

At War with the Weather and Other Extreme Events

Managing Large-Scale Risks in a New Era of Catastrophes

Howard C. Kunreuther

kunreuther@wharton.upenn.edu

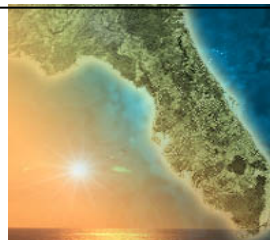
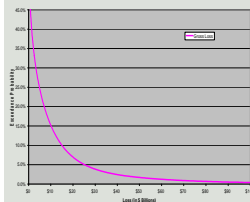
Joint Research with

Neil Doherty, Martin Grace, Robert Klein, Erwann Michel-Kerjan and Mark Pauly

Operations and Information Management (OPIM) Dept.
Risk Management and Decision Processes Center
The Wharton School, University of Pennsylvania

London School of Economics

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Outline of Talk

- 1. A New Era of Catastrophes**
- 2. Guiding Principles for Developing Risk Management Strategies**
- 3. Benefits of Mitigation/Adaptation Measures**
- 4. Need for Long-Term Insurance (LTI)**
- 5. Encouraging Mitigation/Adaptation through Long-Term Flood Insurance**
- 6. Impact of Climate Change on LTI**
- 7. Open Questions for Designing LTI Contracts**
- 8. Summary**

1. A New Era of Catastrophes

A radical change in the scale and rhythm of catastrophes

Natural disasters have caused severe insured losses to property in recent years

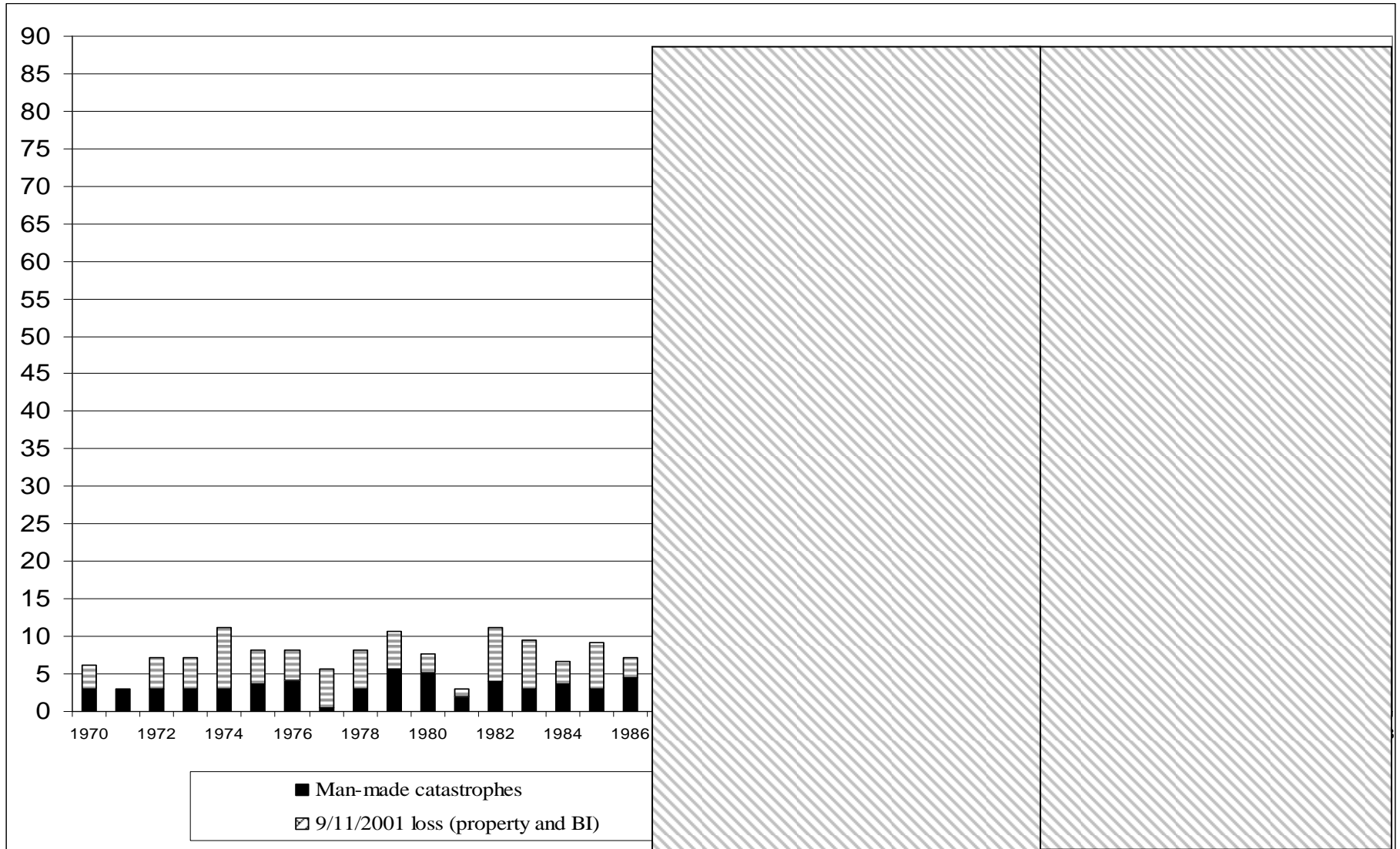
- Hurricane Katrina: \$46.3 billion
- Hurricane Andrew: \$23.2 billion (2005 dollars)
- Hurricane Ike: \$16 billion

Victims complain about receiving substantially less than the actual costs to repair or rebuild their damaged structures

Public sector and international organizations (e.g. World Bank) are committed to providing financial assistance to aid the victims of disasters



Worldwide Evolution of Catastrophe Insured Losses, 1970-2008



(Property and business interruption (BI); in U.S.\$ billion indexed to 2007, except 2008 which is current)

Sources: Kunreuther and Michel-Kerjan, *At War with the Weather* (2009) - data from Swiss Re and Insurance Information Institute

The 25 Most Costly Catastrophe Insurance Losses, 1970-2008

(17 here in in the US, 12 of these since 2001)

\$ Billion	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
16.0	Hurricane Ike *	348	2008	USA, Caribbean, et al.
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
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
5.0	Hurricane Gustav *		2008	USA, Caribbean, et al.
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.
3.9	Typhoon Songda	45	2004	Japan, South Korea
3.6	Thunderstorms *	45	2003	USA
3.5	Hurricane Floyd	70	1999	USA, Bahamas, Columbia

What's Happening?

The Question of Attribution

Higher degree of urbanization

Huge increase in the value at risk

Population of Florida

2.8 million inhabitants in 1950 - 6.8 million in 1970 - 13 million in 1990
19.3 million population in 2010 (590% increase since 1950)

Cost of Hurricane Andrew in 2004 would have been \$120bn

Weather patterns

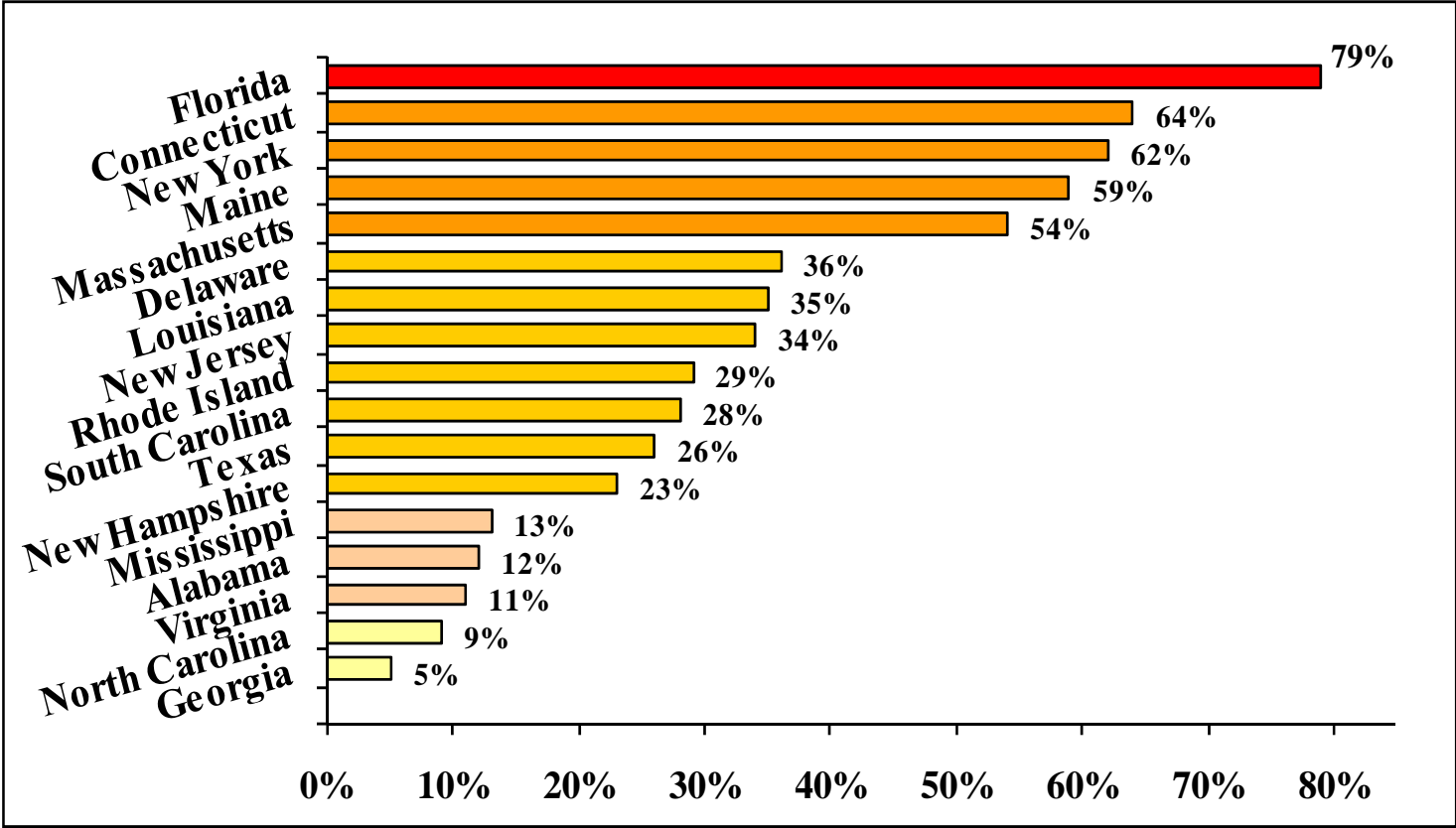
Changes in climate conditions and/or return to a high hurricane cycle?

More intense weather-related events coupled with increased value at risk will cost more, much more.

What Will 2010 Bring?



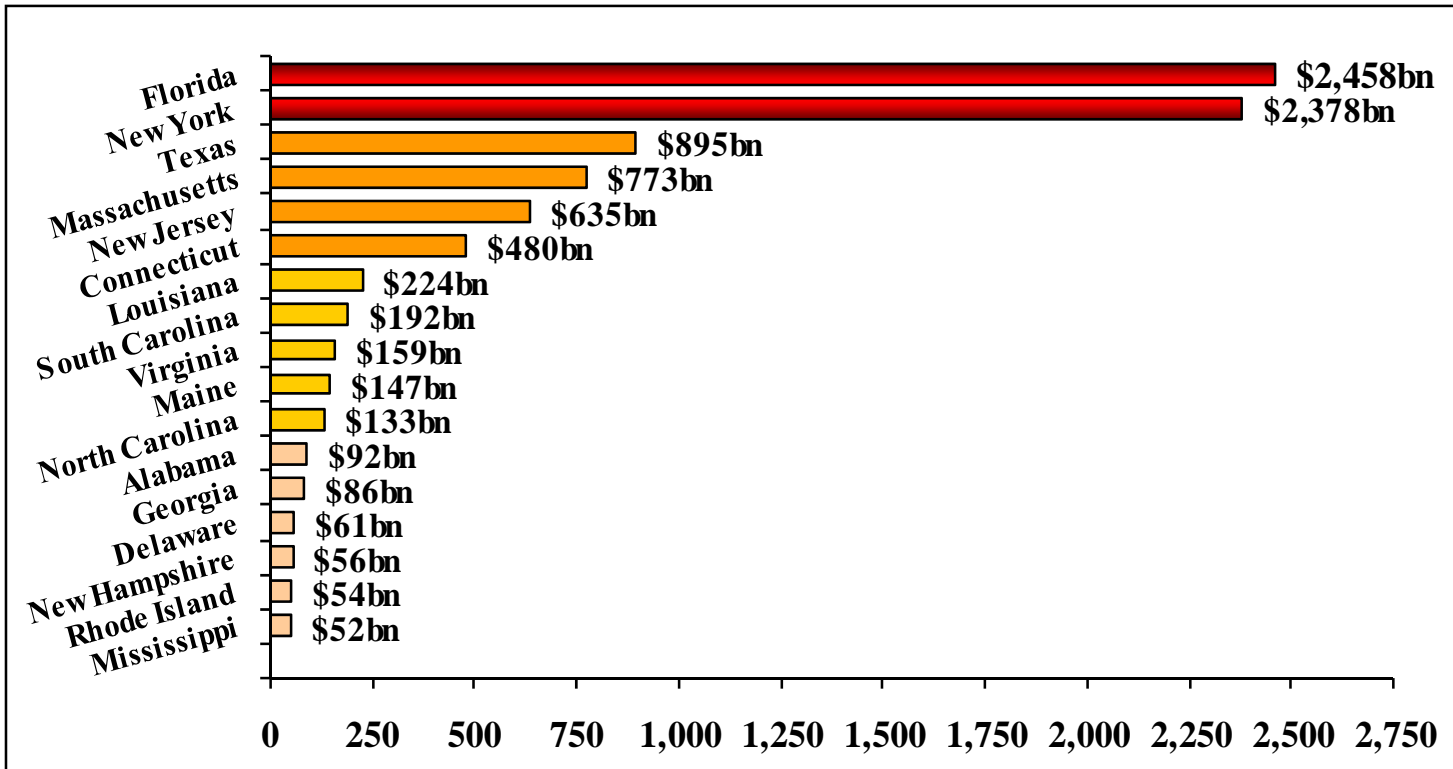
Insured Coastal Exposure as a Percentage of Statewide Insured Exposure as of December 2007 (Residential and Commercial Properties)



Source: Data from AIR Worldwide Corporation

Total Value of Insured Coastal Exposure as of December 2007

(in \$ billion; Residential and Commercial Properties)



Source: Data from AIR Worldwide Corporation

AT WAR WITH THE WEATHER

July 2009 - MIT Press

A better understanding of how individuals decide whether or not to protect themselves against natural disasters.

A set of guiding principles for using insurance to deal more effectively with these events.

Key lessons from the financial management of natural disasters to be applied to other global risks such as pandemics, financial crises and terrorism.

Ideas for the private sector, and sustainable public policy solutions to protect trillions of dollars of assets and the residents at risk in hazard-prone regions.





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Risk Management Solutions



What Is at Stake and Goal of the Book

What is at stake?

- Affordability of living in risky areas
- Who ultimately bears the costs and receives the benefits of such decisions

Research challenge

- Need to better understand the impact of state insurance regulations on the dynamics of the market
- Need *quantitative* measurements of these effects

Goal: Develop a strategy document to help inform the current policy debate

- Role that the private and public sectors can play in reducing future disaster losses
- Enhancing the recovery process due to better financial coverage through insurance and other means.

2. Guiding Principles for Developing Risk Management Strategies

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. Risk-based premiums should also reflect the cost of capital insurers need to integrate into their pricing to assure adequate return to their investors.

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.

Insurance Vouchers

Existing Programs as Models

Food Stamp Program

Mission: Vouchers to purchase food based on annual income and family size

Low Income Home Energy Assistance Program

Mission: Assist low income households in meeting immediate energy needs

Universal Service Fund

Mission: Provide discounts to low-income individuals in rural areas so rates for telecommunications services are comparable to urban areas

Insurance Vouchers

Who should subsidize low income residents?

General taxpayer – Everyone in society is responsible

State government – Source of funding would come from state taxes

Insurance policyholders – All homeowners with insurance

Residents in coastal areas – Those in hurricane-prone areas

Guiding Principles for Developing Risk Management Strategies (cont.)

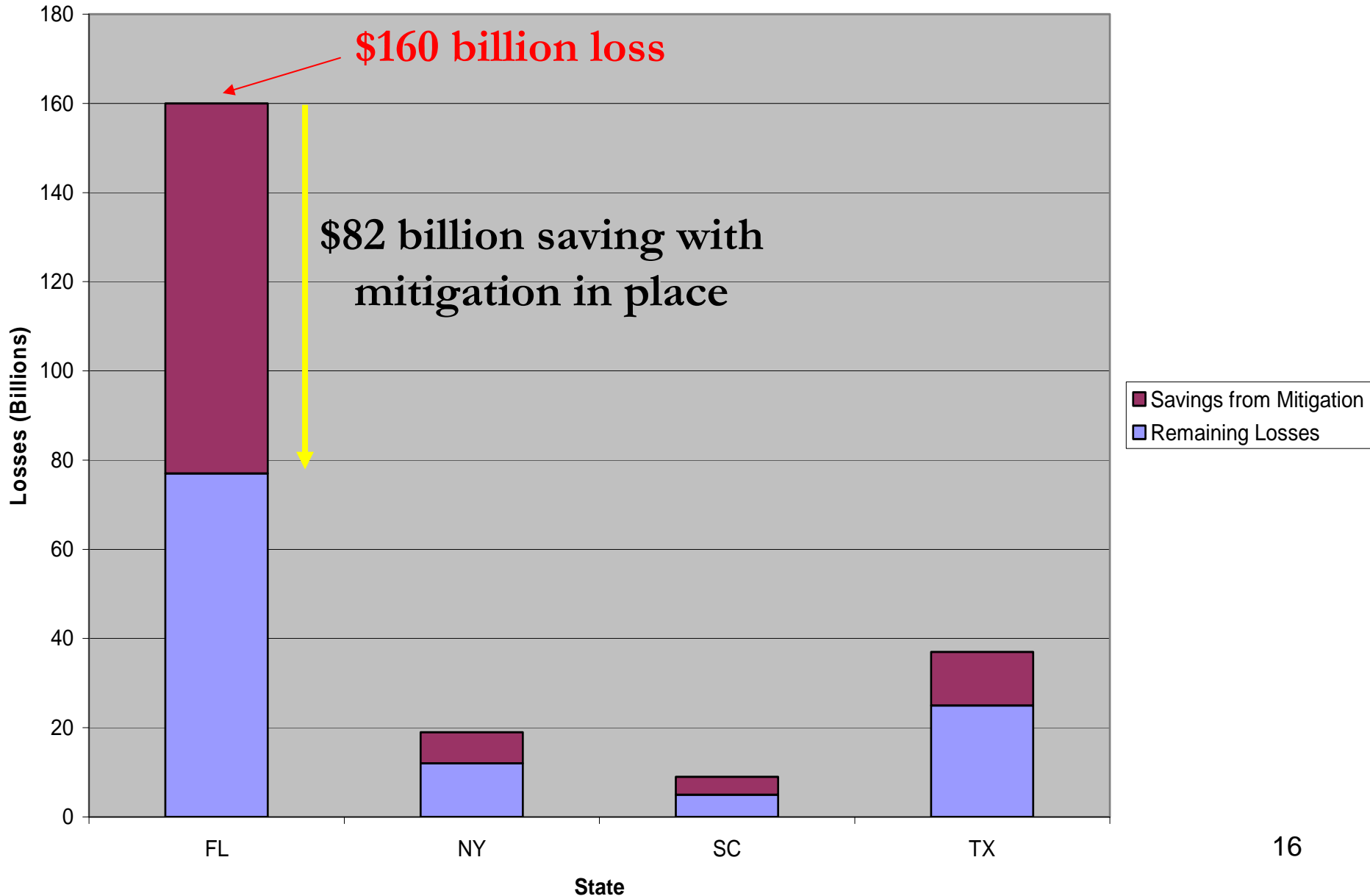
Principle 3: Sufficient Demand for Coverage

The demand by individuals and firms for insurance coverage with risk-based premiums should be sufficiently high so that insurers can cover the fixed costs of introducing a program for providing coverage and spreading the risk broadly through their portfolios. High demand for insurance would also reduce the level of state and federal relief to uninsured or underinsured in the aftermath of the next disaster.

Principle 4: Minimize Likelihood of Insolvency

Insurers and reinsurers should determine how much coverage to offer, and what premium to charge against the risk, so that the chances of insolvency are below some predefined acceptable threshold level.

3. Benefits of Mitigation/Adaptation Measures On a 500-Year Event



Why Property Owners Do Not Invest in Cost-Effective Mitigation Measures

Short Time Horizons (Quick return on investment)

High Short-Term Discount Rates (Hyperbolic discounting)

Misestimating Probability (Flood will not happen to me)

Liquidity and Upfront Costs (We live from payday to payday)

Truncated Loss Distribution (Only responsible for small portion of loss due to disaster relief)

May Move in 2 or 3 Years (Can't recover costs of mitigation)

Encouraging Mitigation with Long-Term Loans

Illustrative Example

Cost of partial roof mitigation: \$1,500

Expected annual benefit of partial roof mitigation:
\$275 (1/1000 * \$27,500)

Annual payments from 20 year \$1,500 loan at
10% annual interest rate: \$145

Reduction in annual insurance payment: \$275

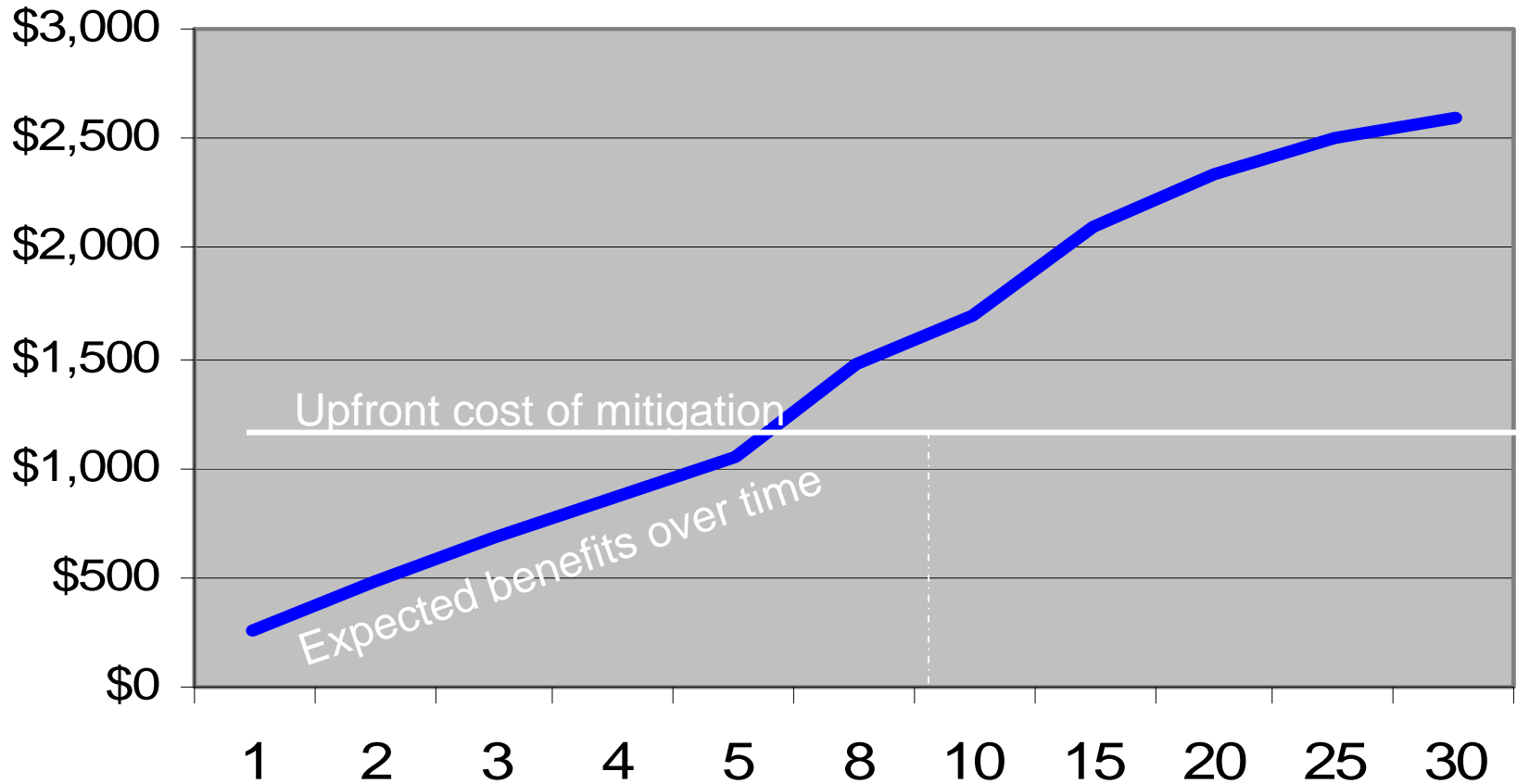
Reduction in annual payments due to mitigation:
 $\$275 - \$145 = \$130$



Expected Benefit-Cost Analysis of Mitigation

(Annual Discount Rate 10%)

Benefits over 30 years



Everyone is a Winner

Homeowner:

Lower total annual payments

Insurer:

Reduction in catastrophe losses and lower reinsurance costs

Financial institution:

More secure investment due to lower losses from disaster

General taxpayer:

Less disaster assistance



4. Need for Long-Term Insurance (LTI)

Problems with a one-year policy

- Availability of insurance post disasters is uncertain for homeowners
- Insurers have marketing costs associated with annual renewals
- Insurers cannot provide financial incentives for homeowners to invest in cost-effective mitigation measures

=> **Market inefficiency** (Jaffee, Kunreuther and Michel-Kerjan, 2008)

Possible solution: 5-10-20 year policies tied to mortgage

- Fixed rate or adjustable rate policies similar to mortgage contracts
- Provides insurance stability to homeowners
- Can encourage adoption of cost-effective mitigation measures for low probability events
- Reduces the need for disaster relief

Benchmark for LTI: Lessons from Mortgage Markets

U.S. mortgage market has evolved from short-term (1-3 years) to long-term (20-40 year) contracts.

Key innovation was FHA fixed-rate long-term loan

- Government action, as short term loans failed during Depression
- Designed as insurance, required actuarial premiums
- Loan format became de facto industry-wide standard
- Spawned private mortgage insurers as well as GNMA and mortgage-backed securities (MBS)

5. Encouraging Mitigation/Adaptation through Long-Term Flood Insurance

Proposed strategy

Long-term flood insurance contracts through National Flood Insurance Program (NFIP)

Long-term home improvement loans for mitigating one's property

Insurance and loans are tied to the property not the individual



Long-Term Flood Insurance Provides Stability to Homeowners

Rates would reflect risk (Principle 1)

[Federal Emergency Management Agency (FEMA) needs to design better maps]

Insurance Vouchers for those needing special treatment (Principle 2)

(Only for those currently residing in flood-prone areas)

Homeowners would know that they are protected against water damage from floods and hurricanes

Long-Term Flood Insurance Provides Stability to NFIP

Would assure spread of risk within the program by having all homeowners in flood prone areas with coverage.

It would sustain revenue for the program over time by having a much larger policy base.

If homeowner moved to another location, the flood policy would remain with the property unless the new owner did not have a federally insured mortgage.

One might also consider have everyone in flood prone areas *required* to take out the insurance as with automobile coverage today.

Long -Term Insurance Prevents Individuals from Cancelling Their Flood Insurance Policies

Many homeowners cancel their flood policy if they have not experienced a flood for several years.

Reason: Flood insurance was not a good investment.

Data: Of 1,549 victims of a flood in August 1998 in northern Vermont, FEMA found 84% of residents in SFHAs did *not* have flood insurance, 45% of whom were required to purchase it. (Tobin and Calfee, 2005)

No Need to Determine Cause of Damage from Hurricanes

If homeowners had flood insurance they would be protected against water damage and not have to argue that the losses were due to wind so they could collect on their homeowners policy.

Would avoid lawsuits such as those filed after recent hurricanes (Florida hurricanes of 2004, Katrina, Ike) as to whether the damage was cause by wind or water.

6. Impact of Climate Change on LTI (Joint research with IIASA, LSE and RMS)

Pricing of insurance for contracts of 5, 10 and 20 years, to see how length of time periods impacts on prices with guaranteed renewability

Role of mitigation/adaptation measures in reducing damage to property with and without climate change

Types of instruments to cover catastrophic losses (e.g. reinsurance, cat bonds, federal or state reinsurance) for long-term insurance and how to price them

Four Cases for Analysis

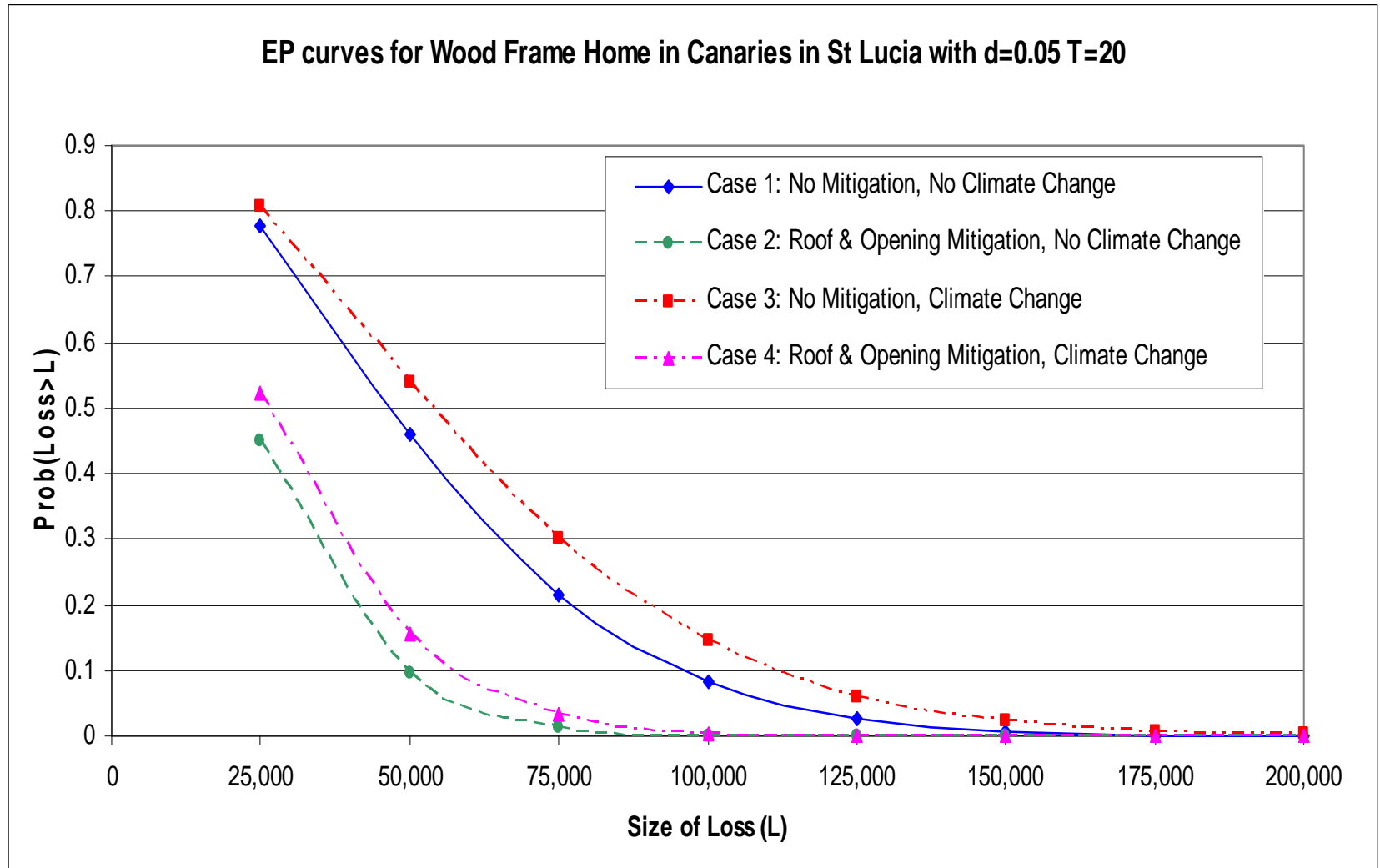
Case 1: No Adaptation, No Climate Change

Case 2: Adaptation, No Climate Change

Case 3: No Adaptation, Climate Change

Case 4: Adaptation, Climate Change

Illustrative Example: St. Lucia



Sensitivity Analysis

Confidence intervals

Worst case scenarios re climate change

Uncertainty in climate change factor

Changes in discount rate

Adaptation measures that protects against wind damage (e.g. strengthening roof)

Data Needs

Impact of climate change on frequency of floods/storm surge and hurricanes of different intensities over time

Impact of climate change (sea level rise; storm surge) on damage to structures with or without adaptation (mitigation) measures in place and cost of adaptation

Developing model that resonates with scientists, social scientists and policy analysts

7. Open Questions for Designing LTI Contracts

Nature of Contract

Fixed Price Contract for full term of policy (e.g. 20 years)

Adjustable Premium Contract

Guaranteed renewal for full term of policy

Annual premium reset based on simple and transparent index

Protection Against Catastrophic Losses

Need for long-term cat bonds and securitization to protect insurers against increases in risk

Government guarantee on ability to pay claims

Understanding the Contract

Transparent information by insurers to policyholders

Required disclosure practices by the government

Institutional Details

Questions for Future Research

How would insurers deal with significant changes in risk estimates over time (e.g. sea level rise)?

What types of risk transfer instruments would have to emerge to protect insurers against catastrophic losses and changes in risk estimates over time?

What steps should be taken to protect homeowners against possible insolvency of insurers providing LTI?

What role would the public sector play in providing protection against catastrophic losses?

8. Summary

The Facts:

Totally new era of “large-scale risks”; huge and still growing concentration of value in high-risk areas; indication of more devastating disasters in the future.

The Reality:

Need guiding principles for insurance and long-term contracts to incentivize investment in loss-reduction measures.

Research and policy questions:

Is the National Flood Insurance Program a good place to start in promoting long-term insurance and long-term loans?

How can we overcome the challenges so that long-term insurance is viewed as feasible by the private sector?

