Pricing Climate Risk: An Insurance Perspective

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Pricing Climate Risk: Refocusing the Climate Policy Debate
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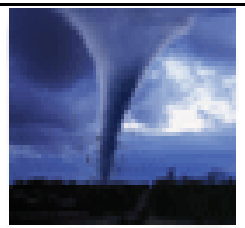
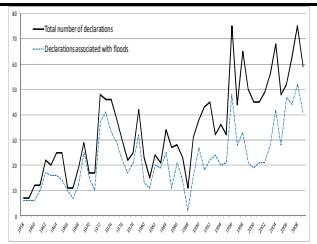
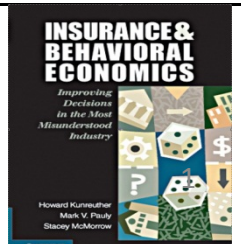
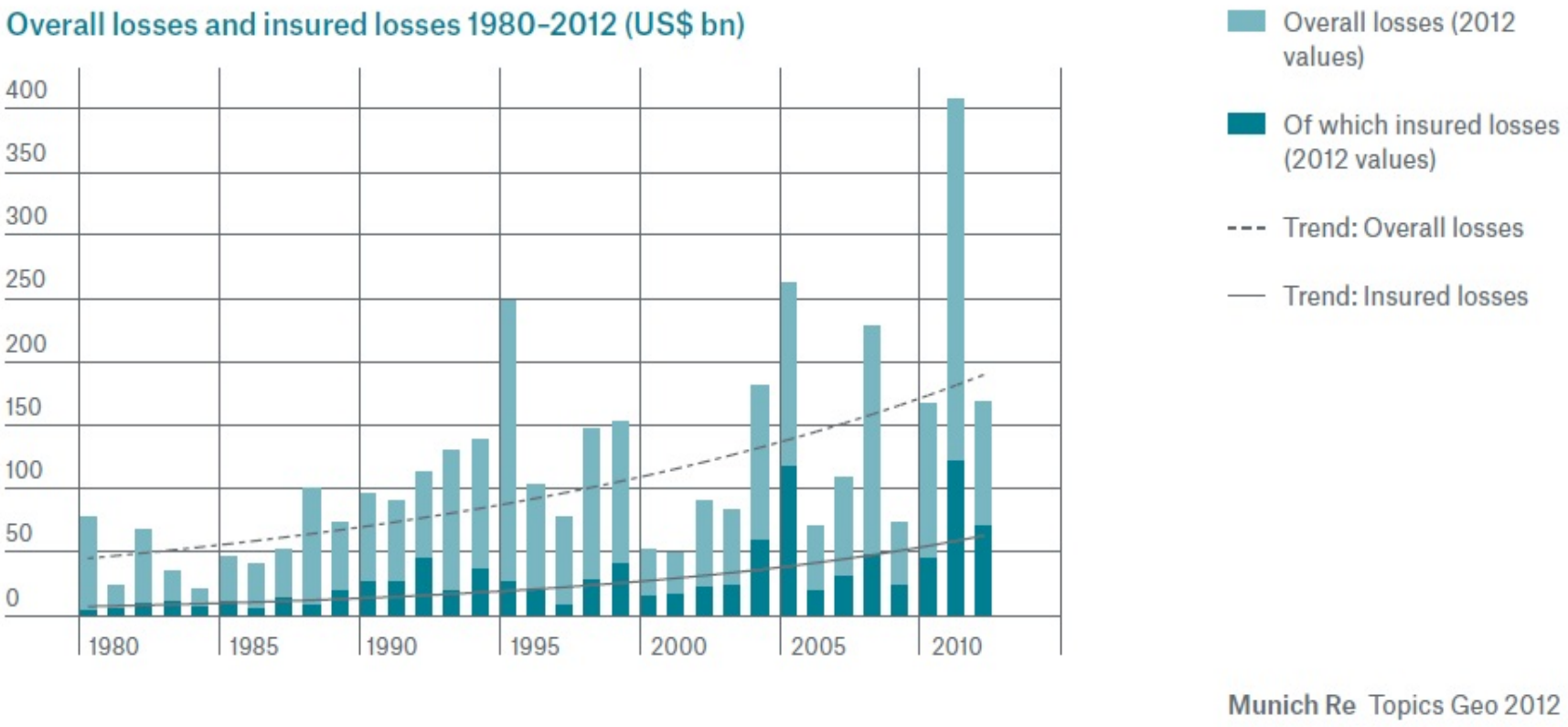






Worldwide Evolution of Catastrophes, 1980-2012

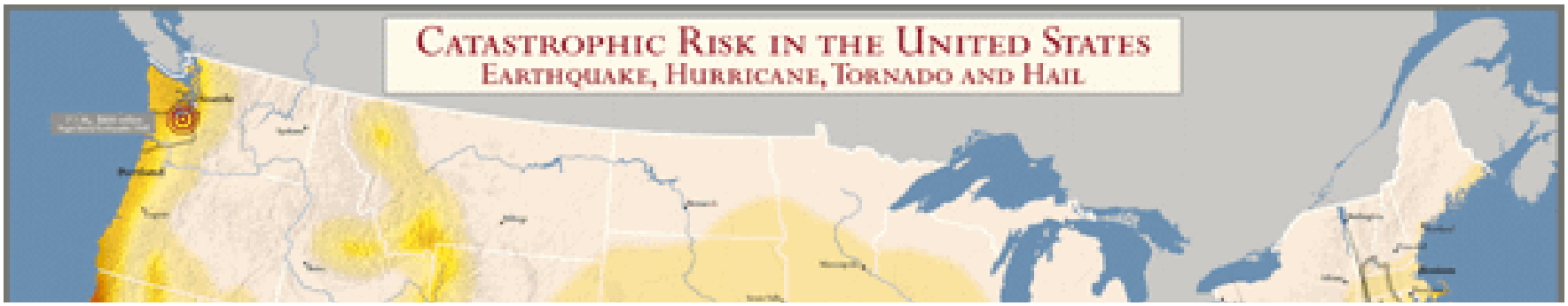


Twenty-Five Most Costly Insured Catastrophes Worldwide, 1970–2011 (in 2011 prices) (14 in the U.S., 15 since 2001)

$ BILLION	EVENT	VICTIMS (DEAD OR MISSING)	YEAR	AREA OF PRIMARY DAMAGE
50.1	Hurricane Katrina	1,836	**2005** *	USA, Gulf of Mexico
38.2	9/11 Attacks	3,025	**2001** *	USA
35-40	Earthquake and Tsunami	15,840	**2011**	Japan
25.6	Hurricane Andrew	43	1992 *	USA, Bahamas
21.2	Northridge Earthquake	61	1994 *	USA
18.5	Hurricane Ike	348	**2008** *	USA, Caribbean
15.3	Hurricane Ivan	124	**2004** *	USA, Caribbean
15.3	Hurricane Wilma	35	**2005** *	USA, Gulf of Mexico
13.0	Earthquake	181	**2011**	New Zealand
11.7	Hurricane Rita	34	**2005** *	USA, Gulf of Mexico, et al.
10.0	Floods, landslides	813	**2011**	Thailand
9.6	Hurricane Charley	24	**2004** *	USA, Caribbean, et al.
9.3	Typhoon Mireille	51	1991	Japan
8.2	Maule earthquake (M_w: 8.8)	562	**2010**	Chile
8.2	Hurricane Hugo	71	1989 *	Puerto Rico, USA, et al.
8.0	Winter Storm Daria	95	1990	France, UK, et al.
7.8	Winter Storm Lothar	110	1999	France, Switzerland, et al.
7.3	Storms and tornadoes	350	**2011** *	USA
7.0	Hurricane Irene	55	**2011** *	USA, Caribbean
6.6	Winter Storm Kyrill	54	**2007**	Germany, UK, NL, France
6.1	Storms and floods	22	1987	France, UK, et al.
6.1	Hurricane Frances	38	**2004** *	USA, Bahamas
5.5	Winter Storm Vivian	64	1990	Western/Central Europe
5.5	Typhoon Bart	26	1999	Japan
4.8	Hurricane Georges	600	1998 *	USA, Caribbean

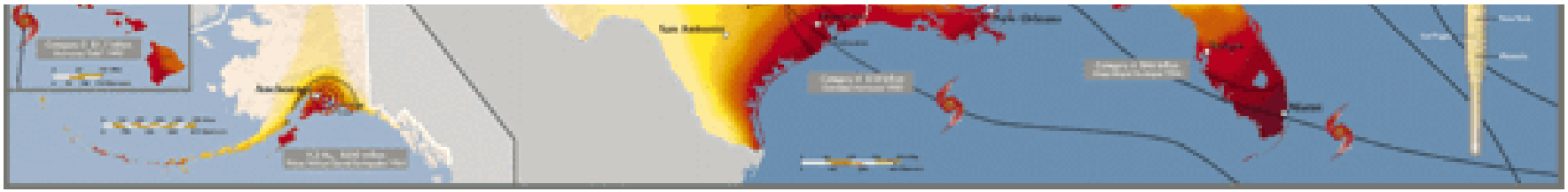
How much insured value (residential and commercial) is located on the coasts from Texas to Maine?

U.S. Exposure to Natural Catastrophes



Insured Exposure on the Coasts
(Texas to Maine as of Dec. 2012):

$15 trillion



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 and sea level rise

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

Sea level rise will cause more flood damage

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

What Will 2013 Bring?

Guiding Principles for Insurance

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 adaptation measures to reduce their vulnerability to catastrophes. Risk-based premiums should also reflect the cost of capital that 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.

Principle 3: Multi-year insurance

To overcome myopia and encourage investment in preventive or protective measures, insurers should design multi-year contracts with premiums reflecting risk. Insurance vouchers should deal with issues of equity and affordability.

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

Proposed Strategy for Flood Insurance

Multi-year flood insurance contracts through the National Flood Insurance Program (NFIP)
(5-, 10-, 20-years insurance coverage)

Home improvement loans for reducing property losses

Insurance and loans tied to the property not the homeowner

Applying the Three Principles to Flood Insurance

Rates would reflect risk (*Principle 1*)
(FEMA is in the process of updating flood maps)

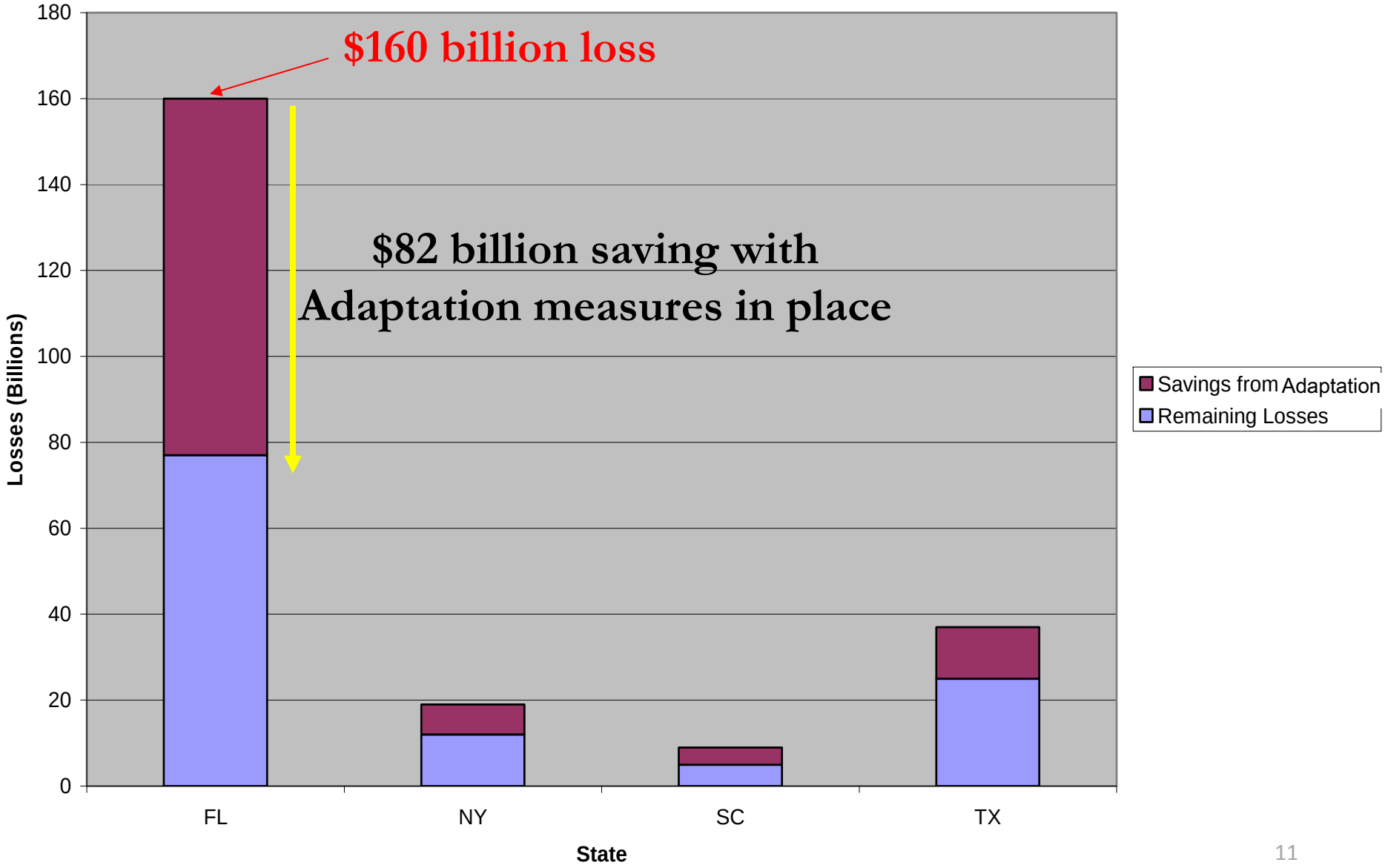
Insurance vouchers for those needing special treatment (*Principle 2*)
(Only for those currently residing in flood-prone areas)

Homeowners know that their premiums are stable over time (*Principle 3*)

Congress renewed NFIP for 5 years in July 2012

Authorized studies by the Federal Emergency Management Agency and the National Academy of Sciences to examine ways to incorporate risk-based premiums coupled with means-tested insurance vouchers

Reduction in Losses from Well-Enforced Building Codes



Encouraging Adaptation Measures: An Example

Characteristic of Adaptation Measures: Upfront cost/long-term benefits

Cost of Adaptation Measure: $1,500 to strengthen roof of house

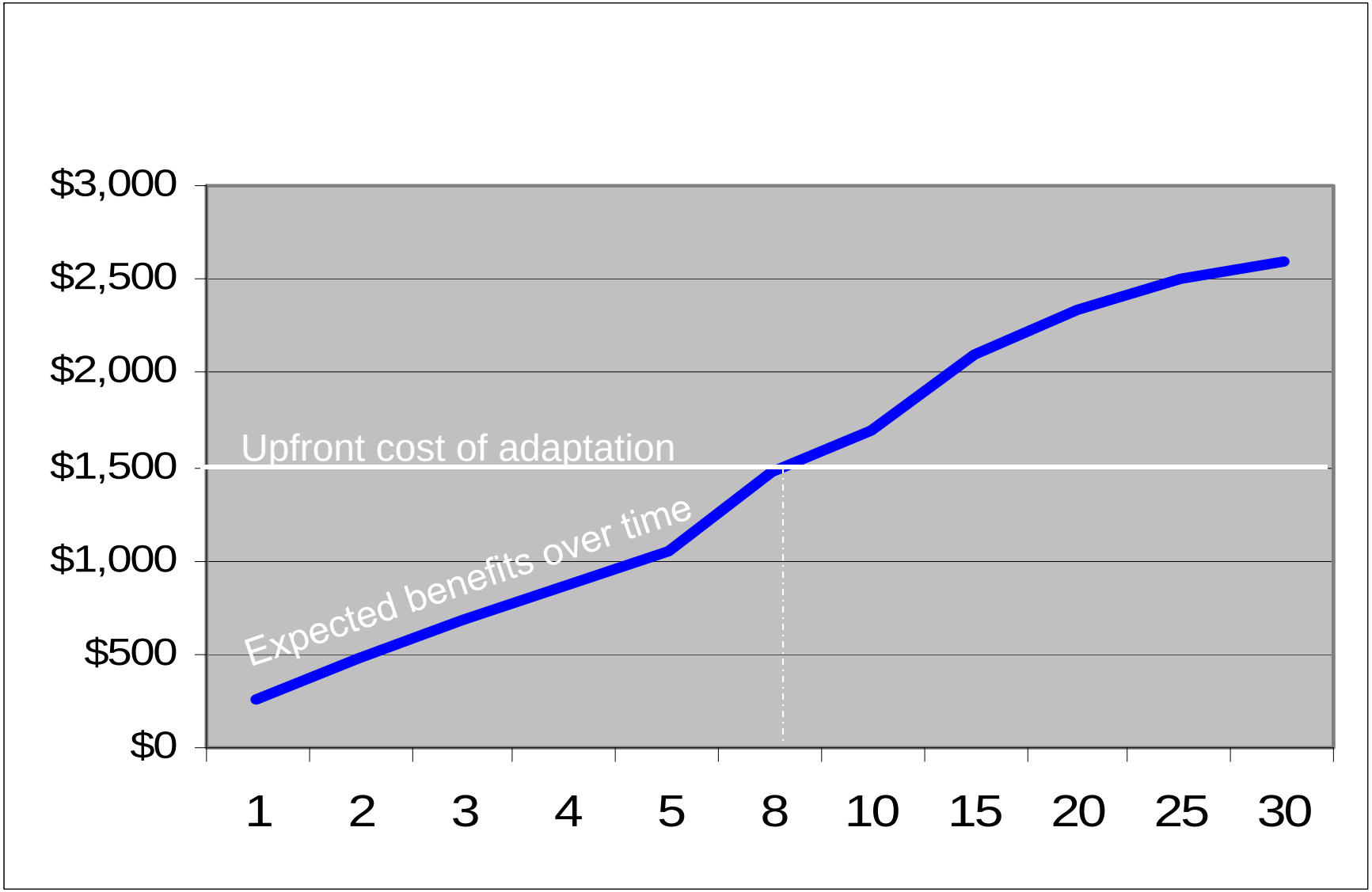
Nature of Disaster:

- 1/100 chance of disaster
- Reduction in loss ($27,500)

Expected Annual Benefits: $275 (1/100 * $27,500)

Annual Discount Rate of 10%

Expected Benefit-Cost Analysis of Adaptation (Annual Discount Rate 10%)



Rationale for Multi-Year Flood Insurance Encouraging Adaptation with Multi-Year Loans

Illustrative Example

Cost of partial roof adaptation: $1,500

Expected annual benefit of partial roof adaptation: $275 (1/100 * $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 adaptation: $275-$145= $130

Linking Multi-Year Home Improvement Loans with Multi-Year Flood Insurance

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

Future Research

Examine role of multi-year insurance contracts in encouraging investment in adaptation measures

- Make the impact of climate change more salient
- Stretch time horizon on likelihood of disasters occurring
  - flood or hurricane with a 100-year return period (.01 annual likelihood)
  - translates into .22 probability of at least one flood or hurricane in 25 years
- Highlight expected benefits of adaptation measures to key interested parties
- Tie loans and insurance to the property (not to the individual) through assumable mortgage contracts or via property taxes

Future Research

Determine costs of adaptation measures so one can undertake a meaningful benefit-cost analysis under different annual discount rates and time horizons.

How to bring together key interested parties together to ensure that:

- Interdependencies and externalities are considered in evaluating these measures
- Property is inspected to confirm that adaptation measures are implemented
- Readjust insurance premiums at regular intervals (e.g., 5 years) to reflect new risk estimates due to climate change and other factors

Future Research

How can insurance by linked with other policy tools to deal with increased losses from climate change?

- Need for FEMA to develop more accurate flood maps
- Well-enforced building codes
- Implementing land-use regulations
- Risk transfer instruments for catastrophic losses (e.g., catastrophe bonds)
- Federal reinsurance

Who should pay for insurance in high hazard areas?

- Should vouchers be phased out over time? To whom?
- Should insurance premiums be actuarially fair if property is transferred or sold?
  - Transferred to family member?
  - Sold to a new owner?
  - What will be the impact on property values?
  - Role of loans for adaptation measures to lower premiums

Conclusions

Insurance can play an important role in providing protection against serious risks.

- It can provide a signal as to the hazardousness of an area
- It can encourage adaptation through premium reductions
- It can provide financial assistance following a loss

Hurricane Sandy provides an opportunity to reevaluate the role that insurance and adaptation measures can play in reducing future losses from catastrophic disasters.

Questions for Discussion

Can one design a multi-year flood insurance policy that will be attractive to homeowners, private insurers and the NFIP?

Should flood insurance be tied to the property rather than the individual?

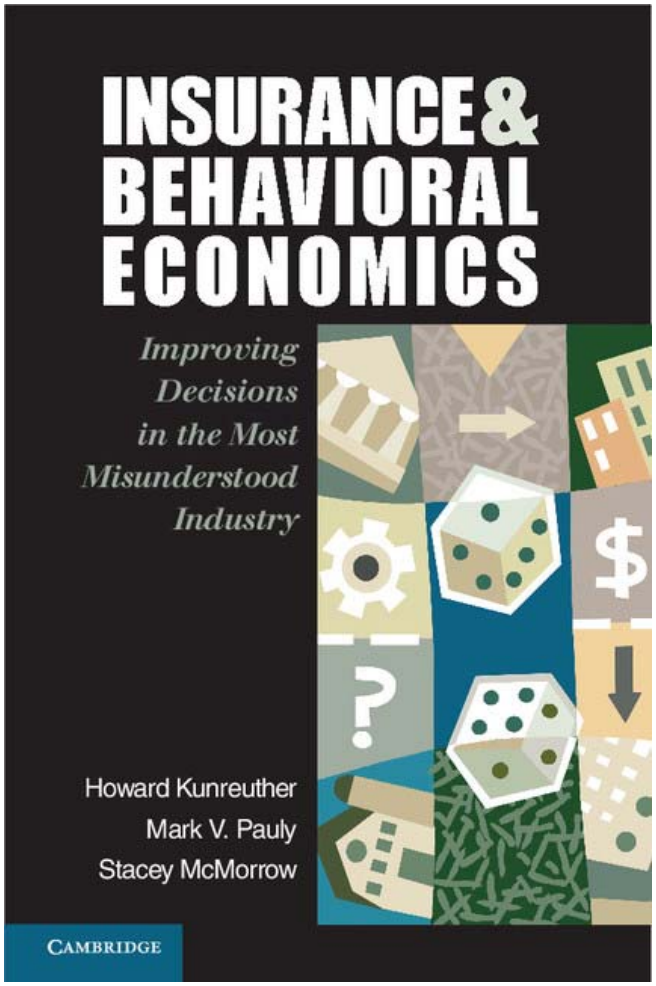
Should flood insurance be required for those residing in flood-prone areas?

How does one revise premiums as risk of flooding changes due to global warming?

The Challenges of Linking Flood Insurance with Adaptation Measures

"Jerry looked into flood insurance but says it's too darned expensive."

Insurance and Behavioral Economics: Improving Decisions in the Most Misunderstood Industry



Part I: Contrasting Ideal and Real Worlds of Insurance

Chapter One: **Purposes of this Book**
Chapter Two: **An Introduction to Insurance in Practice and Theory**
Chapter Three: **Anomalies and Rumors of Anomalies**
Chapter Four: **Behavior Consistent with Benchmark Models**

Part II: Understanding Consumer and Insurer Behavior

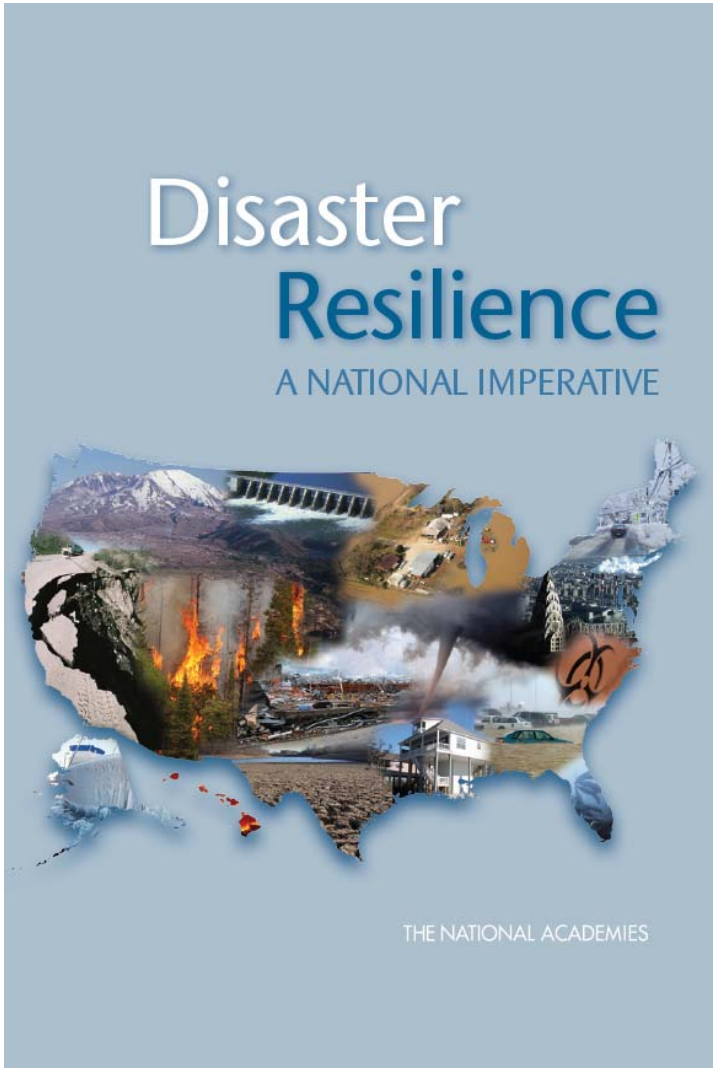
Chapter Five: **Real World Complications**
Chapter Six: **Why People Do or Do Not Demand Insurance**
Chapter Seven: **Demand Anomalies**
Chapter Eight: **Descriptive Models of Insurance Supply**
Chapter Nine: **Anomalies on the Supply Side**

Part III: The Future of Insurance

Chapter Ten: **Design Principles for Insurance**
Chapter Eleven: **Strategies for Dealing with Insurance-Related Anomalies**
Chapter Twelve: **Innovations in Insurance Markets through Multi-Year Contracts**
Chapter Thirteen: **Publicly-Provided Social Insurance**
Chapter Fourteen: **A Framework for Prescriptive Recommendations**

Disaster Resilience: A National Imperative

The National Research Council – National Academies of Science



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