Pricing of Climate Risk Insurance: Regulation and Cross-Subsidies

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*Disclaimer: The views expressed do not represent the views of the Federal Reserve System.

Pricing of homeowners' insurance

- Unprecedented rise in natural disasters; the insurance sector provides front-line defense.
- Homeowners' insurance contracts provide protection against property damages.
  - Climate losses: 93% of all losses (SwissRE).
  - Big market: $15 trillion in coverage catering to 85% of all U.S. homeowners.
  - Prerequisite to getting a mortgage.

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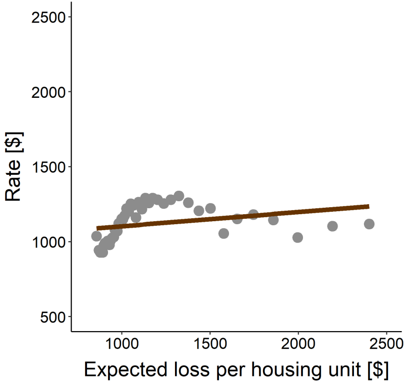
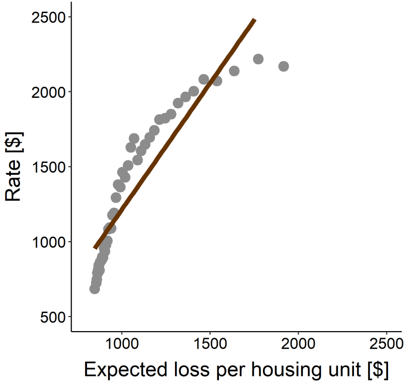
  - Prerequisite to getting a mortgage.
- Little work to understand the economics of the homeowners' insurance market.
- **This paper**:
  - Insurance prices (rates) have become disjoint from underlying risk.
  - State-level rate regulation is a driving force behind this pattern.

Decoupling of insurance rates from risks



(i) Highly regulated



(ii) Less regulated

Based on ZIP code level rates data as of 2019. Expected losses are based on estimates from FEMA and insurance rates are from Quadrant and insure.com.

The two forces driving decoupling of risk and rates

(1) Insurers are restricted in their ability to change rates in a subset of states:

- Rates have not adequately adjusted in response to loss growth.

(2) Insurers cross-subsidize highly regulated states by raising rates in less regulated states:

- When losses occur in highly regulated California, rates increase in less regulated Virginia.
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Why is it important?

- Distortions in who bears climate risk: less regulated subsidizing highly regulated.
- Matters for households' finances: insurance is a big fraction of home ownership costs.
- Whether insurance prices can serve as a useful signal of risk.

Regulation of homeowners' insurance rates

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2. Every time insurers want to change rates, they must seek explicit regulatory approval.
    - Insurers submit extensive filings, which are then subject to rate review.
3. Rates are regulated at a **state of operation** level:
    - Insurer X sells in CA, VA, and NC, it must make separate filings in *each* state.
    - Same insurer is exposed to multiple regulators $\rightarrow$ track the same insurer's pricing behavior across differently regulated states.
4. Several sources of heterogeneity in regulation across states:
    - Pricing inputs permitted (CAT models, territorial risks, reinsurance costs); filing procedure.

Regulation of homeowners' insurance rates

Trial by wildfire: Will efforts to fix home insurance in California stand the test of time?:
In California, insurers are constrained in the way they set premium rates. Instead of being permitted to charge a rate that is indicated by the catastrophe simulation models widely used in private industry, insurers must use a simple minimum 20-year historical average to project losses for future catastrophic events.

Beyond model use constraints and the exclusion of reinsurance costs from rates, California insurers may face hurdles to changing prices, even using state-prescribed methodologies. Insurers must submit rate proposals for regulatory review as a normal course of business. But in California, the review period can be particularly lengthy, and filings can be subject to costly public intervention and hearings. An insurer's request for a rate increase may lead to their being forced to take a rate decrease, and effective dates may be delayed many months (sometimes years) beyond what insurers originally request.

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- **New measure**: based on observed regulatory outcomes that incorporates the different sources of heterogeneity.

Rate filings data and measurement of rate-setting frictions

- New data on rate filings made by insurers to state regulators (2009-2019):
  - **Target rate change**: rate required to meet actuarial costs (e.g., to cover expected losses).
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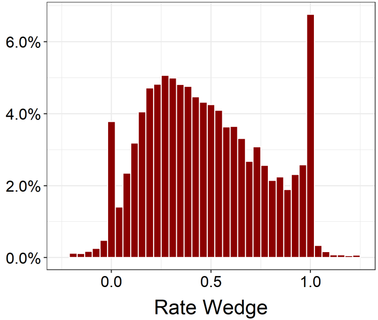

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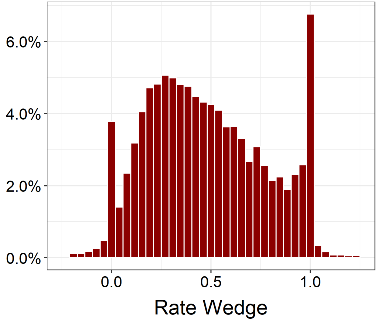

- Large heterogeneity in rate wedge across states.
  - Rank states into **High**, **Medium**, **Low** friction by the average wedge.
  - High (Low) friction $\rightarrow$ states are farthest from (closest to) meeting actuarial costs.

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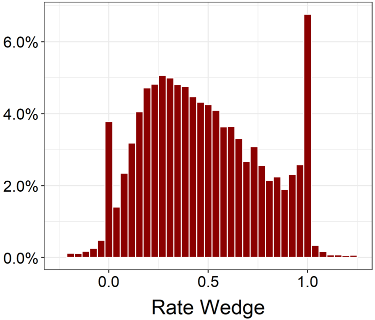

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  - Rank states into **High**, **Medium**, **Low** friction by the average wedge.
  - High (Low) friction $\rightarrow$ states are farthest from (closest to) meeting actuarial costs.
- Wedge captures regulators' actions, not insurer's strategic response. Interpret rate wedge

Empirical approach

- Do insurance rates respond differently to realized losses across states?
  (1) **Same-state losses (SSL)**: losses within the filing state.
  (2) **Out-of-state losses (OSL)**: losses outside the filing state.

- Motivated by standard insurance pricing models: (??)

$$P = \underbrace{E[\text{Losses}]}_{\text{Marginal cost}} \times \underbrace{\text{Markup}}_{\text{Imperfect competition}} \times \underbrace{\text{Shadow cost}}_{\text{Financing frictions}}$$

- **Without regulation**: rates should respond to realized losses (HO contracts are short-dated).

- **With regulation**: rates may be less responsive depending on the degree of regulation.

Roadmap

(1) **Rate filings data**

- State level rate changes data.
- Compare high friction states with low friction states. Example: California vs. Virginia.
- **Advantage**: external validity and results generalize.

(2) **Granular data and border discontinuities:**

- ZIP code level rates data.
- Compare high and low friction ZIP codes along state borders. Example: ZIP codes on North Carolina (high friction) - South Carolina (low friction) border.
- **Advantage**: micro-laboratory (near identical risk exposures but different regulation).

1. Responses to same-state losses

Question: Do rates respond to same-state losses (SSL) differentially across states?

$$\underbrace{Y_{ist}}_{\text{Filing outcomes}} = \underbrace{\gamma \text{SSL}_{ist-1} + \gamma^M \text{SSL}_{ist-1} \times Med_s + \gamma^L \text{SSL}_{ist-1} \times Low_s}_{\text{Responses to losses in filing state}} + \alpha_{is} + \alpha_{st} + \theta X_{it} + \epsilon_{ist}$$

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	Any Filings$_{ist}$	Received$_{ist}$
	(1)	(2)
SSL_{ist-1}	-0.011	0.156
	(0.027)	(0.286)
$\text{SSL}_{ist-1} \times \text{Med}_s$	0.044	0.104
	(0.028)	(0.403)
$\text{SSL}_{ist-1} \times \text{Low}_s$	0.100***	0.688**
	(0.035)	(0.303)
E[LHS]	0.7	3.63
State type	All	All
Controls	Yes	Yes
State $\times$ Year Fixed Effects	Yes	Yes
Insurer $\times$ State Fixed Effects	Yes	Yes
Observations	19,308	19,308

In **High** states relative to **Low** states:

(1) Insurers are less likely to file for a rate change after losses.

(2) They are also less likely to receive a rate change in response to losses.

2. Responses to out-of-state losses

- Asymmetric rate spillovers: rates in **Low** friction states respond to losses in **High** friction states, but the opposite is not true.

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- Asymmetric rate spillovers: rates in **Low** friction states respond to losses in **High** friction states, but the opposite is not true.

$$\underbrace{Y_{ist}}_{\text{Filing outcome}} = \gamma \underbrace{\text{Same-State Losses}_{ist-1}}_{\text{Losses in filing state}} + \beta \underbrace{\text{Out-of-State Losses}_{i\bar{s}t-1}}_{\text{Losses in all other states}} + \alpha_{is} + \alpha_{st} + \theta X_{it} + \epsilon_{ist}$$

(a) Split filing state *s* into Low, Medium, High friction:

- Q: In which states do insurers respond to out-of-state losses?
- **Answer**: In Low friction states but not in High friction states.

(b) Split out-of-state losses depending on where they come from: Low, Medium, High friction:

- Q: Does the response to out-of-state losses vary based on which states losses come from?
- **Answer**: Yes, only out-of-state losses coming from higher friction states matter.

2(a) Low friction states respond to out-of-state losses

	Any Filings_{ist}				
	(1)	(2)	(3)	(4)	(5)
OSL_{ist-1}	0.027*	−0.004	0.013	0.151***	−0.006
	(0.015)	(0.022)	(0.012)	(0.033)	(0.021)
$\text{OSL}_{ist-1} \times \text{Med}_s$					0.019
					(0.025)
$\text{OSL}_{ist-1} \times \text{Low}_s$					0.162***
					(0.041)
E[LHS]	0.7	0.7	0.8	0.7	0.7
State type	All	High	Medium	Low	All
Controls	Yes	Yes	Yes	Yes	Yes
State × Year Fixed effects	Yes	Yes	Yes	Yes	Yes
Insurer × State Fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	17,980	5,656	6,231	6,093	17,980

- In **Low** states, insurers are more likely to file for a rate change after out-of-state losses.

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OSL_{ist-1}	0.632**	0.085	0.758*	1.710***	0.075
	(0.236)	(0.208)	(0.362)	(0.543)	(0.205)
$\text{OSL}_{ist-1} \times \text{Med}_s$					0.693*
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2(b) Only out-of-state losses from higher friction states matter

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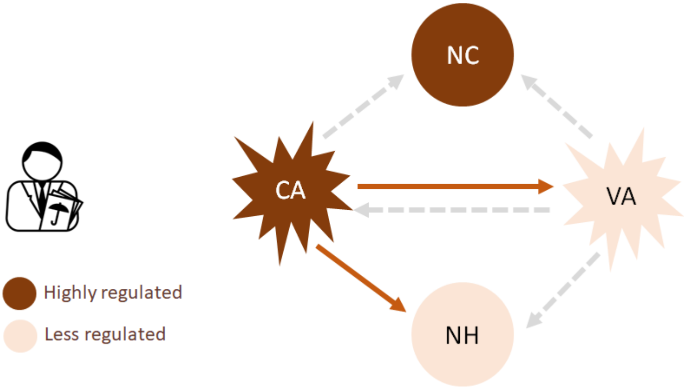
Summary of asymmetric pricing spillovers



✓**High** to **Low** ✗**High** to **High** ✗**Low** to **High** ✗**Low** to **Low**

Evidence from granular rates and border discontinuity design

Concern: Potentially comparing geographically distant states having different underlying risk exposures.

- Differential learning about expected losses.
- Low friction states may have smaller losses, which can adjust locally with no spillovers.

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Approach: Compare rate responses across **Low - High** friction **state borders** for a single representative insurance contract with ZIP code data.

Bordering ZIP codes have:

- Near identical underlying risk exposures ($\rightarrow$ similar pricing patterns).
- But different regulatory friction.

Data and summary statistics

Empirical setting:

- 11 state pairs that border each other and have opposite regulation (514 ZIP codes).
- ZIP code level rates data from Quadrant Information Services from 2011-2020 for the **largest** insurers in a state.

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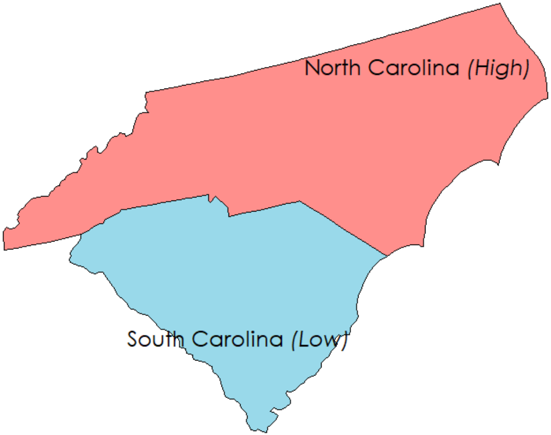
Summary statistics:

	Low friction	High friction
Average insurance rate ($)	3,269	2,869
	(4.27)	(3.13)
Growth rate (2011 to 2020)	41%	33%

1. Response to local losses

Compare response of <u>same</u> insurer and contract, in areas w/ **similar** risks and **different** regulation.

- For each state pair, identify common shocks.



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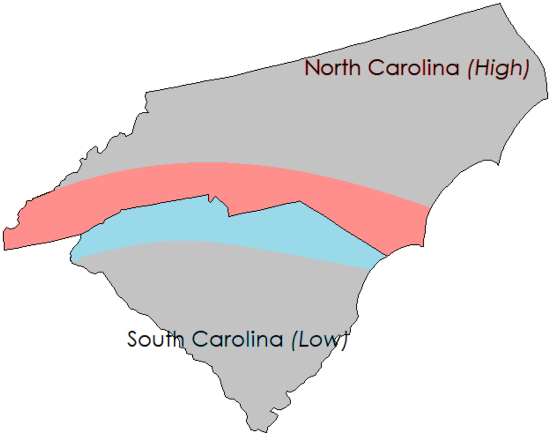

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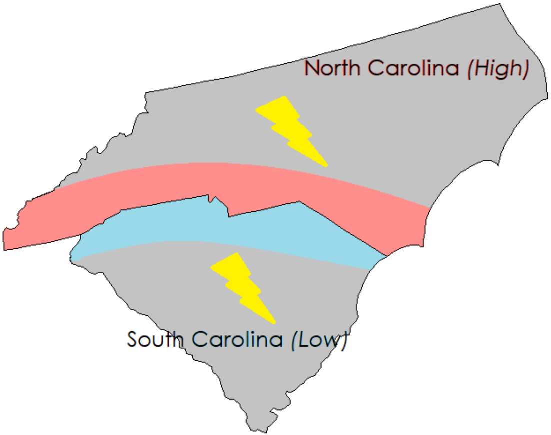

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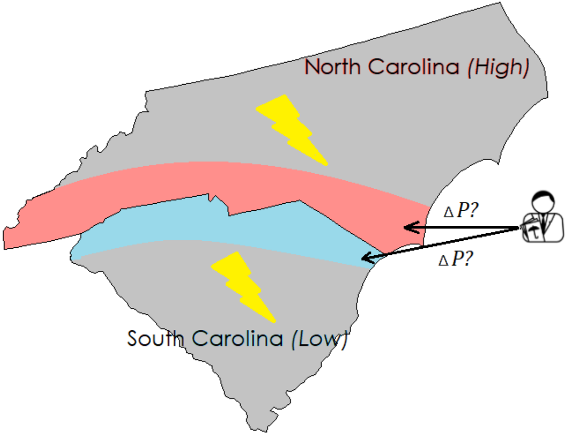
- Ask how rates respond to the common shock across bordering ZIP codes using a DiD event study design.



1. Response to local losses

Compare response of same insurer and contract, in areas w/ **similar** risks and **different** regulation.

- For each state pair, identify common shocks.
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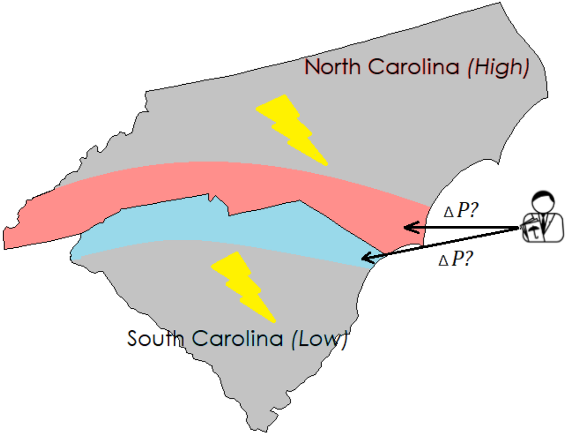
- Rates ↑ more in *Low* than in bordering *High* friction ZIP codes



1. Response to local losses (results)

$$Y_{iz(\in b)t} = \gamma Low_z \times Post_{bt} + \alpha_{ib} + \alpha_z + \alpha_{bt} + \xi X_{it} + \epsilon_{izt}$$

	$\log(\text{Insurance Rate}_{iz(\in b)t})$		
	(1)	(2)	(3)
$Low_z \times Post_{bt}$	0.065***	0.053***	0.049***
	(0.008)	(0.008)	(0.006)
$Post_{bt}$	0.031***	0.031***	
	(0.008)	(0.007)	
Low_z	0.123***		
	(0.022)		
Controls	Yes	Yes	Yes
Insurer × Border Fixed effects	Yes	Yes	Yes
ZIP Code Fixed effects	No	Yes	Yes
Border × Year Fixed effects	No	No	Yes
Observations	18,883	18,883	18,883

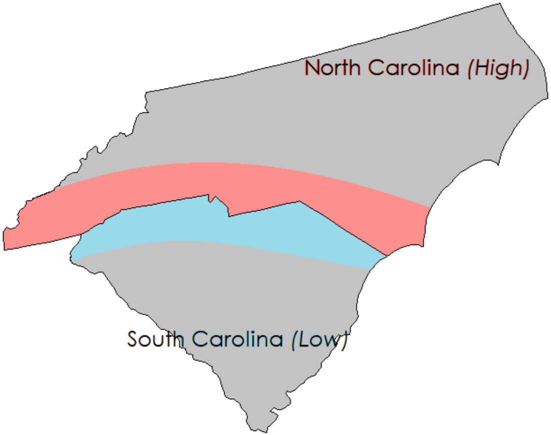
◂ Main

- Rates increase 4-6% more in low friction ZIP codes than in bordering high friction ZIP codes after the shock.

2. Response to out-of-state losses

Compare response of <u>same</u> insurer and contract, in areas w/ **similar** risks and **different** regulation.

- Identify large shocks in any *High* friction state $\notin$ state border pair (out-of-state shock)



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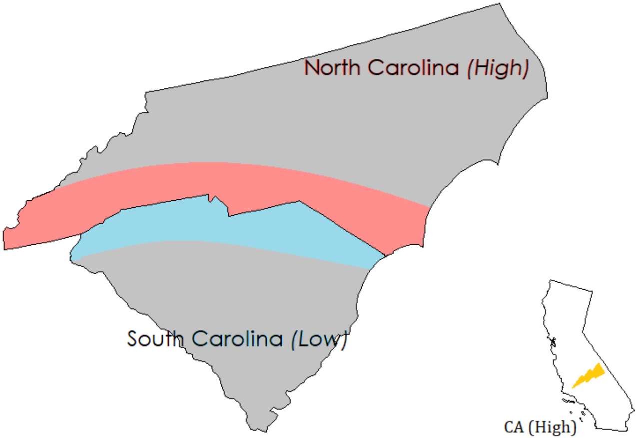

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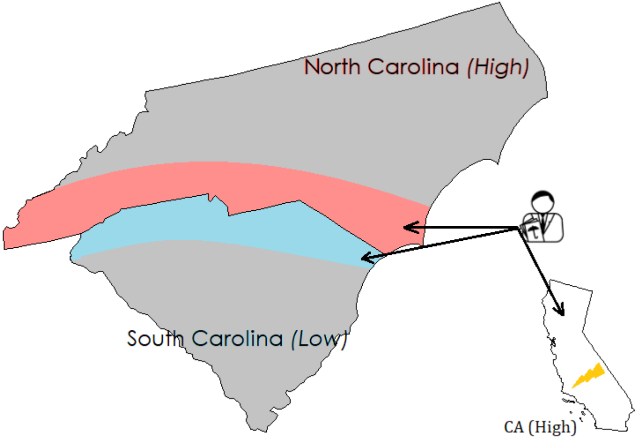

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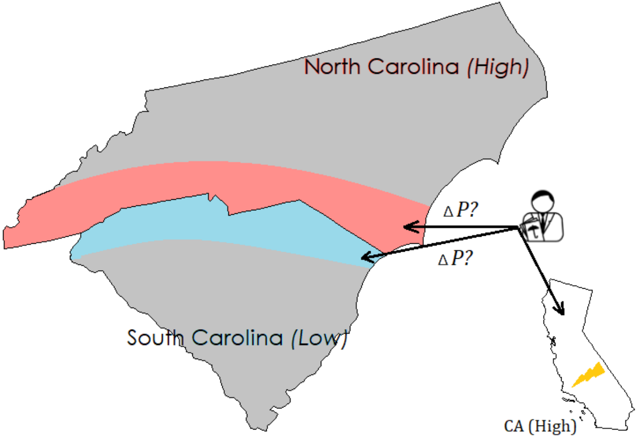

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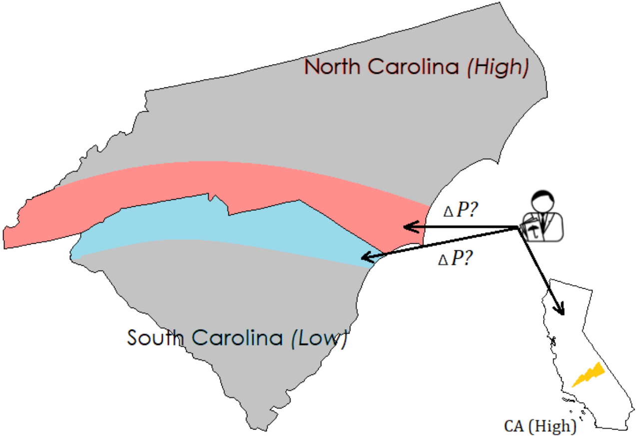
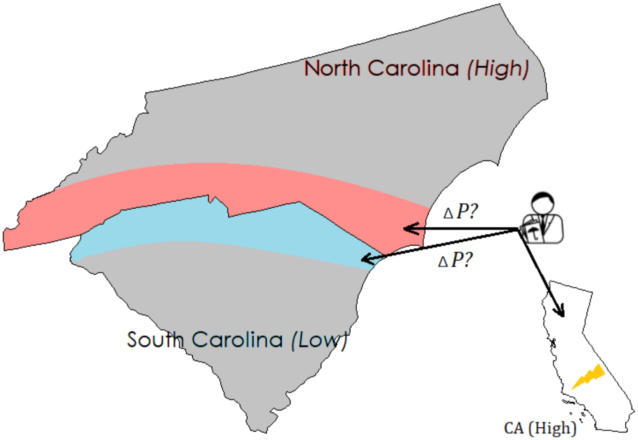


2. Response to out-of-state losses

Compare response of <u>same</u> insurer and contract, in areas w/ **similar** risks and **different** regulation.

- Identify large shocks in any *High* friction state $\notin$ state border pair (out-of-state shock)
- Ask how rates respond across bordering ZIP codes using a triple-diff event study design
- Rates $\uparrow$ more in *Low* than in bordering *High* friction ZIP codes
- Driven by insurers w/ large exposure to the shock (substantial share in CA).



2. Response to out-of-state losses

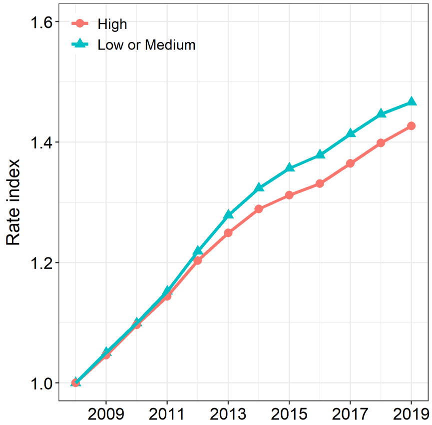
$$Y_{iz(\in b)te} = \beta Low_z \times Post_{te} \times Affected_{ie} + \alpha_{zie} + \alpha_{zte} + \alpha_{ite} + \epsilon_{zite},$$

	log(Insurance Rate$_{iz(\in b)t}$)				
	(1)	(2)	(3)	(4)	(5)
$Low_z \times Post_{te} \times Affected_{ie}$	0.043***	0.033***	0.060***	0.058***	0.058***
	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
$Low_z \times Affected_{ie}$	−0.028***	−0.012*	−0.044***	−0.040***	
	(0.011)	(0.007)	(0.008)	(0.008)	
$Post_{te} \times Affected_{ie}$	0.006	−0.010**	−0.038***		
	(0.004)	(0.005)	(0.006)		
$Low_z \times Post_{te}$	−0.014***	−0.020***			
	(0.003)	(0.003)			
$Post_{te}$	0.053***	0.085***			
	(0.003)	(0.002)			
Low_z	0.129***	0.106***			
	(0.037)	(0.017)			
$Affected_{ie}$	0.055***				
	(0.009)				
Controls	Yes	Yes	Yes	Yes	Yes
Fixed Effects	–	*bie*	*bie* + *bte*	*bie* + *bte* + *ite*	*zie* + *zte* + *ite*
Observations	295,560	295,560	295,560	295,560	295,560

Alternative explanations

1. **Product changes:** Better products in low friction states in response to out-of-state losses?
   - ✗ Granular analysis compares rates for the <u>same</u> contract offered to the <u>same</u> demographic group.
2. **Learning:** Are insurers learning about future expected losses?
   - ✗ Common exposure story: Expect *High* → *Low* and *Low* → *High* spillovers.
   - ✗ Signal story: 1. Expect *High* → *High* spillovers. 2. Spillovers primarily driven by **Affected** insurers.
3. **Competition:** Are low friction states less competititive?
   - ✗ Low, Medium, High are similarly competitive (according to HHI and single state insurers' share).
4. **Size of losses:** Are losses originating in high friction states bigger?
   - ✗ No spillover from low friction states that have comparable losses as the high friction states.
5. **Reinsurance:** Differential shifts in reinsurance prices?
   - ✗ Same-state results → low friction losses affect reinsurance rates more than high friction losses.
   - ✗ Out-of-state results → high friction losses affect reinsurance rates more than low friction losses.

Decoupling of long-run insurance rates from risk



- Rates grew 4pp *slower* in **High** states.
- But **High**: more exposed to climate risk.

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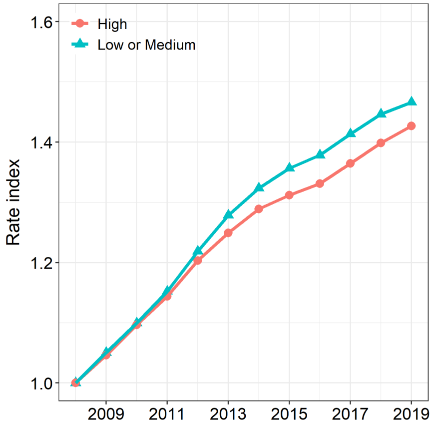
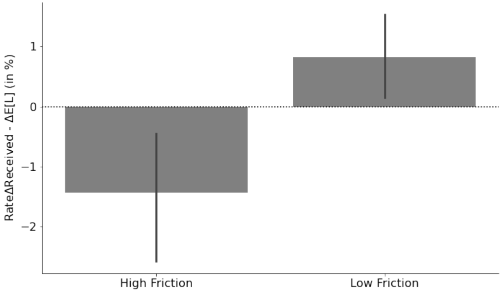
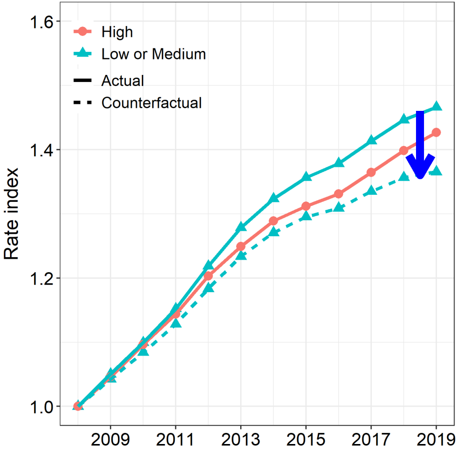




- Rates grew 4pp *slower* in **High** states.
- But **High**: more exposed to climate risk.
- Compared to **Low**, **High** states have lower rate growth relative to growth in E[L].

Long-run insurance rates: actual vs. counterfactual

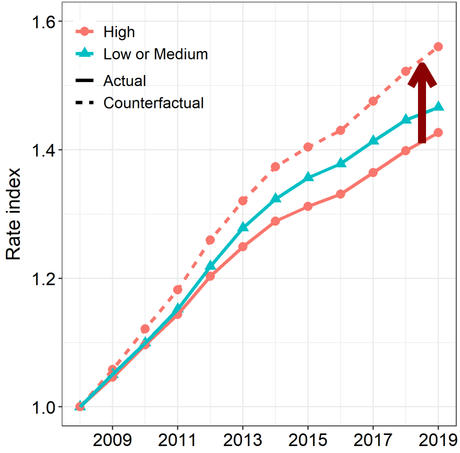


Counterfactual rates:

1. What if there were no spillovers in **Low** and **Med** from **High**?

   → Rate growth would be **10pp** slower.

Long-run insurance rates: actual vs. counterfactual



Counterfactual rates:

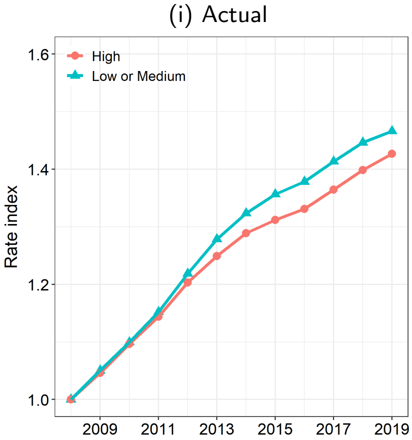
1. What if there were no spillovers in **Low** and **Med** from **High**?

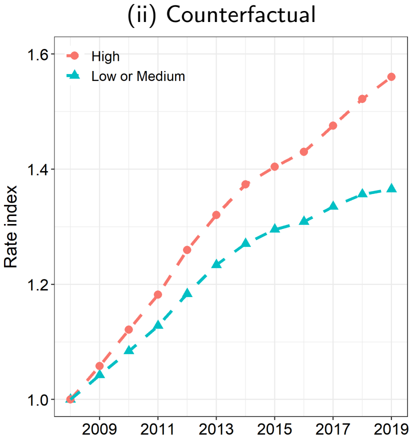
   → Rate growth would be **10pp** slower.

2. What if **High** states were regulated similarly as **Low**?

   → Rate growth would be **13pp** faster.

Long-run insurance rates: actual vs. counterfactual





- Overall, rates would have grown **20pp** faster in **High** than in **Low**, in line with risks.

Conditions necessary to rationalize rate spillovers

(1) Exits should be unattractive.

- In response to strict regulation, insurers could stop selling insurance.
- **Evidence**: exits, policy cancellations, and non-renewals are relatively rare; and mostly concentrated among small insurers.

(2) Insurers' problem should depart from region-by-region profit maximization.

- **Financing frictions.** Supportive evidence: spillovers are stronger for more constrained insurers. ZIP analysis Rate filings
- **Capital market pressure.** Stronger spillovers for publicly traded companies. Insurer type

(3) States should be less than perfectly competitive.

- Evidence and literature is consistent with less competition. Comp Single-state premia

Conclusion and implications

This paper: decoupling of insurance prices from risk, driven by the regulatory landscape.

Implications:

- Risk sharing across states.
- Long-run availability of insurance.
- Whether insurance prices can serve as a useful signal of risk.