23	Allianz of America, Inc.	3.8	0.9%	2.5%	1.1%
24	Philadelphia Insurance Group	1.0	0.8%	0.7%	1.0%
25	Coral Insurance Company	0.0	0.7%	0.0%	0.8%

NEW YORK				
Rank	Company Name	Company Surplus (Billions)	DPW Market Share	Surplus Market Share
1	Allstate Insurance Group	19.2	19.1%	11.5%
2	State Farm Group	12.8	14.6%	7.6%
3	Travelers Insurance Companies	20.2	11.3%	12.0%
4	Chubb Group of Insurance Companies	11.3	10.0%	6.7%
5	Liberty Mutual Insurance Companies	12.1	6.3%	7.2%
6	Central Services Group	0.3	4.1%	0.2%
7	Nationwide Group	12.8	4.0%	7.7%
8	MetLife Auto & Home Group	1.9	3.4%	1.1%
9	Tower Group Companies	0.2	2.2%	0.1%
10	USAA Group	11.7	2.0%	7.0%
11	Hartford Insurance Group	14.5	2.0%	8.7%
12	Allianz of America, Inc.	3.8	1.9%	2.3%
13	American International Group, Inc.	27.0	1.5%	16.1%
14	White Mountains Insurance Group	3.3	1.4%	2.0%
15	Unitrin, Inc.	1.2	1.2%	0.7%
16	Hanover Insurance Grp. Prop. and Cas. Co.	1.5	1.1%	0.9%
17	Preferred Mutual Insurance Company	0.1	1.1%	0.1%
18	Amica Mutual Group	2.1	1.0%	1.2%
19	Farmers Insurance Group	5.3	0.9%	3.1%
20	Andover Companies	0.7	0.8%	0.4%
21	Sterling Insurance Company	0.0	0.8%	0.0%
22	Utica National Insurance Group	0.7	0.7%	0.4%
23	Security Mutual Insurance Company	0.0	0.7%	0.0%
24	Main Street America Group	0.6	0.6%	0.3%
25	Erie Insurance Group	4.3	0.6%	2.6%

SOUTH CAROLINA				
Rank	Company Name	Company Surplus (Billions)	DPW Market Share	Surplus Market Share
1	State Farm Group	12.8	26.0%	7.3%
2	Allstate Insurance Group	19.2	14.9%	11.0%
3	Nationwide Group	12.8	8.9%	7.3%
4	Southern Farm Bureau Group	1.8	6.8%	1.1%
5	USAA Group	11.7	6.8%	6.7%
6	Travelers Insurance Companies	20.2	6.6%	11.5%
7	American International Group, Inc.	27.0	3.9%	15.4%
8	Farmers Insurance Group	5.3	3.9%	3.0%
9	Auto-Owners Insurance Group	4.8	2.9%	2.8%
10	Assurant Solutions	0.9	2.1%	0.5%
11	GeoVera Insurance Group	0.1	1.7%	0.1%
12	Liberty Mutual Insurance Companies	12.1	1.7%	6.9%
13	Safeco Insurance Companies	3.8	1.0%	2.2%
14	Chubb Group of Insurance Companies	11.3	1.0%	6.4%
15	Hartford Insurance Group	14.5	0.9%	8.3%
16	State Auto Insurance Companies	1.6	0.9%	0.9%
17	Companion Property and Casualty Group	0.1	0.7%	0.1%
18	Allianz of America, Inc.	3.8	0.7%	2.2%
19	American National P & C Group	0.7	0.7%	0.4%
20	Horace Mann Insurance Group	0.3	0.7%	0.2%
21	MetLife Auto & Home Group	1.9	0.6%	1.1%
22	Balboa Insurance Group	0.7	0.6%	0.4%
23	Selective Insurance Group	1.0	0.5%	0.6%
24	Zurich Financial Services NA Group	6.2	0.5%	3.6%
25	Homesite Group	0.2	0.4%	0.1%

TEXAS				
Rank	Company Name	Company Surplus (Billions)	DPW Market Share	Surplus Market Share
1	State Farm Group	12.8	29.3%	9.2%
2	Allstate Insurance Group	19.2	15.7%	13.8%
3	Farmers Insurance Group	5.3	12.6%	3.8%
4	USAA Group	11.7	7.4%	8.4%
5	Travelers Insurance Companies	20.2	5.7%	14.5%
6	Nationwide Group	12.8	4.0%	9.2%
7	Southern Farm Bureau Group	1.8	2.6%	1.3%
8	Chubb Group of Insurance Companies	11.3	2.4%	8.1%
9	Liberty Mutual Insurance Companies	12.1	1.9%	8.7%
10	Hartford Insurance Group	14.5	1.6%	10.4%
11	Republic Companies Group	0.2	1.5%	0.1%
12	Safeco Insurance Companies	3.8	1.3%	2.7%
13	NLASCO Group	0.1	1.0%	0.1%
14	Texas FAIR Plan Association	0.0	1.0%	0.0%
15	American Strategic Insurance Companies	0.2	1.0%	0.1%
16	Amica Mutual Group	2.1	0.9%	1.5%
17	Auto Club Enterprises Insurance Group	3.2	0.7%	2.3%
18	Cypress Holdings Group	0.0	0.7%	0.0%
19	Unitrin, Inc.	1.2	0.7%	0.9%
20	State National Companies	0.1	0.6%	0.1%
21	American National P & C Group	0.7	0.6%	0.5%
22	GeoVera Insurance Group	0.1	0.5%	0.1%
23	Allianz of America, Inc.	3.8	0.5%	2.7%
24	MetLife Auto & Home Group	1.9	0.5%	1.3%
25	Colonial Insurance Group	0.0	0.4%	0.0%

**APPENDIX 13-D. LOSS COSTS AND INSURANCE PREMIUMS FOR HURRICANE WIND INSURED DAMAGE
IN ALL COUNTIES IN FLORIDA, NEW YORK, SOUTH CAROLINA AND TEXAS**

FLORIDA				
Rank	County	Loss Costs per \$1,000	50% Loading	Ratio to State
1	MONROE	\$16.22	\$24.32	4.62
2	FRANKLIN	\$6.84	\$10.26	1.95
3	MARTIN	\$6.69	\$10.03	1.90
4	<u>MIAMI-DADE</u>	\$6.48	\$9.73	1.85
5	PALM BEACH	\$6.47	\$9.71	1.84
6	INDIAN RIVER	\$5.67	\$8.51	1.62
7	BROWARD	\$5.64	\$8.46	1.61
8	COLLIER	\$5.04	\$7.56	1.44
9	SAINT LUCIE	\$4.68	\$7.02	1.33
10	SANTA ROSA	\$4.46	\$6.69	1.27
11	MANATEE	\$4.20	\$6.30	1.20
12	LEE	\$4.19	\$6.28	1.19
13	WALTON	\$4.15	\$6.22	1.18
14	SARASOTA	\$4.14	\$6.21	1.18
15	ESCAMBIA	\$4.04	\$6.06	1.15
16	OKALOOSA	\$4.00	\$6.00	1.14
17	GULF	\$3.98	\$5.96	1.13
18	PINELLAS	\$3.87	\$5.81	1.10
19	CHARLOTTE	\$3.29	\$4.94	0.94
20	BREVARD	\$3.09	\$4.63	0.88
21	OKEECHOBEE	\$3.07	\$4.61	0.87
22	GLADES	\$2.91	\$4.37	0.83
23	HENDRY	\$2.88	\$4.32	0.82
24	BAY	\$2.80	\$4.20	0.80
25	DE SOTO	\$2.23	\$3.34	0.64
26	WAKULLA	\$1.89	\$2.83	0.54
27	PASCO	\$1.84	\$2.76	0.52
28	HILLSBOROUGH	\$1.70	\$2.55	0.48
29	DIXIE	\$1.54	\$2.30	0.44
30	LEVY	\$1.47	\$2.20	0.42
31	HARDEE	\$1.45	\$2.18	0.41
32	VOLUSIA	\$1.44	\$2.15	0.41
33	HERNANDO	\$1.41	\$2.12	0.40
34	WASHINGTON	\$1.40	\$2.09	0.40
35	FLAGLER	\$1.32	\$1.99	0.38
36	SAINT JOHNS	\$1.28	\$1.92	0.36
37	TAYLOR	\$1.26	\$1.89	0.36
38	HIGHLANDS	\$1.23	\$1.84	0.35
39	LIBERTY	\$1.09	\$1.63	0.31
40	CITRUS	\$1.07	\$1.61	0.31
41	GILCHRIST	\$1.05	\$1.58	0.30
42	NASSAU	\$1.04	\$1.55	0.30

FLORIDA cont.				
Rank	County	Loss Costs per \$1,000	50% Loading	Ratio to State
43	CALHOUN	\$1.02	\$1.52	0.29
44	POLK	\$0.97	\$1.45	0.28
45	HOLMES	\$0.85	\$1.27	0.24
46	OSCEOLA	\$0.82	\$1.23	0.23
47	LAKE	\$0.78	\$1.17	0.22
48	SUMTER	\$0.75	\$1.12	0.21
49	DUVAL	\$0.74	\$1.11	0.21
50	LAFAYETTE	\$0.70	\$1.05	0.20
51	MARION	\$0.65	\$0.98	0.19
52	PUTNAM	\$0.64	\$0.97	0.18
53	JACKSON	\$0.64	\$0.95	0.18
54	SEMINOLE	\$0.62	\$0.93	0.18
55	JEFFERSON	\$0.60	\$0.90	0.17
56	ORANGE	\$0.60	\$0.90	0.17
57	GADSDEN	\$0.60	\$0.90	0.17
58	LEON	\$0.59	\$0.89	0.17
59	SUWANNEE	\$0.54	\$0.82	0.16
60	MADISON	\$0.52	\$0.78	0.15
61	CLAY	\$0.48	\$0.72	0.14
62	ALACHUA	\$0.46	\$0.69	0.13
63	COLUMBIA	\$0.39	\$0.58	0.11
64	UNION	\$0.37	\$0.55	0.10
65	BRADFORD	\$0.32	\$0.48	0.09
66	HAMILTON	\$0.31	\$0.46	0.09
67	BAKER	\$0.23	\$0.34	0.07
Total	ALL COUNTIES	\$3.51	\$5.27	1.00

NEW YORK				
Rank	County	Loss Cost per \$1,000	50% Loading	Ratio to State
1	SUFFOLK	\$0.38	\$0.56	4.10
2	NASSAU	\$0.17	\$0.25	1.85
3	<u>RICHMOND</u>	\$0.12	\$0.17	1.26
4	<u>QUEENS</u>	\$0.10	\$0.15	1.11
5	<u>KINGS</u>	\$0.08	\$0.12	0.89
6	WESTCHESTER	\$0.08	\$0.12	0.88
7	ROCKLAND	\$0.07	\$0.11	0.78
8	<u>BRONX</u>	\$0.07	\$0.10	0.71
9	PUTNAM	\$0.06	\$0.09	0.69
10	DUTCHESS	\$0.04	\$0.06	0.43
11	COLUMBIA	\$0.04	\$0.05	0.40
12	ULSTER	\$0.03	\$0.05	0.35
13	ORANGE	\$0.03	\$0.05	0.35
14	<u>NEW YORK</u>	\$0.02	\$0.04	0.27
15	RENSELAER	\$0.02	\$0.03	0.22
16	GREENE	\$0.02	\$0.03	0.21
17	WASHINGTON	\$0.02	\$0.03	0.19
18	ALBANY	\$0.01	\$0.02	0.15
19	SARATOGA	\$0.01	\$0.02	0.15
20	SULLIVAN	\$0.01	\$0.02	0.14
21	WARREN	\$0.01	\$0.02	0.11
22	SCHENECTADY	\$0.01	\$0.01	0.10
23	MONTGOMERY	\$0.01	\$0.01	0.09
24	CLINTON	\$0.01	\$0.01	0.08
25	SCHOHARIE	\$0.01	\$0.01	0.08
26	ESSEX	\$0.01	\$0.01	0.07
27	FULTON	\$0.01	\$0.01	0.06
28	DELAWARE	\$0.01	\$0.01	0.06
29	HERKIMER	\$0.00	\$0.01	0.04
30	OTSEGO	\$0.00	\$0.01	0.04
31	HAMILTON	\$0.00	\$0.00	0.03
32	CHENANGO	\$0.00	\$0.00	0.03
33	ONEIDA	\$0.00	\$0.00	0.03
34	BROOME	\$0.00	\$0.00	0.02
35	MADISON	\$0.00	\$0.00	0.02
36	CORTLAND	\$0.00	\$0.00	0.02
37	TIOGA	\$0.00	\$0.00	0.02
38	LEWIS	\$0.00	\$0.00	0.02
39	SENECA	\$0.00	\$0.00	0.01
40	CAYUGA	\$0.00	\$0.00	0.01
41	TOMPKINS	\$0.00	\$0.00	0.01
42	FRANKLIN	\$0.00	\$0.00	0.01
43	SAINT LAWRENCE	\$0.00	\$0.00	0.01
44	JEFFERSON	\$0.00	\$0.00	0.01
45	OSWEGO	\$0.00	\$0.00	0.01

NEW YORK cont.				
Rank	County	Loss Cost per \$1,000	50% Loading	Ratio to State
46	YATES	\$0.00	\$0.00	0.01
47	ONONDAGA	\$0.00	\$0.00	0.01
48	WAYNE	\$0.00	\$0.00	0.01
49	ONTARIO	\$0.00	\$0.00	0.01
50	SCHUYLER	\$0.00	\$0.00	0.01
51	CHEMUNG	\$0.00	\$0.00	0.00
52	STEUBEN	\$0.00	\$0.00	0.00
53	MONROE	\$0.00	\$0.00	0.00
54	LIVINGSTON	\$0.00	\$0.00	0.00
55	GENESEE	\$0.00	\$0.00	0.00
56	ORLEANS	\$0.00	\$0.00	0.00
57	WYOMING	\$0.00	\$0.00	0.00
58	CHAUTAUQUA	\$0.00	\$0.00	0.00
59	CATTARAUGUS	\$0.00	\$0.00	0.00
60	NIAGARA	\$0.00	\$0.00	0.00
61	ALLEGANY	\$0.00	\$0.00	0.00
62	ERIE	\$0.00	\$0.00	0.00
Total	ALL COUNTIES	\$0.09	\$0.14	1.00

SOUTH CAROLINA				
Rank	County	Loss costs per \$1,000	50% Loading	Ratio to State
1	GEORGETOWN	\$2.69	\$4.04	4.74
2	<u>CHARLESTON</u>	\$2.62	\$3.93	4.61
3	HORRY	\$2.11	\$3.17	3.72
4	BEAUFORT	\$2.10	\$3.15	3.70
5	<u>COLLETON</u>	\$1.37	\$2.05	2.41
6	<u>BERKELEY</u>	\$1.20	\$1.80	2.12
7	JASPER	\$0.92	\$1.38	1.62
8	<u>DORCHESTER</u>	\$0.85	\$1.27	1.49
9	WILLIAMSBURG	\$0.81	\$1.21	1.42
10	MARION	\$0.65	\$0.97	1.14
11	HAMPTON	\$0.55	\$0.83	0.97
12	CLARENDON	\$0.50	\$0.75	0.88
13	DILLON	\$0.38	\$0.57	0.67
14	FLORENCE	\$0.36	\$0.54	0.63
15	ORANGEBURG	\$0.36	\$0.53	0.63
16	ALLENDALE	\$0.31	\$0.46	0.54
17	BAMBERG	\$0.27	\$0.40	0.47
18	CALHOUN	\$0.25	\$0.37	0.43
19	DARLINGTON	\$0.20	\$0.30	0.35
20	LEE	\$0.20	\$0.30	0.35
21	SUMTER	\$0.19	\$0.28	0.33
22	MARLBORO	\$0.18	\$0.28	0.32
23	BARNWELL	\$0.15	\$0.23	0.27
24	CHESTERFIELD	\$0.06	\$0.09	0.11
25	KERSHAW	\$0.06	\$0.09	0.10
26	AIKEN	\$0.04	\$0.06	0.07
27	LEXINGTON	\$0.04	\$0.06	0.07
28	RICHLAND	\$0.04	\$0.06	0.07
29	FAIRFIELD	\$0.02	\$0.02	0.03
30	LANCASTER	\$0.02	\$0.02	0.03
31	EDGEFIELD	\$0.02	\$0.02	0.03
32	SALUDA	\$0.01	\$0.02	0.02
33	NEWBERRY	\$0.01	\$0.01	0.01
34	MCCORMICK	\$0.01	\$0.01	0.01
35	CHESTER	\$0.01	\$0.01	0.01
36	GREENWOOD	\$0.00	\$0.00	0.00
37	ABBEVILLE	\$0.00	\$0.00	0.00
38	LAURENS	\$0.00	\$0.00	0.00
39	YORK	\$0.00	\$0.00	0.00
40	UNION	\$0.00	\$0.00	0.00
41	CHEROKEE	\$0.00	\$0.00	0.00
42	ANDERSON	\$0.00	\$0.00	0.00
43	SPARTANBURG	\$0.00	\$0.00	0.00
44	GREENVILLE	\$0.00	\$0.00	0.00
45	PICKENS	\$0.00	\$0.00	0.00
46	OCONEE	\$0.00	\$0.00	0.00
Total	ALL COUNTIES	\$0.57	\$0.85	1.00

TEXAS				
Rank	County	Price	50% Loading	Ratio to State
1	CALHOUN	\$4.60	\$6.89	10.53
2	ARANSAS	\$4.56	\$6.84	10.44
3	<u>GALVESTON</u>	\$3.95	\$5.92	9.05
4	MATAGORDA	\$3.19	\$4.79	7.32
5	<u>CHAMBERS</u>	\$2.59	\$3.88	5.93
6	<u>BRAZORIA</u>	\$2.44	\$3.65	5.58
7	NUECES	\$2.32	\$3.48	5.32
8	SAN PATRICIO	\$2.27	\$3.40	5.19
9	CAMERON	\$2.08	\$3.12	4.77
10	JACKSON	\$2.04	\$3.07	4.69
11	REFUGIO	\$2.01	\$3.01	4.60
12	JEFFERSON	\$1.72	\$2.58	3.95
13	KENEDY	\$1.54	\$2.30	3.52
14	WILLACY	\$1.53	\$2.30	3.52
15	ORANGE	\$1.41	\$2.12	3.24
16	WHARTON	\$1.39	\$2.08	3.18
17	<u>FORT BEND</u>	\$1.07	\$1.61	2.46
18	VICTORIA	\$1.06	\$1.58	2.42
19	<u>LIBERTY</u>	\$1.02	\$1.53	2.34
20	GOLIAD	\$0.91	\$1.37	2.09
21	KLEBERG	\$0.90	\$1.34	2.05
22	<u>HARRIS</u>	\$0.81	\$1.22	1.86
23	BROOKS	\$0.80	\$1.20	1.83
24	HARDIN	\$0.76	\$1.14	1.74
25	JIM WELLS	\$0.75	\$1.12	1.71
26	HIDALGO	\$0.72	\$1.09	1.66
27	BEE	\$0.65	\$0.98	1.50
28	<u>WALLER</u>	\$0.57	\$0.85	1.30
29	<u>AUSTIN</u>	\$0.50	\$0.75	1.14
30	COLORADO	\$0.48	\$0.72	1.11
31	DE WITT	\$0.47	\$0.70	1.08
32	NEWTON	\$0.46	\$0.69	1.05
33	LAVACA	\$0.38	\$0.57	0.87
34	<u>SAN JACINTO</u>	\$0.38	\$0.56	0.86
35	JASPER	\$0.35	\$0.52	0.80
36	<u>MONTGOMERY</u>	\$0.32	\$0.48	0.74
37	DUVAL	\$0.29	\$0.44	0.67
38	LIVE OAK	\$0.29	\$0.44	0.67
39	KARNES	\$0.29	\$0.43	0.66
40	WASHINGTON	\$0.24	\$0.35	0.54
41	TYLER	\$0.22	\$0.34	0.51
42	JIM HOGG	\$0.20	\$0.30	0.45
43	FAYETTE	\$0.19	\$0.29	0.44
44	STARR	\$0.19	\$0.29	0.44
45	GRIMES	\$0.19	\$0.28	0.43
46	MCMULLEN	\$0.18	\$0.27	0.41
47	GONZALES	\$0.18	\$0.26	0.40

TEXAS cont.				
Rank	County	Price	50% Loading	Ratio to State
48	POLK	\$0.16	\$0.25	0.38
49	WALKER	\$0.13	\$0.20	0.31
50	WILSON	\$0.12	\$0.18	0.28
51	SABINE	\$0.10	\$0.16	0.24
52	BURLESON	\$0.10	\$0.16	0.24
53	TRINITY	\$0.10	\$0.16	0.24
54	LEE	\$0.08	\$0.13	0.19
55	ATASCOSA	\$0.07	\$0.11	0.17
56	MADISON	\$0.07	\$0.11	0.16
57	CALDWELL	\$0.06	\$0.09	0.14
58	SAN AUGUSTINE	\$0.06	\$0.09	0.13
59	GUADALUPE	\$0.06	\$0.09	0.13
60	ZAPATA	\$0.05	\$0.08	0.13
61	BASTROP	\$0.05	\$0.07	0.11
62	BRAZOS	\$0.04	\$0.06	0.09
63	ANGELINA	\$0.04	\$0.06	0.09
64	LA SALLE	\$0.04	\$0.06	0.09
65	WEBB	\$0.03	\$0.05	0.08
66	HOUSTON	\$0.03	\$0.05	0.08
67	FRIO	\$0.03	\$0.04	0.07
68	COMAL	\$0.02	\$0.03	0.05
69	ROBERTSON	\$0.02	\$0.03	0.05
70	MILAM	\$0.02	\$0.03	0.05
71	HAYS	\$0.02	\$0.03	0.05
72	NACOGDOCHES	\$0.02	\$0.03	0.04
73	LEON	\$0.02	\$0.03	0.04
74	BEXAR	\$0.02	\$0.02	0.04
75	MEDINA	\$0.01	\$0.02	0.03
76	SHELBY	\$0.01	\$0.02	0.03
77	DIMITT	\$0.01	\$0.01	0.02
78	WILLIAMSON	\$0.01	\$0.01	0.02
79	CHEROKEE	\$0.01	\$0.01	0.02
80	FALLS	\$0.01	\$0.01	0.01
81	BELL	\$0.01	\$0.01	0.01
82	TRAVIS	\$0.01	\$0.01	0.01
83	FREESTONE	\$0.01	\$0.01	0.01
84	KENDALL	\$0.01	\$0.01	0.01
85	ANDERSON	\$0.00	\$0.01	0.01
86	BLANCO	\$0.00	\$0.01	0.01
87	LIMESTONE	\$0.00	\$0.01	0.01
88	ZAVALA	\$0.00	\$0.01	0.01
89	PANOLA	\$0.00	\$0.01	0.01
90	RUSK	\$0.00	\$0.00	0.01
91	CORYELL	\$0.00	\$0.00	0.01
92	NAVARRO	\$0.00	\$0.00	0.01
93	UVALDE	\$0.00	\$0.00	0.00
94	MCLENNAN	\$0.00	\$0.00	0.00

TEXAS cont.				
Rank	County	Price	50% Loading	Ratio to State
95	BANDERA	\$0.00	\$0.00	0.00
96	BURNET	\$0.00	\$0.00	0.00
97	HENDERSON	\$0.00	\$0.00	0.00
98	GREGG	\$0.00	\$0.00	0.00
99	LAMPASAS	\$0.00	\$0.00	0.00
100	HARRISON	\$0.00	\$0.00	0.00
101	BOSQUE	\$0.00	\$0.00	0.00
102	GILLESPIE	\$0.00	\$0.00	0.00
103	LLANO	\$0.00	\$0.00	0.00
104	SMITH	\$0.00	\$0.00	0.00
105	HILL	\$0.00	\$0.00	0.00
106	UPSHUR	\$0.00	\$0.00	0.00
107	HAMILTON	\$0.00	\$0.00	0.00
108	MAVERICK	\$0.00	\$0.00	0.00
109	MARION	\$0.00	\$0.00	0.00
110	KERR	\$0.00	\$0.00	0.00
111	VAN ZANDT	\$0.00	\$0.00	0.00
112	RAINS	\$0.00	\$0.00	0.00
113	KAUFMAN	\$0.00	\$0.00	0.00
114	ELLIS	\$0.00	\$0.00	0.00
115	JOHNSON	\$0.00	\$0.00	0.00
116	WOOD	\$0.00	\$0.00	0.00
117	CAMP	\$0.00	\$0.00	0.00
118	FRANKLIN	\$0.00	\$0.00	0.00
119	MILLS	\$0.00	\$0.00	0.00
120	MORRIS	\$0.00	\$0.00	0.00
121	CASS	\$0.00	\$0.00	0.00
122	HUNT	\$0.00	\$0.00	0.00
123	TITUS	\$0.00	\$0.00	0.00
124	SOMERVELL	\$0.00	\$0.00	0.00
125	MASON	\$0.00	\$0.00	0.00
126	HOOD	\$0.00	\$0.00	0.00
127	SAN SABA	\$0.00	\$0.00	0.00
128	HOPKINS	\$0.00	\$0.00	0.00
129	ROCKWALL	\$0.00	\$0.00	0.00
130	BOWIE	\$0.00	\$0.00	0.00
131	REAL	\$0.00	\$0.00	0.00
132	ERATH	\$0.00	\$0.00	0.00
133	RED RIVER	\$0.00	\$0.00	0.00
134	DELTA	\$0.00	\$0.00	0.00
135	BROWN	\$0.00	\$0.00	0.00
136	COMANCHE	\$0.00	\$0.00	0.00
137	PARKER	\$0.00	\$0.00	0.00
138	TARRANT	\$0.00	\$0.00	0.00
139	DALLAS	\$0.00	\$0.00	0.00
140	COLLIN	\$0.00	\$0.00	0.00
141	LAMAR	\$0.00	\$0.00	0.00

TEXAS cont.				
Rank	County	Price	50% Loading	Ratio to State
142	PALO PINTO	\$0.00	\$0.00	0.00
143	EASTLAND	\$0.00	\$0.00	0.00
144	EDWARDS	\$0.00	\$0.00	0.00
145	FANNIN	\$0.00	\$0.00	0.00
146	MCCULLOCH	\$0.00	\$0.00	0.00
147	DENTON	\$0.00	\$0.00	0.00
148	VAL VERDE	\$0.00	\$0.00	0.00
149	KINNEY	\$0.00	\$0.00	0.00
150	JACK	\$0.00	\$0.00	0.00
151	WISE	\$0.00	\$0.00	0.00
152	KING	\$0.00	\$0.00	0.00
153	ANDREWS	\$0.00	\$0.00	0.00
154	ARCHER	\$0.00	\$0.00	0.00
155	ARMSTRONG	\$0.00	\$0.00	0.00
156	BAILEY	\$0.00	\$0.00	0.00
157	BAYLOR	\$0.00	\$0.00	0.00
158	BORDEN	\$0.00	\$0.00	0.00
159	BREWSTER	\$0.00	\$0.00	0.00
160	BRISCOE	\$0.00	\$0.00	0.00
161	CALLAHAN	\$0.00	\$0.00	0.00
162	CARSON	\$0.00	\$0.00	0.00
163	CASTRO	\$0.00	\$0.00	0.00
164	CHILDRESS	\$0.00	\$0.00	0.00
165	CLAY	\$0.00	\$0.00	0.00
166	COCHRAN	\$0.00	\$0.00	0.00
167	COKE	\$0.00	\$0.00	0.00
168	COLEMAN	\$0.00	\$0.00	0.00
169	COLLINGSWORTH	\$0.00	\$0.00	0.00
170	CONCHO	\$0.00	\$0.00	0.00
171	COOKE	\$0.00	\$0.00	0.00
172	COTTLE	\$0.00	\$0.00	0.00
173	CRANE	\$0.00	\$0.00	0.00
174	CROCKETT	\$0.00	\$0.00	0.00
175	CROSBY	\$0.00	\$0.00	0.00
176	CULBERSON	\$0.00	\$0.00	0.00
177	DALLAM	\$0.00	\$0.00	0.00
178	DAWSON	\$0.00	\$0.00	0.00
179	DEAF SMITH	\$0.00	\$0.00	0.00
180	DICKENS	\$0.00	\$0.00	0.00
181	DONLEY	\$0.00	\$0.00	0.00
182	ECTOR	\$0.00	\$0.00	0.00
183	EL PASO	\$0.00	\$0.00	0.00
184	FISHER	\$0.00	\$0.00	0.00
185	FLOYD	\$0.00	\$0.00	0.00
186	FOARD	\$0.00	\$0.00	0.00
187	GAINES	\$0.00	\$0.00	0.00
188	GARZA	\$0.00	\$0.00	0.00

TEXAS cont.				
Rank	County	Price	50% Loading	Ratio to State
189	GLASSCOCK	\$0.00	\$0.00	0.00
190	GRAY	\$0.00	\$0.00	0.00
191	GRAYSON	\$0.00	\$0.00	0.00
192	HALE	\$0.00	\$0.00	0.00
193	HALL	\$0.00	\$0.00	0.00
194	HANSFORD	\$0.00	\$0.00	0.00
195	HARDEMAN	\$0.00	\$0.00	0.00
196	HARTLEY	\$0.00	\$0.00	0.00
197	HASKELL	\$0.00	\$0.00	0.00
198	HEMPHILL	\$0.00	\$0.00	0.00
199	HOCKLEY	\$0.00	\$0.00	0.00
200	HOWARD	\$0.00	\$0.00	0.00
201	HUDSPETH	\$0.00	\$0.00	0.00
202	HUTCHINSON	\$0.00	\$0.00	0.00
203	IRION	\$0.00	\$0.00	0.00
204	JEFF DAVIS	\$0.00	\$0.00	0.00
205	JONES	\$0.00	\$0.00	0.00
206	KENT	\$0.00	\$0.00	0.00
207	KIMBLE	\$0.00	\$0.00	0.00
208	KNOX	\$0.00	\$0.00	0.00
209	LAMB	\$0.00	\$0.00	0.00
210	LIPSCOMB	\$0.00	\$0.00	0.00
211	LOVING	\$0.00	\$0.00	0.00
212	LUBBOCK	\$0.00	\$0.00	0.00
213	LYNN	\$0.00	\$0.00	0.00
214	MARTIN	\$0.00	\$0.00	0.00
215	MENARD	\$0.00	\$0.00	0.00
216	MIDLAND	\$0.00	\$0.00	0.00
217	MITCHELL	\$0.00	\$0.00	0.00
218	MONTAGUE	\$0.00	\$0.00	0.00
219	MOORE	\$0.00	\$0.00	0.00
220	MOTLEY	\$0.00	\$0.00	0.00
221	NOLAN	\$0.00	\$0.00	0.00
222	OCHILTREE	\$0.00	\$0.00	0.00
223	OLDHAM	\$0.00	\$0.00	0.00
224	PARMER	\$0.00	\$0.00	0.00
225	PECOS	\$0.00	\$0.00	0.00
226	POTTER	\$0.00	\$0.00	0.00
227	PRESIDIO	\$0.00	\$0.00	0.00
228	RANDALL	\$0.00	\$0.00	0.00
229	REAGAN	\$0.00	\$0.00	0.00
230	REEVES	\$0.00	\$0.00	0.00
231	ROBERTS	\$0.00	\$0.00	0.00
232	RUNNELS	\$0.00	\$0.00	0.00
233	SCHLEICHER	\$0.00	\$0.00	0.00
234	SCURRY	\$0.00	\$0.00	0.00
235	SHACKELFORD	\$0.00	\$0.00	0.00

TEXAS cont.				
Rank	County	Price	50% Loading	Ratio to State
236	SHERMAN	\$0.00	\$0.00	0.00
237	STEPHENS	\$0.00	\$0.00	0.00
238	STERLING	\$0.00	\$0.00	0.00
239	STONEWALL	\$0.00	\$0.00	0.00
240	SUTTON	\$0.00	\$0.00	0.00
241	SWISHER	\$0.00	\$0.00	0.00
242	TAYLOR	\$0.00	\$0.00	0.00
243	TERRELL	\$0.00	\$0.00	0.00
244	TERRY	\$0.00	\$0.00	0.00
245	THROCKMORTON	\$0.00	\$0.00	0.00
246	TOM GREEN	\$0.00	\$0.00	0.00
247	UPTON	\$0.00	\$0.00	0.00
248	WARD	\$0.00	\$0.00	0.00
249	WHEELER	\$0.00	\$0.00	0.00
250	WICHITA	\$0.00	\$0.00	0.00
251	WILBARGER	\$0.00	\$0.00	0.00
252	WINKLER	\$0.00	\$0.00	0.00
253	YOAKUM	\$0.00	\$0.00	0.00
254	YOUNG	\$0.00	\$0.00	0.00

PART IV

CREATING INNOVATIVE SOLUTIONS

CHAPTER 14

PROPOSED INNOVATIONS FOR DEALING WITH CATASTROPHIC RISKS

KEY FINDINGS

Two principles must guide the development of new catastrophe insurance programs.

Principle 1: Premiums Reflecting Risk is designed to provide signals to individuals regarding the hazards they face and encourage the adoption of cost-effective mitigation measures.

Principle 2: Dealing with Equity and Affordability Issues addresses ways to provide special treatment to homeowners currently residing in hazard-prone areas (e.g. low-income uninsured or inadequately insured homeowners).

To provide protection to homeowners in hazard-prone areas, two innovations are proposed based on the above principles. *Innovation 1:* Long-term homeowners insurance could be tied to a mortgage thus stabilizing a homeowner's premiums over time. Home improvement loans can encourage the adoption of cost-effective mitigation measures. *Innovation 2:* A program of insurance vouchers, similar in concept to food stamps, could assist low-income residents in disaster-prone areas so they can purchase adequate insurance coverage.

Several specific insurance-related proposals have been initiated that involve the private and public sectors.

- **A Coastal Hurricane Zone (CHZ)** has been proposed with regulations established by the federal government and consistent across states within the CHZ. After several years of operation, any surplus would be redistributed to homeowners, and deficits met through surcharges. Such a system would allow insurers to make long-term commitments of capital to provide coverage against wind damage from hurricanes.
- **A national catastrophe fund** has been proposed as a financial backstop for state catastrophe funds and augment private reinsurance.
- **Auctioned reinsurance contracts** could be developed by the federal government to cover truly cataclysmic events.
- **Alternative risk transfer instruments** offered by the financial market to cover catastrophic losses could be expanded through innovative products, making this market much more liquid than it is today.

A data collection and information sharing platform could be created to inform the private sector and policy makers on the extent of insurance penetration. Despite the series of recent catastrophes, the United States does not have any system in place to ascertain on a national scale who has purchased insurance coverage and how much, and who is uninsured. We propose the creation of a national insurance data collection system to better understand the level of coverage of homeowners against future disasters. The implementation of this concept could be achieved at a very small cost via the Internal Revenue Service (IRS), with homeowners answering a few questions about their property insurance coverage on their annual IRS tax returns.

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KEY FINDINGS, cont.

Two bills, which passed the U.S. House of Representatives in the fall of 2007 and are pending in the U.S. Senate, address issues related to catastrophe insurance and mitigation. *The Homeowners' Defense Act of 2007* (H.R. 3355), if enacted, would establish a non-profit Consortium as a federal-state pool to encourage state programs such as the Florida Hurricane Catastrophe Fund to pool their catastrophic risk with one another and move toward broader utilization of private capital through risk transfer mechanisms, such as cat bonds, for catastrophic losses. It also creates a federal loan program to provide funds to state reinsurance programs both prior to a disaster (liquidity loans) and after a disaster (catastrophic loans). It would also create the Federal Natural Catastrophe Reinsurance Fund that would protect private and state reinsurers against natural disasters that have a probability of occurrence of 0.5 percent (1-in-200 year return) or lower. The total liability of the federal government from this Fund would be capped at \$200 billion. *The Flood Insurance Reform and Modernization Act of 2007* (H.R. 3121) would expand the scope of the National Flood Insurance Program (NFIP) by offering windstorm coverage

There is a need for in-depth analyses to evaluate these proposed innovations, concepts and pending legislation. The proposed innovations, concepts and the two pending bills raise important questions regarding the economic effectiveness, equitability and feasibility of current disaster management programs. Addressing these issues to assure well-reasoned public policy requires a series of in-depth analyses that go beyond the scope of the present report.

CHAPTER 14

PROPOSED INNOVATIONS FOR DEALING WITH CATASTROPHIC RISKS

14.1. Guiding Principles

Given the significant increase in damage from hurricanes and other natural disasters during the past fifteen years, and the growing population and assets in high-risk areas, we need a new approach for insuring these risks and encouraging individuals who reside in these hazard-prone areas to undertake effective mitigation measures. Two principles, which appear to conflict with each other, should guide the development of new programs for reducing future losses and allocating the costs of disasters in an efficient and equitable manner.

Principle 1 – Premiums Reflecting Risk. Insurance premiums should be based on risk to provide signals to individuals as to the hazards they face and to encourage them to engage in cost-effective mitigation measures to reduce their vulnerability to catastrophes.

Principle 2 – Dealing with Equity and Affordability Issues. Any special treatment given to homeowners currently residing in hazard-prone areas (e.g., low-income uninsured or inadequately insured homeowners) should come from general public funding and not through insurance premium subsidies.

Principle 1 is important because its application would provide a clear signal of likely damage to those currently residing in areas subject to natural disasters and those who are considering moving into these regions. Risk-based premiums would also enable insurers to provide discounts to homeowners and businesses who invest in cost-effective loss-reduction mitigation measures. If insurance premiums are not risk-based, 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 some residents in high-hazard areas who will be faced with large premium increases if insurers are permitted to adhere to Principle 1. As noted throughout this report, regulations imposed by state insurance commissioners keep premiums in many regions subject to hurricane damage artificially lower than the risk-based level. If insurers are permitted to charge premiums that reflect risk, homeowners residing in hurricane-prone areas would pay considerably more for coverage than they do today. Therefore, there might be a need for a transition period, so that over time (e.g., 3 or 5 years), premiums increase to the risk-based level. Doing so might actually also reduce the premiums paid by other policyholders, who are currently paying more than their risk-based exposure in order to subsidize those in highly exposed areas.³⁷³

³⁷³ See Kunreuther, H. (2007), “Who Will Pay for the Next Hurricane?” *New York Times*, (August 25) for more details as to why we need these principles for developing new approaches for dealing with disasters. http://opim.wharton.upenn.edu/risk/library/oped_NYT2007%2708%2725.pdf.

Note: Principle 2 applies only to those individuals who current reside in a hazard-prone area. Those who decide to move to the area in the future should be charged premiums that reflect the risk. If they were provided with financial assistance from public sources to purchase insurance, the resulting public policy would directly encourage development in hazard-prone areas and exacerbate the potential for catastrophic losses from future disasters.

14.2. Developing Insurance Programs Using Guiding Principles

The above two principles can be used to design any insurance program where there are data available for developing premiums reflecting risk. As discussed in Chapter 6, catastrophe models have been developed to estimate the likelihood and damages resulting from future disasters of different magnitudes and intensities. Although there is uncertainty surrounding the estimates from these catastrophe models, they have been widely used by insurers and reinsurers to better determine their exposure, and to price the risk.

Premiums Reflecting Risk

The first step in developing an insurance program that would adhere to *Principle 1* is to estimate the risk-based rates that would apply to different regions of the country. In Chapter 13 we presented rates that reflect the risk for hurricane wind-related damage for counties in the four states that we studied (Florida, New York, South Carolina and Texas). We also specified how this translates into premiums when a loading factor was utilized by insurers to cover the costs of marketing policies, assessing and paying claims after a loss. The appropriate loading factor also integrates the cost of capital that private insurers need to access to cover catastrophic events and maintain their ratings while earning a high enough return for investors to want to allocate funds to the insurance company.

A major issue that needs to be addressed is how to reach agreement on a given risk assessment, and the role that state regulators will play in the process. We believe that to enable insurers to charge premiums which reflect risk, regulators should not be involved in matters pertaining to rate setting. If a truly competitive market were allowed to operate, insurers would not engage in price-gouging since they would be undercut by another competing company that could profitably market policies at a lower price. Regulators would still have an important role to play in other aspects of the insurance operation, such as making certain that insurers have sufficient surplus to protect unsuspecting consumers against the possibility of their becoming insolvent following the next severe disaster.

Affordability of Coverage

The second step in the process relates to the affordability and equity issues indicated in *Principle 2*. The analyses in Chapter 11 reveal that many homeowners who supposedly cannot afford insurance (because their income is below a pre-defined threshold; e.g., 125 or 200 percent of poverty level), *do* actually purchase coverage, and some people who can afford it are *not* buying it. In Chapter 11 we also address the question of equity. If changes in premiums are distributed very unevenly across households, one might take the view that those subject to very large increases are not being treated fairly and justly. More specifically, if premiums are raised in high-hazard areas so as to reflect risk, those residents may feel they are treated unjustly relative to others with similar homes whose premiums remain unchanged.

To deal with these issues of equity and affordability, we recommend that some type of insurance voucher be provided by the state or federal government. This type of in-kind assistance, rather than an unrestricted grant, assures that the recipients will use the funds for obtaining insurance rather than having the freedom to spend the money on other goods and services. If this system were applied to a low-income family in a hazard-prone area, this family would pay an insurance premium to cover its house that reflects its risk, and then be reimbursed by the state in which they reside for a portion of the increased cost of insurance over the prior year's policy. The amount of reimbursement would be determined by their income and the insurance premium that they are charged.

There are several existing programs that could serve as models for developing such a voucher system that we now briefly discuss.

Food Stamp Program. Under the Food Stamp Program, a family is given vouchers to purchase food based on their annual income and size of the family. The idea for the program was born in the late 1930s, revived as a pilot program in 1961 and extended nationwide in 1974. The current program structure was implemented in 1977 with a goal of alleviating hunger and malnutrition by permitting low-income households to obtain a more nutritious diet through normal purchasing of food from grocery stores. Food stamps are available to most low-income households with limited resources regardless of age, disability status or family structure. Households, except those with elderly or disabled members, must have gross incomes below 130 percent of the poverty line. All households must have net incomes below 100 percent of poverty to be eligible.³⁷⁴ The program is funded entirely by the federal government. Federal and state governments share administrative costs (with the federal government contributing nearly 50 percent). In 2006, the budget for the federal food stamp program was \$36 billion.³⁷⁵

As of June 2007, more than 26 million individuals have benefited from this program, including 1.2 million in Florida, 1.8 million in New York and 2.4 million in Texas (Food Research and Action Center, 2007).³⁷⁶ It would be of value to determine whether these same people also lack proper insurance against natural disasters. If so, these homeowners could comprise a test group for an insurance voucher program.

Low Income Home Energy Assistance Program (LIHEAP). The mission of this program is to assist low-income households that pay a high proportion of their income for home energy in meeting their immediate energy needs. The funding is provided by the federal government but is administered by the states and federally-recognized tribes or insular areas (e.g., Guam, Puerto Rico, Virgin Islands) to help eligible low-income homeowners and renters meet their heating or cooling needs (eligibility based on criteria similar to the food stamp program).³⁷⁷ The federal government became involved in awarding energy assistance funds to low-income households as a result of the increase in oil prices resulting from the Organization of Petroleum Exporting Countries (OPEC) oil embargo in 1973. Over the past few years, the annual appropriation of this program has averaged \$2 billion.³⁷⁸

³⁷⁴ More details can be found at http://www.frac.org/html/federal_food_programs/programs/fsp.html.

³⁷⁵ See <http://www.usda.gov/agency/obpa/Budget-Summary/2006/04.ProgHighlights.htm>.

³⁷⁶ Sources: Food Research and Action Center. http://www.frac.org/data/FSPparticipation/2007_06.pdf.

³⁷⁷ For instance, at the end of August 2007, Secretary of Health and Human Services (HHS) Mike Leavitt announced that \$50 million in emergency energy assistance will be given to 12 states that experienced much hotter temperatures than normal conditions during the summer.

³⁷⁸ See U.S. Department of Health and Human Services at <http://www.acf.hhs.gov/programs/liheap>.

Universal Service Fund (USF).³⁷⁹ The USF was created by the Federal Communications Commission in 1997 to ensure that consumers in all regions of the nation have access to and pay rates for telecommunications services that are reasonably comparable to those in urban areas. To achieve this goal, the program first provides discounts to all households in particular high-cost areas (e.g., rural areas) so they all pay the same subsidized rate regardless of income. Then there are universal service programs that are strictly aimed at low-income households, regardless of whether they live in high-cost or low-cost areas.³⁸⁰ Under the Telecommunications Act of 1996, all telecommunication carriers that provide service internationally and between states pay contributions into the USF. The carriers may build this factor into their billing systems if they choose to recoup this amount from their customers. Between 1998 and 2006, more than \$50 billion has been disbursed by this fund. The Federal Communications Commission is now considering a proposal to allocate USF monies to eligible carriers based on reverse auctions (the bidders asking for the least money to serve the designated beneficiary groups would win rights to the subsidy).³⁸¹

Who Should Fund Insurance Vouchers?

The above programs have different methods to subsidize low-income families for specific goods and services. With respect to homeowners insurance, funding for vouchers could be provided in several ways, which mirror these programs. We will discuss these in turn.

General Taxpayer. If one takes the position that everyone in society is responsible for assisting those who reside in hazard-prone areas and who cannot afford insurance coverage, then one could utilize general taxpayer revenue from the federal government to cover the costs of insurance vouchers. This is what is currently done by the Food Stamp Program and the Low Income Home Energy Assistance Program.

State Government. An alternative (or complementary) source of funding would come from taxes paid by residents and/or commercial enterprises in states exposed to natural disasters. One argument that could be made for this type of funding arrangement is that states obtain significant financial benefits from economic development in their jurisdictions through the collection of property taxes or other state revenue such as gasoline taxes, state income taxes or sales taxes. If residents in coastal areas derive greater benefits from the economic development in these regions than others in the state, they should be taxed proportionately more than those residing inland.

Insurance Policyholders. A special tax could be levied on insurance policyholders to provide vouchers to those currently residing in hazard-prone areas who require special treatment. The rationale for this type of tax would be that all homeowners (as opposed to all taxpayers) should be responsible for helping to protect those who cannot afford protection. The justification for such a program would be similar to the rationale for establishing the Universal Service Fund for telecommunication service: providing affordable telephone service to all residents in the country.

³⁷⁹ For more details on this program see <http://www.usac.org/about/universal-service> as of September 2007.

³⁸⁰ We thank Genio Staranczak for insightful comments on the operation of the fund.

³⁸¹ Litan, R., F. Nutter, and M. Racicot (2007), "Easing the Homeowners' Insurance Crisis on the Atlantic and Gulf Coasts," (October), www.aidc.org and www.reinsurance.org.

14.3. Long-Term Homeowners Insurance³⁸²

Nature of the Program

Insurers might consider marketing long-term insurance contracts on residential property as a way of providing stability to homeowners and encouraging adoption of cost-effective mitigation measures. The precedent for long-term insurance contracts in our country goes back to the time of Benjamin Franklin, who started the *Philadelphia Contributionship for the Insuring of Houses from Fire* in 1752. It eventually became the *Green Tree Mutual Assurance Company*, which closed its doors in 2004.³⁸³

One should consider whether long-term homeowners insurance should be required on all residential property. This would not be a radical change from the current situation – homeowners who have a mortgage are normally required by the bank which finances the loan to purchase coverage against wind damage for the length of the mortgage. Similarly, those in flood-prone areas are required to purchase flood insurance under the National Flood Insurance Program if they have a federally insured mortgage. Insurance coverage is required today for other consumer purchases. Today in all states, motorists must show proof of financial responsibility on their automobile insurance policy, or bodily injury and property damage liability in order to register their car.

For a long-term insurance policy to be feasible, insurers would have to be able to charge a premium that reflects their best estimate of the risk over that time period (say, 10 or 25 years) (*Principle 1*). The uncertainty surrounding these estimates could be reflected in the premium as a function of the length of the insurance contract (see Section 6.3), in much the same way that the interest rate on fixed-rate mortgages varies between 15-, 25- and 30-year loans. Insurance vouchers could be provided to homeowners who cannot afford coverage if premiums reflect risk (*Principle 2*).

The obvious advantage of a long-term insurance contract from the point of view of policyholders is that it provides them with stability and an assurance that their property is protected for as long as they own it. This has been a major concern in hazard-prone areas where insurers have cancelled policies following severe disasters such as those that occurred during the 2005 hurricane season. With a long-term insurance policy in place, homeowners in hazard-prone areas would be protected following the next disaster, providing them with financial resources for recovery and reducing the need for liberal disaster assistance.

³⁸² This subsection is based on H. Kunreuther (2007), "Catastrophe Insurance: Challenges for the U.S. and Asia." Paper presented at 1st International Conference on Asian Catastrophe Insurance: Innovation and Management, Kyoto University, 3-4 December 2007; Kunreuther, H. (2008), "Flirting with Disaster," *Forbes*, (February 11).

³⁸³ The Philadelphia Contributionship and other perpetual insurance companies require a large fixed payment at the time that one purchases insurance. The interest earned on this "insurance investment" covers the annual premiums on the property. We thank Felix Kloman for calling attention to this type of long-term insurance relationship. Kloman has favored long-term commitments and partnerships between the insurer and insured for many years, having written columns on the topic in his publication, *Risk Management Reports* in September 1994 and October 1995.

Encouraging Adoption of Mitigation Measures

Long-term insurance also provides economic incentives for homeowners to invest in mitigation, whereas current annual insurance policies (even if they are risk-based) are unlikely to do so. To highlight this point, consider the following simple example in which we do not impose a loading factor when pricing insurance. Suppose a family could invest \$1,500 to strengthen the roof of its house so as to reduce the damage by \$30,000 from a future hurricane with an annual probability of 1 in 100. An insurer charging a risk-based premium would be willing to reduce the annual charge by \$300 (i.e., $1/100 \times \$30,000$) to reflect the lower expected losses that would occur if a hurricane hit the area in which the policyholder was residing. If the house was expected to last for 10 or more years, the net present value of the expected benefit of investing in this measure would exceed the upfront cost at an annual discount rate as high as 15 percent.

Under current annual insurance contracts, many property owners would be reluctant to incur the \$1,500 expenditure, because they would get only \$300 back next year and are likely to only consider the benefits over the next few years when making their decisions. If they underweight the future, the expected discounted benefits would likely be less than the \$1,500 upfront costs. In addition, budget constraints could discourage them from investing in the mitigation measure. Other considerations would also play a role in a family's decision not to invest in these measures. The family may not be clear how long they will reside in the house and/or whether their insurer would reward them again when their policy is renewed.

A 20-year required insurance policy ties the contract to the property rather than to the individual. In fact, the homeowner could take out a \$1,500 home improvement loan tied to the mortgage at an annual interest rate of 10 percent, resulting in payments of \$145 per year. If the insurance premium was reduced by \$300, the savings to the homeowner each year would be \$155. Alternatively, this loan could be incorporated as part of the mortgage at even a lower interest rate than 10 percent.

These mitigation loans would constitute a new financial product. A bank would have a financial incentive to provide this type of loan, since it is now better protected against a catastrophic loss to the property, and the insurer knows that its potential loss from a major disaster is reduced. Moreover, the general public will now be less likely to have large amounts of their tax dollars going for disaster relief. A win-win-win-win situation for all! (Kunreuther, 2006).³⁸⁴

There is an additional benefit to insurers in having banks encourage individuals to invest in cost-effective mitigation measures. The cost of reinsurance, which protects insurers against catastrophic losses, should now decrease. If reinsurers know that they are less likely to make large payments to insurers because each piece of property in a region now has a lower chance of experiencing a large loss, then they will reduce their premiums to the insurer for the same reason that the insurer is reducing its premium to the property owner.

³⁸⁴ Kunreuther, H. (2006), "Disaster Mitigation and Insurance: Learning from Katrina," *The Annals of the American Academy of Political and Social Science*, 604: 208-227.

Suppose that an insurer had 1,000 identical insurance policies in a particular area, and that each would expect to make claims payments of \$40,000 following a hurricane if homeowners had not strengthened their roofs. The insurer's loss from such a disaster would be \$40 million. Suppose also that the insurer would want to have \$25 million in coverage from a reinsurer to protect its surplus. If the hypothetical hurricane has a 1 in 100 chance of hitting the region where these families reside, the expected loss to a reinsurer would be \$250,000 and the premium charged to the insurer would reflect this. On the other hand, if the bank required that all 1,000 homes had their roofs mitigated to meet the local building code, and each homeowner's loss were reduced to \$10,000, then the insurer's total loss would be \$10 million should all 1,000 homes be affected, and it would **not** require reinsurance. This savings would be passed on by the insurer to the homeowner in the form of a lower premium.

Open Issues and Questions³⁸⁵

There are a number of issues and questions associated with the development of a long-term insurance policy which have a direct impact on insurers and homeowners, and indirect effects on other stakeholders, which require further research and analysis. Some of the issues that need to be resolved include:

Nature of the Contract. Long-term insurance could be offered by insurers in the form of a fixed-price contract (FPC) for the full term of the policy (e.g., 20 years) or an adjustable premium contract (APC) at a variable premium with guaranteed renewal for the term of the policy. The annual premium would be reset based on an index that would have to be simple and transparent. Policyholders will want the option to terminate the contract; mortgage markets provide examples of both good and bad practices. On FPCs, formal arrangements to make the insurer whole through provisions such as yield maintenance and defeasance (the two most common methods for dealing with prepayment costs on commercial mortgages) may be necessary.³⁸⁶ On APCs, the borrower would want the right to terminate the contract without cost within a certain time period of a premium increase notification (e.g., 3 months).³⁸⁷

Protection Against Catastrophic Losses. One would also need to know how the rating agencies will view long-term FPC commitments, since the insurer is now locked into the premium even if the expected losses rise. To protect itself against possible increases in the probability of catastrophic losses over time, insurers marketing FPCs would have to be able to invest in cat bonds or other forms of securitized risks. Some type of government guarantee might be necessary to deal with both insurers' and policyholders' concerns with respect to the ability to pay claims in the future following a catastrophic loss. As for the pricing of the product, FPC premiums would likely be somewhat higher than APC premiums to protect insurers against an increase in the risk during the contract period. This behavior would be similar to the pricing of fixed-rate mortgages relative to adjustable rate mortgages.

³⁸⁵ Portions of this subsection are based on interchanges with Dwight Jaffee at UC Berkeley on the challenges in implementing a long-term insurance policy tied to a mortgage (Personal correspondence, September 3, 2007 and September 27, 2007).

³⁸⁶ See <http://www.rivkinradler.com/rivkinradler/Publications/newformat/200302weissman.shtml> for additional details on these two contractual arrangements. For a fuller discussion of the defeasance option, see Dierker, M., D. Quan and W. Torous (2004), "Pricing the Defeasance Option in Securitized Commercial Mortgages."

³⁸⁷ Failure to require this condition has created major problems for subprime mortgages.

One of the central issues will be how high will the price of a long-term contract be, given the ambiguities associated with the risk and the capital costs for covering catastrophic losses. Without some type of protection against large losses either through long-term risk transfer instruments (which currently do not exist) and/or a government reinsurance program at the state or federal level, the premiums for FPCs are likely to be extremely high so that there would be little demand for this type of coverage.³⁸⁸

Understanding the Contract. Those who purchase insurance policies often have a difficult time understanding the terms of the contract – what risks are covered, what risks are not, and the basis for being charged a specific rate. The problem is likely to be compounded for a long-term insurance contract. There is an opportunity for insurers to educate consumers as to the basis for the premiums they charge by providing more detail on the types of risks that are covered and the amount charged for different levels of protection. More specifically, insurers could break down the premium into coverage against fire, theft, wind damage and other losses included in a homeowners policy, and how the premium varied with the length of the long-term contract. It would be very beneficial for insurers to reveal this information, so that homeowners will be able to make better decisions by understanding the nature of the contract and what alternative options cost them. They will then be able to make tradeoffs between costs and expected benefits – impossible for them to do today. Thaler and Sunstein (in press)³⁸⁹ argue for this type of information disclosure by proposing a form of government regulation termed RECAP (Record, Evaluate and Compare Alternative Prices). They recommend that the government not regulate prices but require disclosure practices – not in a long, unintelligible document, but in a spreadsheet-like format that includes all relevant formulas.

Institutional Details. Some of the open questions regarding institutional details which require further analysis and discussion with key stakeholders are:

- Under what circumstances could a property owner change his insurance policy over time?
- What role would the modeling companies and the scientific community studying climate science play in providing estimates for developing risk-based premiums and suggesting a rationale for changes over time as new risk models become available?
- How would insurers deal with significant changes in risk estimates over time?
- What types of risk transfer instruments would have to emerge from the reinsurance market as well as from the capital markets to protect insurers against catastrophic losses and changes in risk estimates over time?
- What role would the public sector play in providing protection against catastrophic losses?
- How concerned will consumers be at possible insolvency of insurers providing long-term contracts, and what steps should be taken to protect homeowners should this occur?

³⁸⁸ A related question is whether long-term contracts are immune to renegotiation when there are changes in the level of the perceived risks. What protection does the insurance and reinsurance industry have if one discovers that the dikes in New Orleans are not built to specification and companies have a large book of business in the area with rates fixed for the next 10 years? We appreciate Paul Kleindorfer raising this point. (Personal communication, November 21, 2007).

³⁸⁹ Thaler, R. and C. Sunstein, (in press) *Nudge: The Gentle Power of Choice Architecture*. New Haven: Yale University Press.

Whether long-term insurance will be attractive to insurers, homeowners, regulators and other relevant stakeholders is uncertain. What is clear today is that we need innovative programs for reducing future losses from disasters that involve the public and private sectors. For insurance to play an important role in this regard, one needs to understand what a policy can and cannot do as a function of the nature of the risk, the type of coverage provided by the insurer and the premium structure.

14.4. All-Hazards Insurance³⁹⁰

The long-term contract addresses the issue of time diversification. Another proposed program to consider is all-hazards insurance. Current insurance programs for residents in hazard-prone areas are segmented across perils. Standard homeowners and commercial insurance policies, normally required as a condition for a mortgage, cover damage from fire, wind, hail, lightning, winter storms and volcanic eruption. Earthquake insurance can be purchased for an additional premium. Flood insurance is offered through the National Flood Insurance Program.

Features of the Program

An all-hazards insurance policy, if developed, should adhere to the two principles of rates reflecting risk and affordability, discussed in Section 14.2. The idea of an insurance program where all natural disasters are covered by a single policy has been adopted in other countries. In 1954, Spain formed a public corporation, the Consorcio de Compensación de Seguros that today provides mandatory insurance for so-called “extraordinary risks,” including natural disasters and political and social events such as terrorism, riots and civil commotion. Such coverage is an add-on to property insurance policies that are marketed by the private sector. The Consorcio pays claims only if the loss is not covered by private insurance, if low-income families did not buy insurance and/or the insurance company fails to pay because it becomes insolvent. The government collects the premiums and private insurers market the policies and handle claims settlements (Freeman and Scott, 2005).³⁹¹

In France, a mandatory homeowners policy covers a number of different natural disasters, along with terrorism risk. The main difference comes at the reinsurance level, which is partially provided by a publicly-owned reinsurer, the Caisse Centrale de Reassurance, for flood, earthquakes, and droughts, and by an insurance pool, Gareat, with unlimited government guarantee for terrorism. There is no public reinsurance for storms (Michel-Kerjan and de Marcellis-Warin, 2006).³⁹²

³⁹⁰ This section draws on Kunreuther, H. (2007), “Reflections on U.S. Disaster Insurance Policy for the 21st Century,” in Quigley, J. and L. Rosenthal, (eds.), *Risking House and Home: Disasters, Cities, Public Policy*, Berkeley: Berkeley Public Policy Press.

³⁹¹ Freeman, P. and K. Scott (2005), “Comparative Analysis of Large Scale Catastrophe Compensation Schemes,” in *Catastrophic Risks and Insurance*, Paris: Organization for Economic Cooperation and Development (OECD), July.

³⁹² Michel-Kerjan, E. and N. de Marcellis-Warin (2006), “Public-Private Programs for Covering Extreme Events: The Impact of Information Distribution on Risk-Sharing,” *Asia-Pacific Journal of Risk and Insurance*, 1(2): 21-49.

Advantages of All-Hazards Insurance

Consider an insurer who wishes to market homeowners coverage in different parts of the country. With risk-based rates, it would collect premiums that reflect the earthquake risk in California, hurricane risk on the Gulf Coast, tornado damage in the Great Plains states, and flood risk in the Mississippi Valley. Each of these disaster risks is independent of the others. This higher premium base and the diversification of risk across many hazards reduce the likelihood that the insurer would suffer a loss that exceeds its surplus in any given year for a given book of business.

An all-hazards homeowners policy should also be attractive to both insurers and policyholders in hurricane-prone areas, because it avoids the costly process of having an adjuster determine whether the damage was caused by wind (today, covered by private insurers and state-run companies in certain states) or water (today, covered by the National Flood Insurance Program). As noted in Chapter 2, this problem of differentiating wind damage from water damage was a particularly challenging one following Hurricane Katrina. Across large portions of the coast, all that remained of demolished buildings were foundations and steps, making it difficult to determine the cause of damage. In these cases, insurers may decide to pay the coverage limits rather than incurring litigation costs to determine whether the damage came from water or wind. For a house still standing, this process is somewhat easier since one knows, for example, that roof destruction is likely to be caused by the wind, and water marks in the living room are signs of flooding (Towers Perrin, 2005).³⁹³

An all-hazards policy would also deal with the problem that insurers currently face with respect to fire damage caused by earthquakes. Even if a homeowner has not purchased an earthquake insurance policy, it will be able to collect reimbursements for damages from a fire caused by an earthquake. In the case of the 1906 San Francisco earthquake, most of the damage was caused by fire, and insurers were obligated to cover these losses. In this sense, homeowners insurance actually covers a portion of earthquake losses even though this coverage is excluded from the policy.

Another reason for having an insurance policy that covers all hazards is that there will be no ambiguity by the homeowner as to whether or not she has coverage. Many residing in the Gulf Coast believed they were covered for water damage from hurricanes by their homeowners policies. The attractiveness of insurance that guarantees that the policyholder will have coverage against all losses from disasters independent of cause has been demonstrated experimentally by Kahneman and Tversky (1979).³⁹⁴ They showed that 80 percent of their responders preferred such coverage to what they termed “probabilistic insurance,” where there was some chance that a loss was not covered. What matters to an individual is the knowledge that she will be covered if her property is damaged or destroyed, not the cause of the loss.

³⁹³Towers Perrin (2005), “Hurricane Katrina: Analysis of the Impact on the Insurance Industry.” http://www.towersperrin.com/tillinghast/publications/reports/Hurricane_Katrina/katrina.pdf

³⁹⁴Kahneman, D. and A. Tversky (1979), “Prospect theory: An analysis of decision under risk,” *Econometrica*, 47(2): 263-291.

Another advantage of all-hazards homeowners insurance is that it may address some of the issues that currently plague the National Flood Insurance Program (NFIP). As noted recently by the U.S. Government Accountability Office, only half of the properties eligible for flood insurance are covered by it. Furthermore, a number of properties that suffered water damage from Hurricane Katrina were not eligible to purchase flood insurance under the NFIP. Those who did have flood insurance and suffered large losses from the rising waters were able to cover only a portion of their losses, because the maximum coverage limit for flood insurance under the NFIP is \$250,000 on building property and \$100,000 on personal property.

Naturally, an all-hazards insurance policy will be more expensive than the standard homeowners policy because it is more comprehensive. If premiums are based on risk, however, then policyholders would be charged only for hazards that they face. Thus, a homeowner in the Gulf Coast would theoretically be covered for earthquake damage but would not be charged anything for this additional protection if the area in which she resides is not a seismically active area. In promoting this all-hazard coverage, one needs to highlight this point to the general public, who may otherwise feel that they are paying for risks that they do not face.

Disadvantages of All-Hazards Insurance

The major disadvantage of an all-hazards insurance program with premiums reflecting risk (*Principle 1*) is that it will force insurers to raise their prices considerably to cover the potential damage in hazard-prone areas. A large increase in premium could be viewed by homeowners as unjustified and there would be significant resistance to paying for this coverage. For high-income residents who have second homes on the coast, there is an economic rationale for them to pay the cost of their insurance. For lower-income residents, some type of insurance voucher may have to be provided so that these homeowners can afford coverage (*Principle 2*).

Many insurers are likely to resist all-hazards insurance because they may fear the possibility of even larger losses than they have suffered to date, due to the increase of their exposure. Some rightly note that if both wind and water damage were to be included in homeowners policies, the losses from Hurricane Katrina to private insurers would be considerably higher. Other might argue that insurers would have also collected more premiums over the years. To assume the additional risk, there would be a need for a substantial increase in insurers' surplus and/or increased capacity through reinsurance, insurance-linked securities, state funds or federal reinsurance.

There will also be special needs facing small insurers operating in a single state who have smaller surplus than larger firms and are limited in their ability to diversify their risk. These insurers may find that the variance in their losses increases by incorporating the flood and earthquake risks as part of a homeowners policy. For example, a Louisiana insurance company providing protection against hurricane damage might find the variance in losses to be higher than it is today if both wind and water damage were covered under a homeowners policy. For these companies to compete with larger firms, they would have to be able to protect themselves against catastrophic losses through either private- or public-based risk transfer instruments that would not price them out of the market.

Insurers who market an all-hazards insurance policy face an additional challenge in trying to convince homeowners that they will pay only for risks that they actually face. As mentioned above, one way for insurance companies to do this is to itemize the cost of different types of coverage on the policy itself in much the way current homeowners or automobile insurance breaks up the cost for different types of protection. If a family living on the Gulf Coast knew that it would be paying \$3,000 for wind coverage, \$1,500 for water coverage, \$500 for fire coverage and \$0 for earthquake coverage, it would not complain about covering damage from seismic risk facing California homeowners. Such an itemized list of coverage would also highlight the magnitude of risks of living in that particular area, another role that insurance can play – a signal as to how hazardous a particular place is likely to be.

We now turn to three other proposals that have been advocated recently to address the issue of financing catastrophic losses from natural disasters: a federally-regulated Coastal Hurricane Zone, and a national catastrophe fund. We describe these two concepts without making any judgment as to their economic effectiveness, equitability and feasibility, since this would require a series of in-depth analyses that go beyond the scope of the present report.

14.5. Creation of a Coastal Hurricane Zone³⁹⁵

One way to address the challenge of lack of liquidity to cover catastrophic losses from hurricanes is to establish a multi-state zone in which risks are diversified and the market regulated at a federal level. Travelers Companies recently proposed the creation of a federally-regulated *Coastal Hurricane Zone* from Texas to Maine. Private insurers would still market policies covering wind damage from hurricanes, and the federal government would regulate and oversee most aspects of wind underwriting by private insurers including pricing.

The rationale for this proposal is that the current system, wherein each state regulates and oversees its own insurance market, has led to regulatory inconsistency and unpredictability with respect to rates for insurers and customers alike following major hurricanes. A properly designed and executed Coastal Hurricane Zone would provide a more stable set of rules that would allow insurers to make long-term commitments of capital to those areas for wind risks, increasing the availability of insurance. Federal oversight would ensure that rates are actuarially sound, so that premiums reflect the risk (*Principle 1*). States would continue their regulatory oversight, including monitoring insurer insolvency and administering markets of last resort (i.e., residual markets).

Beyond this regulatory innovation, the proposed Coastal Hurricane Zone would also include a mechanism to equitably adjust premiums after periods of significant weather-related profits or losses. If actual hurricane-related damage and loss over a predefined multi-year period were less than anticipated, a portion of premiums would be returned to the policyholders; if actual losses were more than anticipated, the price of insurance would be increased so that policyholders' rates were actuarially fair. A rolling five- or ten-year time period might be appropriate for determining whether a portion of insurer profits would be returned or an assessment be made, thus constituting a type of mutual organization.

³⁹⁵ This section is based on Fishman, J. (2007), "Something's Gotta Give: A private market-based hurricane wind concept," Paper presented at the American Risk and Insurance Association Annual Meeting, August 6th, Quebec City, Canada. The basic concepts also appeared in Fishman, J. (2007), "Before the Next 'Big One' Hits," *Wall Street Journal*, August 27. Jay Fishman is CEO of Travelers Companies.

To deal with affordability problems (*Principle 2*), temporary federal tax credits would be offered to low-income residents with homes along the Atlantic and Gulf Coasts to purchase insurance to cover their wind exposure. The tax credit would be based upon need (as determined by income and asset level), property value and cost of wind insurance. The tax credits would be funded by increases in taxes of those residing in the Coastal Hurricane Zone who can afford it.

To reduce losses from inevitable hurricanes, federal, state and local governments have another critical role to play in promoting risk-mitigation programs. Foremost in this regard is the adoption and enforcement of similar multi-state building codes for both new construction and renovations. The use of storm shutters and impact-resistant windows should be encouraged through economic incentives. Coastal states would be entitled to federal grants if they adopt a proposed federal building code and related mitigation measures. Other loss-mitigation plans include prudent land use management, such as acknowledging the importance of coastal wetlands in minimizing a hurricane's impact upon landfall.

14.6. National Catastrophe Fund³⁹⁶

ProtectingAmerica.org, a national coalition of emergency management officials, first responders, disaster relief agencies, non-profits, businesses and insurers created in 2005, has proposed a national catastrophe fund to serve as a financial backstop for state catastrophe funds, and augments capacity provided by private reinsurance. The elements of the plan are as follows: A portion of private insurance company revenues would be deposited into the national catastrophe fund, which would provide reinsurance to state catastrophe funds for losses above a specified amount. The fund would be self-supporting except for \$10 million in start-up costs. The U.S. Treasury Department would administer the fund and protect it from being raided for other purposes. The fund would be operated on a tax-exempt, not-for-profit basis. Premiums would be set on an actuarially sound basis to ensure that rates reflect the risk that consumers face and to avoid subsidization of consumers in high-risk areas by consumers in lower-risk areas (*Principle 1*). State catastrophe funds that purchase reinsurance from the national fund would be required to set aside up to 35 percent of investment income from the state fund for prevention, mitigation and public education programs.

Private insurance companies would be required to meet all their obligations before utilizing the state catastrophe fund to pay claims. The state catastrophe fund would discharge its financial obligations before the national fund is accessed. This guarantees that the national fund covers only losses from mega-catastrophes that cause damage of such magnitude that private insurers and state catastrophe plans are at significant risk of financial collapse. Since the national catastrophe fund would be exempt from taxation, it could charge lower rates than the private market and pass those savings to consumers.

This proposal also raises important questions: What would be the impact of such a mechanism on the reinsurance markets and the future development of insurance-linked securities? Would the U.S. Treasury be financially responsible for claims that might arise from truly extreme events in the first years of the operation of the fund, which would then not have

³⁹⁶ More details on the National Catastrophe Fund can be found at http://www.protectingamerica.org/pdf/WhitePaper_US.pdf, as of September 2007.

enough reserve to pay for it? Perhaps most importantly, the question central to the implementation of the program is what should be the threshold at which such a national fund is triggered? A \$25 billion threshold is rather different than one at \$100 billion or \$200 billion.

14.7. Auctions for Federal Reinsurance Contracts

In the aftermath of Hurricane Andrew in 1992 and the Northridge earthquake in 1994, Lewis and Murdock (1996)³⁹⁷ developed a proposal that the federal government offer catastrophe reinsurance contracts that would be auctioned annually in order to provide the private sector with more capacity to handle truly extreme events. The U.S. Treasury Department would auction a limited number of contracts indexed on the aggregate direct insured losses occurring as a result of a catastrophic natural disaster. Originally, they proposed contracts covering losses between \$25 billion and \$50 billion but then modified this so that private insurers, reinsurers and/or state pools could select any trigger level that did not crowd out coverage available in the private market.³⁹⁸ The design of such contracts would have to be specified, and a more detailed analysis would have to be undertaken to determine the potential impact of such an auction mechanism on the relevant stakeholders.

14.8. Making Insurance-Linked Securities a More Liquid Market

Since finding a way to cover losses from truly cataclysmic events is of major concern, the development of new types of insurance-linked securities is worth pursuing. Chapter 8 discusses current instruments and proposes innovations to transfer additional exposure to financial markets so that a more liquid market for providing protection against catastrophic losses can be created. It is very likely that none of these proposals will work alone. Rather, one should aim at developing a combination of them to align with the policy goals and key principles that we, as a society, stand for.

14.9. Creation of a Data Collection and Information Sharing Entity

Another innovation to consider is that one develops more granular data collection on insurance coverage and claims payment over time: the evolution of different lines of coverage in specific locations. With the increased population in coastal regions, we need to better understand and quantify who has insurance coverage and the amount of protection they have. We propose the creation of a data collection entity to determine the degree of insurance penetration in different parts of the country. The implementation of this concept could be achieved at a very small cost via the Internal Revenue Service (IRS), with homeowners answering a few questions about their property insurance coverage for flood, earthquake and wind on their annual tax returns. The IRS could collect this information and make it available on an aggregate level (e.g., postal zone) so that individuals cannot be identified. By providing more detailed data on the degree of insurance protection of homeowners, it should be possible to develop strategies for reducing losses and aiding recovery from future natural disasters.

³⁹⁷ Lewis, C. and L. Murdock (1996), "The role of government contracts in discretionary reinsurance markets for natural disasters," *Journal of Risk and Insurance*, 63: 567-597.

³⁹⁸ Cummins, J.D., Lewis, C. and Phillips, R. (1999), "Pricing Excess-of-Loss Reinsurance Contracts against Catastrophe Loss" Chap. 3 in Froot, K. (ed.) *The Financing of Catastrophe Risk*. Chicago: University of Chicago.

14.10. A View from the Hill: Proposed Congressional Legislation

In this final section we discuss two pending bills facing Congress today and consider a set of questions raised by the current forms of the bills.

The Homeowners' Defense Act of 2007 (H.R. 3355)

Nature of the Bill. On November 8, 2007 the House passed H.R. 3355, the "Homeowners Defense Act of 2007." If enacted, H.R. 3355 would establish a non-profit Consortium as a federal-state pool to encourage state programs such as the Florida Hurricane Catastrophe Fund to pool their catastrophic risk with one another and move toward broader utilization of private capital through risk transfer mechanisms, such as cat bonds, for catastrophic losses. It also creates a federal loan program to provide funds to state reinsurance programs both prior to a disaster (liquidity loans) and after a disaster (catastrophic loans). It would also create the Federal Natural Catastrophe Reinsurance Fund that would protect private and state reinsurers against natural disasters that have a probability of occurrence of 0.5 percent (1-in-200 year return) or lower. The total liability of the federal government from this fund would be capped at \$200 billion.

Questions for Discussion. The following questions may be appropriate ones to address in evaluating the proposed legislation:

- What economic analysis is this proposal based upon?
- How well does the proposed legislation conform to the principle of premiums reflecting risk (*Principle 1*)?
- How will the proposed legislation deal with the equity and affordability issues (*Principle 2*)?
- To what extent does the program encourage further displacement of the private insurance for homeowners coverage by the state? Is this increased public sector involvement in providing insurance viewed as desirable, and if so, why?
- How will different states feel about joining a consortium, given their current insurance arrangements? For example, would a state like South Carolina be comfortable in a consortium that includes Florida?
- What type of leverage would a consortium have to generate interest by private investors in funding cat bonds in ways that differ from current arrangements with insurers and reinsurers?
- What are the costs and benefits to state reinsurance programs prior to a disaster?
- Should states be subsidized by the federal government for providing protection against catastrophic losses?
- To what extent would the bill encourage the creation of additional catastrophe funds, and what public policy is served by any such expansion?
- Does it make sense to finance predictable risks such as hurricane losses through debt schemes rather than by holding capital?

- Would the consortium provide a more effective or efficient means of obtaining cat bonds than the private sector does? Would capital market investors look at these instruments differently from the way they look at private sector bonds today, and if so, how?
- What would be the impact of the Federal Natural Catastrophe Reinsurance Fund on the private reinsurance market?
- What would be the cost of the Federal Natural Catastrophe Reinsurance Fund to the general taxpayer?

Flood Insurance Reform and Modernization Act of 2007 (H.R. 3121)

Nature of the Bill. The “Flood Insurance Reform and Modernization Act of 2007” (H.R. 3121) legislation passed the House on September 27, 2007. If enacted, it would expand the scope of the National Flood Insurance Program (NFIP) to offer windstorm coverage so that the insurer and policyholder would not be required to differentiate between damage that was caused by wind and damage that caused by flooding. Premiums would be set at “actuarial rates” with maximum policy limits of \$500,000 per residential dwelling unit and \$1 million for commercial structures. The insurance policies could not be provided to any property that is in violation of state or local laws intended to reduce damage caused by windstorms or floods. Beginning in 2011, subsidized rates would not be continued for properties with pre-1975 construction starts. The penalties for federally insured lenders who do not ensure that property in flood-prone areas is insured are increased from \$350 to \$2,000 per violation.

Questions for Discussion. The following questions may be appropriate to address in evaluating the proposed legislation:

- What economic analysis is this proposal based on?
- How well does the proposed legislation conform to the principle of premiums reflecting risk (*Principle 1*)?
- How will the proposed legislation deal with the equity and affordability issues (*Principle 2*)?
- Is it more efficient for wind coverage to be incorporated in the NFIP program than to be marketed by private insurers?
- What is the nature of the deficit that the expanded program will incur following future catastrophic hurricanes?
- What impact would the bill have on market penetration of wind coverage if it was included as part of the NFIP?
- Would the legislation encourage the purchase of NFIP flood coverage by more homeowners?
- Does the bill do anything to facilitate “wind vs. water” dispute resolution for policyholders who purchase homeowners insurance but not flood insurance?
- What impact will inclusion of wind business currently written by state programs (e.g., Citizens, and the Texas Windstorm Insurance Association) have on the ability of the NFIP to pay claims?
- Would it be more feasible to give private insurers the option to include NFIP flood coverage within their homeowners insurance?

- NFIP deficits are funded by the U.S. taxpayer. Is windstorm risk more appropriately allocated to the homeowners and businesses that choose to build in hurricane-prone areas?
- Is the federal government, with its ability to borrow and tax post-event, a more efficient vehicle for financing catastrophic risks from natural disasters than the free market which pays investors to allocate capital to insurance companies?

14.11. Moving Forward

As this report is being written, it is difficult to predict the legislative path that will be taken by Congress regarding the future of natural disaster insurance and mitigation in the United States. Decisions by Congress and other legislative bodies should be based on a sound conceptual framework and well-documented empirical analyses. This report is written with these two criteria in mind. We believe that it provides ingredients for evaluating alternative insurance and mitigation programs for reducing future disaster losses.

During the coming months we look forward to interacting with the key stakeholders to evaluate alternative proposals for managing future natural disasters. We believe that the United States will then be better equipped to decide on and implement well-designed programs for managing large-scale risks in a new era of catastrophes.

SUMMARY OF CHAPTER 14

This concluding chapter examines strategies for satisfying two complementary objectives: providing financial protection to homeowners in hurricane-prone areas through insurance, and reducing losses through cost-effective mitigation measures. Two principles should guide the policy debate as to what should constitute a sustainable efficient and equitable solution for managing and financing large-scale risks of natural disasters in the United States. They are:

Principle 1 – Premiums Reflecting Risk: Insurance premiums should be based on risk to provide signals to individuals as to the hazards they face and to encourage them to engage in cost-effective mitigation measures to reduce their vulnerability to catastrophes.

Principle 2 – Dealing with Equity and Affordability Issues: Any special treatment given to homeowners currently residing in hazard-prone areas (e.g., low-income uninsured or inadequately insured homeowners) should come from general public funding and not through insurance premium subsidies.

To enable insurers to charge premiums reflecting risk, regulators should **not** be involved in matters pertaining to rate-setting. To deal with issues of equity and affordability, we recommend that some type of insurance voucher be provided by the state or federal government. Funding for these vouchers could come from the general taxpayer, taxes paid by residents and/or commercial enterprises in states exposed to natural disasters, or insurance policyholders.

Based on the above two principles, several insurance programs are proposed that involve both the private and public sectors: long-term homeowners insurance; all-hazards insurance; creation of a Coastal Hurricane Zone; a national catastrophe fund; auctions for federal reinsurance contracts; making insurance-linked securities a more liquid market; and the creation of a data collection and information sharing entity. The chapter concludes with a summary of two bills on disaster insurance that are being considered by the U.S. Congress and raises a set of questions for evaluating them.

About the Authors

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Howard Kunreuther is the Cecilia Yen Koo Professor of Decision Sciences and Public Policy at the Wharton School, and Co-Director, Risk Management and Decision Processes Center.

He has a long-standing interest in ways that society can better manage low-probability/high-consequence events related to technological and natural hazards and has published extensively on the topic. He is a member of the OECD's High Level Advisory Board on Financial Management of Large-Scale Catastrophes; a Fellow of the American Association for the Advancement of Science (AAAS); a member of the National Earthquake Hazards Reduction Program's Advisory Committee on Earthquake Hazards Reduction; Distinguished Fellow of the Society for Risk Analysis, receiving the Society's Distinguished Achievement Award in 2001.

Dr. Kunreuther has written and co-edited numerous books and papers, including *On Risk and Disaster: Lessons from Hurricane Katrina*, (with Ronald J. Daniels and Donald F. Kettl; 2006), *Catastrophe Modeling: A New Approach to Managing Risks* (with Patricia Grossi; 2005), and *Paying The Price: The State of Natural Disaster Insurance in the United States* (with John Roth, Sr.; 1998). He is the recipient of the Elizur Wright Award for the publication that makes the most significant contribution to the literature of insurance. He received his Ph.D. in Economics from the Massachusetts Institute of Technology.



Erwann Michel-Kerjan is Managing Director of the Wharton Risk Management and Decision Processes Center at the Wharton School, where he also teaches *Value Creation* in the Wharton MBA program.

His work focuses on developing strategies and policies for managing and financing extreme events, primarily natural disasters and mega-terrorism, optimal catastrophe risk sharing in public-private partnerships, climate change, the economics of national security, energy interdependence and non-proliferation. His work also includes projects on critical services protection in collaboration with the defense industry and federal agencies. He has consulted with companies, governments and international organizations, and he is a founding member of the High Level Advisory Board on Financial Management of Large-Scale Catastrophes recently established by the Secretary General of the OECD (30 richest countries).

He has studied at or collaborated with McGill, Columbia and Harvard, and joined Wharton in 2002 after he completed his doctoral studies in economics and mathematics at the Ecole Polytechnique in Paris (at age 26).

Dr. Michel-Kerjan has authored or co-authored more than 40 publications at the crux of financial management and global risk governance, and his views regularly appear in leading media. His first book, *Treatise on New Risks* (with O. Godard, C. Henry and P. Lagadec), was published by Gallimard in 2002. From 2003 to 2005 he served on the OECD Task Force on Terrorism Insurance which published *Terrorism Insurance in OECD Countries* in July 2005, and in 2005 he co-led, with Howard Kunreuther, the Wharton initiative *TRIA and Beyond* on the future of terrorism risk financing in the United States. His most recent book, *Seeds of Disaster, Roots of Response: How Private Action Can Reduce Public Vulnerability* (with P. Auerswald, L. Branscomb and T. LaPorte, Harvard/George Mason University), is the first attempt to analyze the private efficiency-public vulnerability tradeoff in the context of extreme event management (Cambridge University Press, 2006; www.SeedsofDisaster.com).

In 2007, Dr. Michel-Kerjan was named a Young Global Leader by the World Economic Forum (Davos), a five-year nomination bestowed to recognize and acknowledge the most extraordinary leaders of the world under the age of 40.

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A principal area of interest is in corporate risk management focusing on the financial strategies for managing risks that traditionally have been insurable. Such strategies include the use of existing derivatives, the design of new financial products and the use of capital structure. Dr. Doherty has written three books in this area, including *Corporate Risk Management: A Financial Exposition*, 1985; *The Financial Theory of Insurance Pricing*, 1987 (with S. D'Arcy); and *Integrated Risk Management*, 2000. Dr. Doherty is also interested in the economics of risk and information and has written papers on adverse selection, the value of information, and the design of insurance contracts with imperfect information and related issues. These papers have appeared in the *Journal of Risk and Insurance*, *Journal of Political Economy*, *Quarterly Journal of Economics*, *Journal of Public Economics*, *Journal of Finance*, and *Journal of Risk and Uncertainty*, among others. He is the co-author of *Managerial Economics* (2003, with B. Allen and K. Weigelt).

In 2005, Dr. Doherty coauthored two reports on the insurance industry. The first, *The Economics of Insurance Intermediaries* provided an economic analysis of some of the issues raised by Elliot Spitzer's investigation into broker compensation and bidding for insurance. The second, *TRIA and Beyond*, as part of the Wharton Risk Center's Managing and Financing Extreme Events project, provided an economic analysis of terrorism insurance and the public policy option facing the government with the expiration of TRIA.



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Dr. Grace's research has been published in various journals in economics and insurance concerning the economics and public policy aspects of insurance regulation and taxation, with a focus on industrial organization and econometrics. In particular, Dr. Grace has undertaken various studies of the efficiency of insurance firms, insurance taxation, optimal regulation of insurance in a federal system, and solvency regulation. His latest book is *Regulation, Pricing and Demand in Catastrophe Insurance Markets* (with Robert Klein, Paul Kleindorfer, and Michael R. Murray, 2003).

Dr. Grace is a former President of The Risk Theory Society and he is a current associate editor of the *Journal of Risk and Insurance*. He earned both a Ph.D. in economics and a J.D. from the University of Florida in 1987.



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He has written numerous articles, books and monographs on various topics in insurance and its regulation, including the structure and performance of insurance markets, insurance regulation and public policy, and the political economy of risk and insurance. His research has encompassed many areas of insurance and its regulation, including catastrophe risk and associated issues for insurance markets and public policy. Dr. Klein also has testified frequently at legislative and regulatory hearings on significant issues affecting insurance consumers and the industry.

Prior to joining Georgia State University in September 1996, Dr. Klein was the Director of Research and Chief Economist for the National Association of Insurance Commissioners. He also has served as staff economist for the insurance department and state legislature in Michigan. He has a B.A. (1976), M.A. (1982) and Ph.D. (1986) in economics from Michigan State University. Dr. Klein is a Sloan Fellow at the Financial Institutions Center at the Wharton School of Business. He has served on the Board of Directors for the American Risk and Insurance Association and currently serves on the editorial boards for the *Journal of Insurance Regulation and Risk Management and Insurance Review*.



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Dr. Pauly is a former commissioner on the Physician Payment Review Commission and an active member of the Institute of Medicine. One of the nation's leading health economists, Dr. Pauly has made significant contributions to the fields of medical economics and health insurance. His classic study on the economics of moral hazard was the first to point out how health insurance coverage may affect patients' use of medical services. Subsequent work, both theoretical and empirical, has explored the impact of conventional insurance coverage on preventive care, on outpatient care, and on prescription drug use in managed care.

Dr. Pauly is a co-editor-in-chief of the *International Journal of Health Care Finance and Economics* and an associate editor of the *Journal of Risk and Uncertainty*. He has served on Institute of Medicine panels on public accountability for health insurers under Medicare, and on improving the financing of vaccines. Dr. Pauly is a former member of the advisory committee to the Agency for Health Care Research and Quality, and most recently a member of the Medicare Technical Advisory Panel.

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Dr. Hartwig previously served as director of economic research and senior economist with the National Council on Compensation Insurance (NCCI) in Boca Raton, Florida, where he performed rate of return and cost of capital modeling and testified at workers' compensation rate hearings in many states. He has also worked as senior economist for the Swiss Reinsurance Group in New York and as senior statistician for the United States Consumer Product Safety Commission in Washington, DC. In 2005 and 2006 Dr. Hartwig served on the state of Florida's Task Force for Long-Term Homeowners Insurance Solutions.

Dr. Hartwig received his Ph.D. and M.S. degrees in economics from the University of Illinois at Urbana-Champaign. He received a B.A. in economics cum laude from the University of Massachusetts at Amherst and he also holds the Chartered Property Casualty Underwriter (CPCU) credential.



Paul Kleindorfer is the Anheuser Busch Professor of Management Science (Emeritus) at the Wharton School of the University of Pennsylvania and Distinguished Research Professor at INSEAD, France. Dr. Kleindorfer has held university appointments at Carnegie Mellon University, Massachusetts Institute of Technology, the Wharton School, and several and international research institutes. Until 2005, he was the co-director of the Wharton Risk Management and Decision Processes Center, which he

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A world leading expert in global supply chain security, Dr. Kleindorfer's current research is focused on risk management, with emphasis on environmental management and on natural hazards and security risks. His most recent books include *Liberalization of the Postal and Delivery Sector* (with M. Crew, 2007), *Pricing and Demand in Catastrophe Insurance Markets*, (with M. Grace and M. Murray, 2003), and *Decision Sciences: An Integrative Perspective* (with H. Kunreuther and P. Schoemaker, 1993). He has consulted with companies and governmental agencies worldwide on risk management and restructuring in such sectors as postal service, chemical manufacturing and energy.

Dr. Kleindorfer holds several editorial and professional positions, including being current president of the Society for Economic Design. He graduated with distinction from the U.S. Naval Academy in 1961. He studied on a Fulbright Fellowship in Mathematics at the University of Tübingen, Germany (1964/65), followed by doctoral studies in the Graduate School of Industrial Administration at Carnegie Mellon University (Ph.D., 1970).



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In 1998, President William J. Clinton nominated and the Senate confirmed Dr. Rosenthal to serve a five-year term on the U.S. Chemical Safety and Hazards Investigation Board. From 2005 to 2007, Dr. Rosenthal served on the British Petroleum investigation 11-member panel chaired by former Secretary of State James A. Baker, III.

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