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Who monitors climate risk of financial institutions?

Evidence from catastrophe risks in insurance

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From insight to impact.

Climate Risk and the Role of Insurers

- Climate change is increasing the frequency and severity of natural catastrophes (NatCats)
- Insurers are critical in managing this risk:
  - Risk transfer for households and firms
  - Information production about climate risk
  - Pricing of risk that signals exposure levels
- Challenge:
  - To play this role effectively, insurers must be financially sound
  - But insurers themselves are exposed to increasing NatCat risks

The Problem of Monitoring Insurers' Financial Strength

➢ Why Monitoring Matters:

- Financial strength is hard to assess directly
- External certification needed for policyholders and investors

➢ Key Players:

- Public monitoring: State insurance regulators (via RBC capital requirements)
- Private monitoring: Credit rating agencies (e.g., A.M. Best)

➢ Research Gap:

- Who is more effective in evaluating and disciplining climate-related risk exposure?

Unique Setting: Post-Katrina Shake-Up

➢ Natural Experiment:

- 2005 hurricane season (Katrina, Rita, Wilma): major losses
- Triggered changes in risk monitoring:
  - 2006: A.M. Best tightened NatCat risk assessment
  - 2017: NAIC introduced NatCat RBC charges (11-year delay)

➢ Research Objective:

- Compare responses to A.M. Best's stricter rating standards vs. regulatory capital changes
- Evaluate long-term effectiveness of each monitor

Research Questions

- RQ1: Are credit rating agencies (CRAs) more effective than regulators in disciplining climate risk exposure?
  - Yes
- RQ2: Do insurers respond differently depending on their clientele (commercial vs. personal lines)?
  - Yes
- RQ3: What are the long-term effects of stricter monitoring?
  - Insurance market fragmentation in terms of climate exposures

Theoretical Framework

➢ Model assumptions

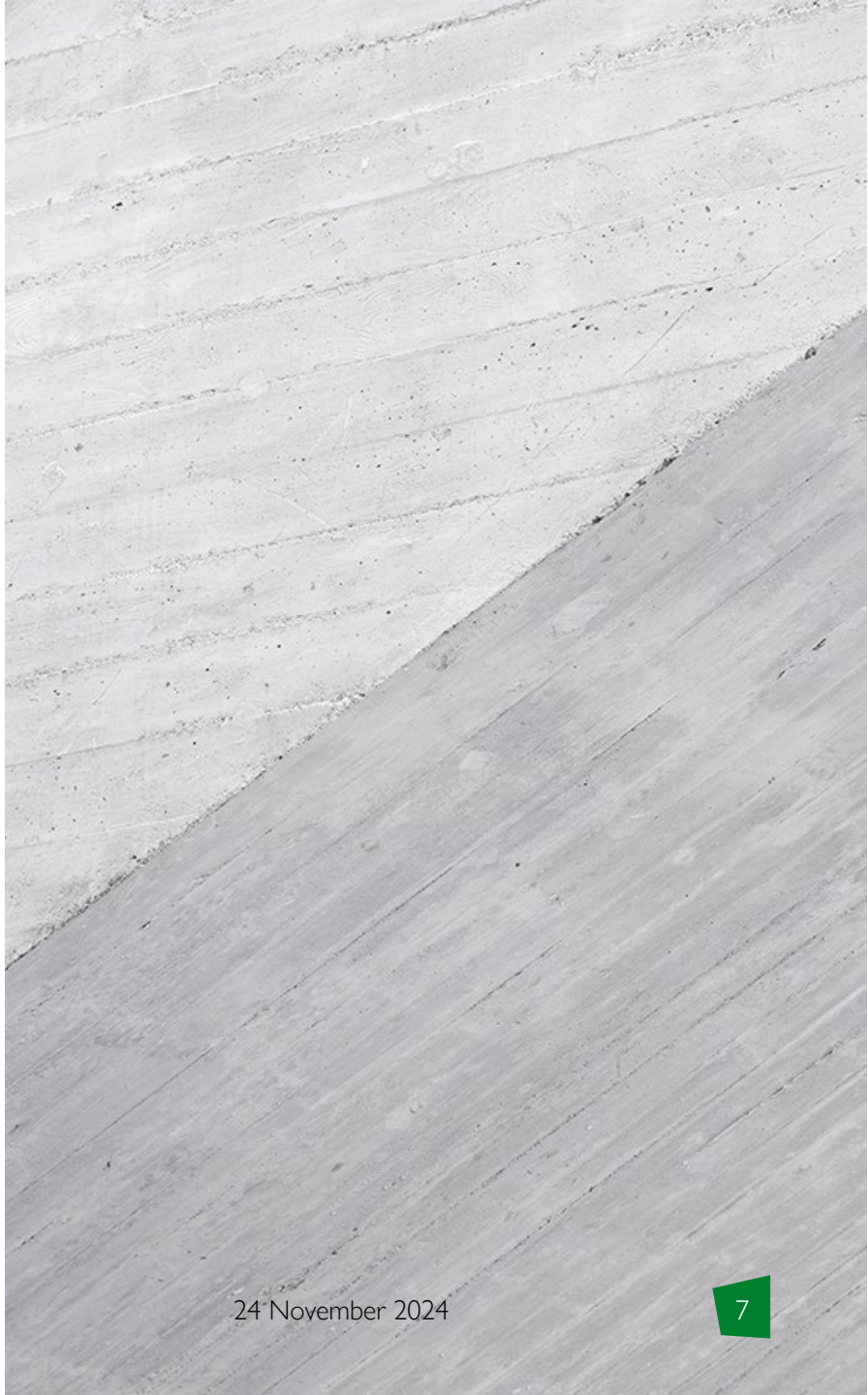
- Insurers differ in quality (q) and are subject to CRA ratings
- Insurers strategically invest effort (e) to improve rating
- Heterogeneous incentives based on:
  - Marginal cost of effort
  - Benefit of higher rating
  - Customer sensitivity to ratings

➢ Predictions

- Commercial insurers (high sensitivity) are more likely to defend ratings
- Personal insurers (low sensitivity, protected by guarantee funds) are not

Empirical Analysis

1. Data
2. Response of premiums to regulatory and rating changes
3. Assessment of the rating downgrade pressure post-Katrina and adjustment channels
4. Assessment of the long-term effects (2010-2022)



Data

Panel data on US insurers

➢ Data sources

- A.M. Best ratings
- NAIC statutory regulatory filings

➢ US property-casualty insurance companies between 2001-2022

- Include all insurers with A.M. Best rating
- Around 11,000 insurer-year observations at the individual company level

➢ Insurers' characteristics

- A.M. Best financial strength ratings at the company level
- Key metrics utilized by rating agencies and regulators to assess insurers' capital adequacy, profitability, financial and reinsurance leverage, firm size, and capital market access

Measuring the NatCat exposure of insurers

➢ For each insurer, we observe

- Direct premiums written by business line and by state
- Incurred losses by business line and by state
- Characteristics reported in the Core pages of insurers' NAIC filings

➢ Exposure to Katrina: PCAT

- Percentage of premiums in NatCat exposed lines of business written in Katrina-affected states Alabama, Florida, Louisiana, Mississippi, South Carolina, and Texas

➢ Exposure to other NatCat regions

- Percentage of premiums in NatCat exposed lines of business written in NatCat exposed regions

Commercial and personal insurance

- **Segmented market:** 32% of insurers specialize and write 90-100% of their premiums in commercial lines

- **Definition:** Commercial insurers are those that write at least 50% of premiums in commercial lines
  - Alternative specifications
    - Continuous measure
    - > Median (82%)
    - > 75%
    - > 90%

Response to regulatory and rating changes

Who Cares about Ratings or Regulatory Capital Changes?

Commercial insurers:

- Clientele: Sophisticated corporate buyers
- Market Features:
  - No state guarantee protections
  - Demand highly elastic to rating changes

Personal insurers:

- Clientele: Retail households
- Market Features:
  - Protected by state guarantee funds
  - Demand inelastic to rating changes

A.M. Best Ratings:

- BCAR: Capital adequacy considering catastrophe risk
- 2006 change: Dual-stress testing introduced (1-in-100-year events x2)

NAIC RBC Standards:

- Capital requirements adopted only in 2017
- Much slower and less sensitive to NatCat exposures

Implication:

Commercial insurance demand more sensitive to ratings → greater incentives to maintain high ratings



Impact of Rating vs. Regulation

- Ratings more influential on premiums and markups than RBC ratios
- Especially true for commercial insurers
- Downgrades lead to:
  - 4% drop in premium growth
  - 46bps drop in markups (97bps for commercial)

Downgrade pressure post-Katrina

➢ Baseline specification Difference-in-Differences (DiD)

$$(1) \quad Rating_{it} = \beta_1 (Post \times PCAT_{it}) + \beta_2 Post + \beta_3 PCAT_{it} + \varepsilon_{it}$$
$$(2) \quad Rating_{it} = \beta_1 (Post \times PCAT_{it}) + v_i + \tau_t + \varepsilon_{it}$$

➢ Variables

- $Rating_{it}$: Numerical conversion of a rating from 13 (A++) to 1 (C)
- $Post$: A time dummy equal to 0 for years 2001-5 and equal to 1 for years 2006-8
- $PCAT_{it}$: Exposure of insurer i in year t to Katrina-affected areas
- Fixed Effects: insurer and time
- Controls: insurer's capital, profitability, leverage, size, and corporate structure

➢ Prediction: $\beta_1 < 0$

Alternative specifications

- Baseline specification (2) with insurers' controls, Ordered Probit , Ordered Logit

Result 1: Downgrade pressure on Katrina-exposed insurers

	(1) OLS Rating	(2) OLS Rating	(3) OLS Rating	(4) OProbit Rating	(5) OLogit Rating
Post × PCAT	-0.196	-0.406***	-0.367***	-0.239**	-0.382
	(0.186)	(0.119)	(0.114)	(0.114)	(0.238)
Post	0.131***			-0.132***	-0.235***
	(0.026)			(0.021)	(0.036)
PCAT	-0.194			-0.130	-0.136
	(0.241)			(0.166)	(0.328)
Firm FE	No	Yes	Yes	No	No
Year FE	No	Yes	Yes	No	No
Controls	No	No	Yes	Yes	Yes
Observations	11,190	11,190	11,044	11,044	11,044

Katrina-exposed insurers → downgrade pressure

- Robust across main specifications, errors clustered at insurer level
- Economically large: costs about 40% of a rating notch

Impact on Personal vs. Commercial Insurers

➢ Differential downgrade pressure on personal and commercial insurers

- Triple interaction extension of the baseline specification

$$(3) \quad Rating_{it} = \beta_1(Post \times PCAT_{it} \times I(Comm)) + \beta_2(Post \times I(Comm)) + \beta_3(Post \times PCAT_{it}) + v_i + \tau_t + \varepsilon_{it}$$

➢ Prediction: $\beta_1 \neq 0$, i.e. commercial and personal insurers face different downgrade pressure for the same PCAT exposure

- $\beta_1 > 0$ commercial insurers tend to get downgraded less for the same PCAT exposure

Alternative specifications

- Baseline specification (3) with insurers' controls
- Ordered Probit
- Ordered Logit

Result 2: Commercial insurers evade downgrade pressure

	(1) OLS Rating	(2) OLS Rating	(3) OLS Rating	(4) OProbit Rating	(5) OLogit Rating
Post×PCAT	-0.922***	-0.866***	-0.866***	-0.707***	-1.398***
	(0.281)	(0.199)	(0.189)	(0.175)	(0.413)
Post×PCAT×I(Comm)	1.483***	0.942***	1.012***	0.976***	1.922***
	(0.363)	(0.226)	(0.216)	(0.226)	(0.508)
Post×I(Comm)	-0.064	0.010	0.007	-0.022	-0.048
	(0.084)	(0.043)	(0.040)	(0.057)	(0.102)
PCAT×I(Comm)	-0.338	-0.134	-0.174	-0.334	-0.551
	(0.467)	(0.151)	(0.150)	(0.322)	(0.664)
Firm FE	No	Yes	Yes	No	No
Year FE	No	Yes	Yes	No	No
Controls	No	No	Yes	Yes	Yes
Observations	11,190	11,190	11,044	11,044	11,044

Downgrade pressure: personal but not commercial insurers

- | Post×PCAT×I(Comm) | + | Post×PCAT | is close to zero

What drives the downgrade pressure?

➢ Downgrade pressure factors

- Rating scale change
- Katrina impact on firm's characteristics: Incurred losses, increasing cost of reinsurance, etc

➢ Downgrade pressure decomposition

- **PDGs:** Propensity to be downgraded (PDG) due to the scale change

$$PDGs = \begin{cases} 1, if\ (Rating_{Post}(X_{Pre}) < Rating_{Pre}(X_{Pre}) \\ 0, otherwise \end{cases}$$

- **PDGx:** Propensity to downgrade due to the change in insurer's characteristics

$$PDGx = \begin{cases} 1, if\ Rating_{Pre}(X_{Post}) < Rating_{Pre}(X_{Pre}) \\ 0, otherwise \end{cases}$$

Factors driving the downgrade pressure

➢ Contribution of standard change and Katrina losses to downgrade pressure

- Run a horse race between PDGs and PDGx in explaining the downgrade pressure

$$Rating_{it} = \beta_s(Post \times PDGs_{it}) + \beta_x(Post \times PDGx_{it}) + v_i + \tau_t + \varepsilon_{it}$$

➢ Alternative specification

- Evaluate the impact of Katrina losses directly by replacing $PDGx_{it}$ with **the loss ratio** LR_{it} in Katrina-exposed states
- *Loss ratio* is the ratio of insured losses to premiums earned, reported for each insurer by line of business and state

Result 3: Contribution of rating scale and insurer's factors

	(1) OLS	(2) OLS	(3) OLS	(4) OProbit	(5) OLogit
Post×PDGs	-0.314***	-0.221***	-0.203***	-0.188***	-0.338***
	(0.088)	(0.066)	(0.063)	(0.061)	(0.106)
Post×PDGx	-0.314***	-0.258***	-0.091**	0.102**	0.237***
	(0.049)	(0.045)	(0.045)	(0.045)	(0.078)
PDGs	1.127***			0.321***	0.660***
	(0.166)			(0.102)	(0.183)
PDGx	0.203**			0.024	0.039
	(0.100)			(0.073)	(0.126)
Post	0.420***			-0.013	-0.018
	(0.086)			(0.061)	(0.104)
Firm FE	No	Yes	Yes	No	No
Year FE	No	Yes	Yes	No	No
Controls	No	No	Yes	Yes	Yes
Observations	9,322	9,322	9,238	9,238	9,238

Both factors matter for downgrade pressure

- Each factor contributed about **a half** to the downgrade pressure

Result 4: Commercial insurers are more resilient

	(1) OLS	(2) OLS	(3) OLS	(4) OPribit	(5) OLogit
Post×PDGx	-0.638***	-0.467***	-0.303**	-0.158	-0.253
	(0.170)	(0.129)	(0.125)	(0.128)	(0.229)
Post×PDGx×I(Comm)	0.388**	0.261*	0.265**	0.319**	0.583**
	(0.182)	(0.134)	(0.130)	(0.143)	(0.253)
Post×I(Comm)	0.142*	0.122***	0.115**	0.094	0.142
	(0.078)	(0.046)	(0.045)	(0.058)	(0.110)
PDGx×I(Comm)	-0.129	-0.193	-0.180	-0.061	-0.036
	(0.263)	(0.128)	(0.130)	(0.222)	(0.415)
Firm FE	No	Yes	Yes	No	No
Year FE	No	Yes	Yes	No	No
Controls	No	No	Yes	Yes	Yes
Observations	9,322	9,322	9,238	9,238	9,238

- Commercial insurers are more willing and capable to surmount the unfavorable impact of Katrina compared to personal insurers
- Commercial insurers had more flexibility to adjust in the aftermath of Katrina

Evaluation of adjustment channels post-Katrina

What could insurers do to surmount the 2005 events?

- Overall capitalization
  - Regulatory capital RBC
  - A.M. Best Risk-Based Capital BCAR
- Capital policy
  - new capital issuance, dividend cuts, zero dividends
- Reinsurance
  - retention ratio
- Asset quality
  - holdings of risky bonds (3-6 SVO), holdings of stocks
- Geographic exposures
  - exit risky states in Florida and Gulf and expand coverages in other states



Result 5: Risk-based capital

	(1) BCAR	(2) BCAR	(3) BCAR	(4) RBC	(5) RBC	(6) RBC
Post×PCAT	-2.643	4.734	20.433*	705.919**	668.621**	750.805***
	(20.830)	(16.876)	(12.353)	(320.523)	(260.899)	(231.213)
Post	33.966***			93.983*		
	(3.186)			(47.928)		
PCAT	21.370			431.685		
	(20.042)			(294.649)		
Controls	No	No	Yes	No	No	Yes
Observations	11,190	11,084	11,044	11,067	10,963	10,921
R2	0.012	0.050	0.095	0.008	0.013	0.084
Method	LPM	LPM	LPM	LPM	LPM	LPM
Firm & Year FE	No	Yes	Yes	No	Yes	Yes

- Insurers improve regulatory statutory accounting-based RBC but not NatCat sensitive rating agency capital score BCAR
- No significant differences between personal and commercial insurers

Results on capital and risk management policy adjustments

- **Capital policy**
  - Increase in the propensity to pay zero dividends by 7%
  - No significant response in terms of capital issuance or dividend cuts
- **Reinsurance**
  - Katrina-exposed insurers increase their reinsurance coverage by 4-7%
- **Asset quality**
  - Higher rating scale pressure PDGs motivates insurers to reduce investment in risky bonds; but no response to PDGx or PCAT
  - PCAT-exposed insurers reduce investment in common stock
- **Geographic exposure**
  - Commercial insurers reallocated NatCat business to North East, Earthquake and Tornado regions and reduce Florida exposure
  - Some evidence on the growing exposure to FL by personal insurers

Long-term impact of rating standard changes (2010-2022)

Long-Term Effects of Stricter Rating Standards

➢ Objective:

Assess whether A.M. Best's 2006 rating methodology change had a lasting impact on insurers' risk-taking behavior.

➢ Method:

- Outcome: **Loss Ratio** = (Claims / Premiums) — proxy for risk exposure
- Key variable: **Rating Downgrade Pressure in 2006**
- Interaction with insurer type: Commercial vs. Personal
- Control for insurer and year fixed effects

➢ Key Findings:

Commercial insurers exposed to rating downgrade pressure in 2006:

- Significantly lower loss ratios in the long run (2010–2022)
- Indicates improved risk management and effective discipline

Personal insurers:

- **No evidence** of improvement in loss ratios
- In some cases, NatCat exposure actually **increased**

Interpretation:

- **Only commercial insurers** responded meaningfully to stricter monitoring
- **Guarantee fund protection** likely muted incentives for personal insurers

Interpretation and Broader Implications

➢ Why Did Only Commercial Insurers Improve?

- Commercial lines cater to **sophisticated buyers** → high demand elasticity to ratings
- Downgrades = loss of clients or higher capital costs
- Strong incentive to adjust behavior and defend rating
- Personal lines serve **households with low elasticity**
  → protected by **state guarantee funds**
  → little downside to accepting a downgrade

➢ Regulatory Monitoring Impact:

- **RBC standards remained insensitive** to NatCat risk
- Personal insurers could still meet regulatory capital standards despite rising risk

Conclusion

Conclusion & Policy Takeaways

- **Contributions**
  - New evidence on how rating methodology changes discipline firm behavior
  - Extends climate finance and insurance regulation literatures
  - Shows differential responses within a regulated industry
- **Broader Implications**
  - Large segments of the market remain under-monitored
  - Guarantee funds create moral hazard
  - Regulatory inertia undermines climate resilience in insurance
- **Policy Relevance**
  - Need to align regulatory frameworks with evolving climate risks
  - Consider revising guarantee fund structures to preserve incentives for prudent risk-taking