Is Flood Risk Priced in Bank Returns?

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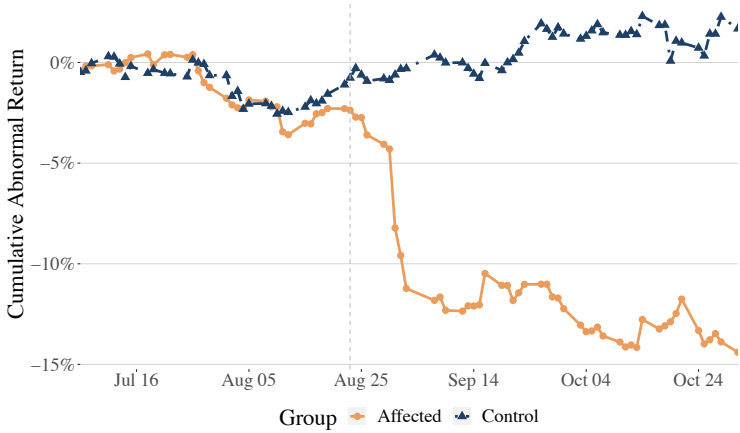
EEA, August 22 2022

Climate risk to financial sector

'Physical risks, stranded assets and greater firm default risk expose the financial system to losses'

— Christine Lagarde, ECB

- Climate change has become a major topic for financial regulators
- Fear that markets are not paying enough attention
- Climate risk is potentially a threat to banking sector
- The issue remains controversial
- In general still little knowledge about the interaction of climate risk and bank stock returns



Cumulative abnormal returns of banks affected by Hurricane Katrina (orange) and non-affected banks (blue)

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This paper

Research questions:

- What is the impact of flood risk on bank stock returns?

What do I do?

- Use mortgage data to create novel regional exposure measure for banks
- Link to a flood probability map to quantify **flood risk exposure** and compute a flood risk premium
- Use past flood disasters to measure realized costs of floods for banks

Preview of results

- Negative return predictability of flood risk exposure
  - Flood discount → *Puzzle*
  - Banks with higher flood risk exposure earn a lower return
  - 10 most exposed banks earn 50 basis points lower monthly return
  - No underperformance for large banks
- Underperformance not driven by 'transition period'
  - Climate change concerns
- Underperformance not washed out by flood shocks

Related Literature

- **Climate risk and asset prices**

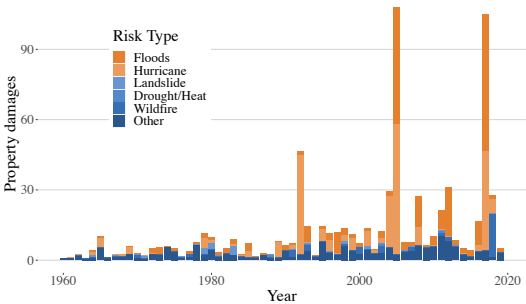
  Hong, Li, and Xu (2019), Bolton and Kacperczyk (2021), Choi, Gao, and Jiang (2020), Engle, Giglio, Kelly, Lee, and Stroebel (2020), Garbarino and Guin (2021), Bernstein, Gustafson, and Lewis (2019), Baldauf, Garlappi, and Yannelis (2020), Gibson and Mullins (2020), Murfin and Spiegel (2020), Keys and Mulder (2020)

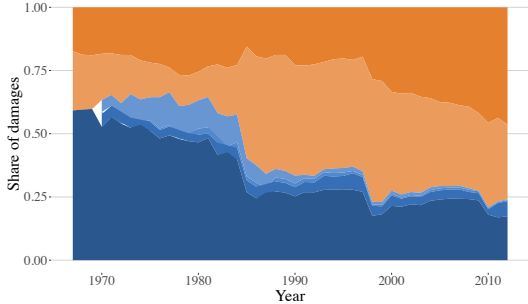
- **Weather disasters and bank lending**

  Cortés and Strahan (2017), Schüwer, Lambert, and Noth (2019),Blickle, Hamerling, and Morgan (2021), Brown, Gustafson, and Ivanov (2021), **?**, Ivanov, Macchiavelli, and Santos (2022)

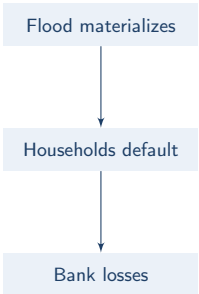
- This paper: flood risk premium in bank returns

Why focus on floods?





The flood risk channel

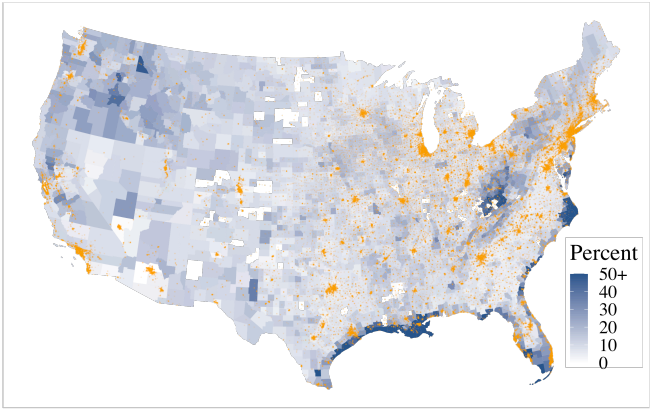


Hypothesis: Positive flood premium for exposed banks

Validate flood risk channel

1. Flood realizations decrease bank performance
2. Floods increase mortgage delinquencies
3. Delinquencies decrease bank performance

Geographic variation in risk of flooding



Share of residential housing defined as 'high risk'. Bank branches added in orange

Estimating geographic exposure

- Need a measure to capture regional exposure
- Common approach is using the location of headquarters/branches
- But flood exposure is in the real estate
- Construct a measure based on mortgages
- Use HMDA restricted to single-family home purchases and retained by the bank

$$\text{County Exposure}_{bct} = \frac{\sum_t \text{retained}_{bct}}{\sum_c \sum_t \text{retained}_{bct}} \tag{1}$$

- Main focus on retained mortgages to avoid bank hedging

Quantifying exposure to flood risk

- Need to adequately capture bank-level exposure from bank-county-level risks
- Exposure to flood risk combines flood probabilities with HMDA

$$\text{Flood Risk Exp.}_{by} = \sum_{c} (\text{County Exposure}_{bcy} \times \text{Flood Probability}_{c}) \tag{2}$$

Do markets price the exposure to high flood regions?

Flood premium for exposed banks

- Regress monthly bank excess returns on flood risk exposure
- Controlling for past month return, log(assets), BE/ME, leverage, ΔVIX
- Cross-section regression
  - Fama-MacBeth: monthly cross-section average across time
- Pooled-OLS
  - With time fixed effects and clustered standard errors

Negative risk premium for high flood exposure

- Flood discount
- Results driven by most exposed
- Ten most exposed banks have 50 basis points lower monthly returns

Measures | Geographic

Table 1: Flood risk exposure and stock returns

	Fama-MacBeth		pooled-OLS	
	(1)	(2)	(3)	(4)
Flood Risk Exposure (std)	-0.15***		-0.15***	-0.14***
	(-3.56)		(-2.77)	(-2.85)
High Flood Risk		-0.390***		
		(-3.35)		
Medium Flood Risk		-0.15		
		(-1.236)		
Bank Controls	✓	✓	✓	✓
Observations	60'130	60'130	58,431	58,431
R^2	0.352	0.353	0.049	0.255
Time fixed effects				✓

Fama-MacBeth: Newey-West adjusted with 3 lags; Pooled-OLS: clustered at the bank level.
Statistical significance is given by $*$: $p < 0.10$; $**$:$p < 0.05$; $***$:$p < 0.01$

Heterogeneity of effects

	Excess Returns					
	Risk Exposure		Mortgage Loan Share		Size	
	High	Low	High	Low	Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)
Flood Risk Exposure	-0.21***	-0.04	-0.24***	-0.12	-0.29***	0.008
	(-3.0)	(-0.14)	(-3.2)	(-1.5)	(-3.8)	(0.11)
Obs.	22,690	20,926	20,935	22,681	23,648	19,968
R^2	0.318	0.261	0.251	0.324	0.199	0.457

All regressions include bank controls and month fixed-effects. Standard errors are clustered at the bank level. t-statistics are in parenthesis. Statistical significance is given by $*$: $p < 0.10$; $**$:$p < 0.05$; $***$:$p < 0.01$

What drives the negative result?

Change in investors' climate-change concerns

- Demand effect exists
- But underperformance remains

	Excess Returns		
	UMC: Aggregate	SVI: Climate Change	SVI: Flood
	(1)	(2)	(3)
Flood Risk Exposure	-0.14*	-0.15**	-0.15**
	(-1.7)	(-2.4)	(-2.4)
ΔCC	-0.46***	-0.14***	-0.76***
	(-6.9)	(-3.2)	(-11.8)
Flood Risk Exposure	0.09	0.005	-0.16***
$\times \Delta CC$	(1.1)	(0.14)	(-2.9)
Obs.	35,008	42,499	42,499
R^2	0.07	0.07	0.08

Regressions control for bank characteristics and economic variables. Standard errors are clustered at the bank level. Statistical significance is given by $*$: $p < 0.10$; $**$:$p < 0.05$; $***$:$p < 0.01$

Exposure to past disasters

- Disaster exposure reduces ER further
- But underperformance remains

	Excess Returns		Return Residuals
	Weighted Damages	High Damage	Weighted Damages
	(1)	(2)	(3)
Flood Risk Exposure	-0.12**	-0.15**	-0.09*
	(-2.0)	(-2.5)	(-1.7)
Flood Damages	-0.08***	-0.24*	
	(-2.7)	(-1.7)	
Flood Risk Exposure	-0.001	0.34**	
× Flood Damages	(-0.08)	(2.1)	
Obs.	50,957	50,957	50,957
R^2	0.05	0.05	0.03

Regressions control for bank characteristics and economic variables. Standard errors are clustered at the bank level. Statistical significance is given by $*$: $p < 0.10$; $**$: $p < 0.05$; $***$: $p < 0.01$

Removing disaster months

	Excess Returns			
	w/o Hurricane Katrina	w/o major storms	Zero Damage Exposure	Zero Damage Exposure and High Flood Risk
	(1)	(2)	(3)	(4)
Flood Risk Exposure	-0.18***	-0.19***	-0.16*	-0.33*
	(-3.1)	(-3.3)	(-1.6)	(-1.7)
Obs.	42,403	41,809	11,062	2,809
R^2	0.28	0.29	0.24	0.32

Regressions include bank controls and month fixed-effects. Standard errors are clustered at the bank level. Statistical significance is given by $*$: $p < 0.10$; $**$:$p < 0.05$; $***$:$p < 0.01$

Heterogeneity in disaster effects

	Excess Returns			
	Small		Large	
	Full	Zero Damage Exposure	Full	Zero Damage Exposure
	(1)	(2)	(3)	(4)
Flood Risk Exposure	-0.20**	-0.27**	0.03	0.17
	(-2.5)	(-2.5)	(0.32)	(0.99)
Flood Damages	-0.50***		-0.34**	
	(-3.1)		(-2.5)	
Obs.	24,677	9,905	26,280	4,466
R^2	0.06	0.06	0.06	0.09

Regressions include bank controls and month fixed-effects. Standard errors are clustered at the bank level. Statistical significance is given by $*$: $p < 0.10$; $**$:$p < 0.05$; $***$:$p < 0.01$

Additional tests

- Results robust to different risk horizons and exposure weights Measures
- Results also not driven by regional economic activity Geographic
- Results similar using small business loans SBL
- Exposure to high flood insurance rate weakens result NFIP
- Portfolio of top 25% minus bottom 25% lost 2.2% annually
- Explains up to 25% in return variation of exposed banks in the top quartile

Conclusion

- Flood risk is a key factor driving bank stock returns of small banks
- Puzzle: flood risk-exposed banks underperform
- Different from flood realizations
- Not fully explained by 'transition period'

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