Natural Disasters and Credit Risk

10th Conference on Financial Development and Stability – Financial Market Commission (CMF)

"Towards a robust, trustworthy, and inclusive financial system in the era of digital transformation"

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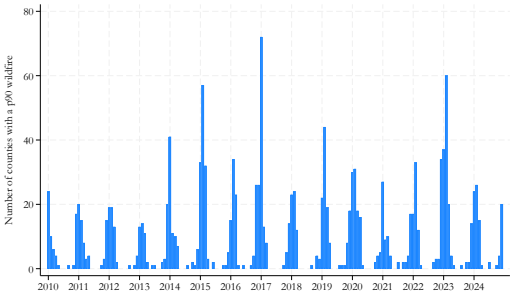
Motivation

- Natural disasters are now **frequent, costly, and climate-linked**.
- Damage to borrowers can propagate to **banks** and threaten **financial stability**.
- Regulators (Basel, BIS, BCCh) concerns: *how should climate risk enter prudential frameworks?*
- Evidence on **realized, acute physical shocks** is scarce.



Counties with a large wildfire, Chile 2010–2024.

Research question

Do large natural disasters generate credit-risk effects that are large enough to threaten bank solvency, and how do banks respond to climate risk after realized shocks?

Three sub-questions:

1. Do wildfires **causally raise firm credit risk** (delinquency, days past due)?
2. Do banks **recognize** this risk through provisions — and is the bank-level effect **macroeconomically significant**?
3. Do banks **update beliefs about future climate risk** (loan pricing, supply) in ex-ante exposed but undamaged areas?

This paper

We use **universal bank–firm credit registry data** from Chile (2010–2024) matched with the **wildfires records** (Min. Environment) and firm characteristics (SII) to:

- Identify causal effects of large physical shocks using **LP-DiD with clean controls**.
- Trace effects from **borrower distress** $\rightarrow$ **bank provisions** $\rightarrow$ **aggregate solvency**.
- Identify **direct damage** from **belief-updating**.

Preview of findings

1. **Firms.** Wildfires raise delinquency by **0.7 pp** (6.3% of mean) at h=12; delinquent debt +12%; days past due +3 days.
2. **Heterogeneity.** Effects are concentrated in **small firms**, **agriculture & forestry**, and **weak bank–firm relationships**.
3. **Banks.** Provisions rise at the firm level, but the effect **vanishes once aggregated** to the bank–month: too small to threaten solvency.
4. **Repricing.** After a major wildfire, interest rates rise **+46 bps** (+4.4%) in counties with *high ex-ante* wildfire exposure that were *not* directly hit.

Method preview: LP-DiD with firm and bank×time FE; identification from event timing across counties, conditioning on clean treated and clean control windows.

Related literature & contribution

- **Natural disasters, firm performance, and credit risk**

  Leiter et al. (2009); Barrot & Sauvagnat (2016); Zhou & Botzen (2021); Meier et al. (2023); Barbaglia et al. (2023); Aguilar-Gomez et al. (2024); Fatica et al. (2024); Collier et al. (2025); Shao (2025); Chowdhury (2026)

  → Firm-level causal evidence for **wildfires**, concentrated in **small** and **agriculture/forestry** firms, and a role for **bank–firm relationships** .

- **Bank pricing, credit supply, and provisioning under climate risk**

  Cortés & Strahan (2017); Do et al. (2021); Javadi & Masum (2021); Koetter et al. (2021); Aslan et al. (2022); Berg & Schrader (2012); Correa et al. (2022); Meisenzahl et al. (2023); Álvarez (2024); Dal Maso et al. (2024).

  → Evidence that wildfires raise rates in exposed-but-undamaged counties, cut lending in affected zones, and lift firm-level provisions — yet the rise in provisions **dissipates at aggregated levels.**

- **Climate shocks and financial stability**

  Brei et al. (2019); Caloia & Jansen (2021); Battiston et al. (2021); Rehbein & Ongena (2022); Chabot & Bertrand (2023); Noth & Schüwer (2023); Walker et al. (2023); De Bandt et al. (2025); D'Orazio (2025); Koch et al. (2026)

  → A **micro-to-macro** aggregation evidence, showing thatacute physical shocks exposures are concentrated in small borrowers to materially threaten **aggregate bank solvency.**

Data and variables

Source	Variable	Frequency / Granularity
CMF	Bank–firm credit stock, delinquency, provisions	Monthly, firm×bank
CMF	New loans: rate, amount, maturity, collateral	Monthly, loan-level
Min. Environment	Hectares burned by wildfire	Monthly, county
SII (tax authority)	Sector (ISIC 4), size, location	Annual, firm

- **Large wildfire:** burned share $>$ 90th percentile of the county-month distribution.
- **Ex-ante exposure:** cumulative burned area 2002–2010 (pre-sample).
- Universe of bank–firm relationships: $\sim$25M firm-bank-month observations.

Identification: LP-DiD with clean controls

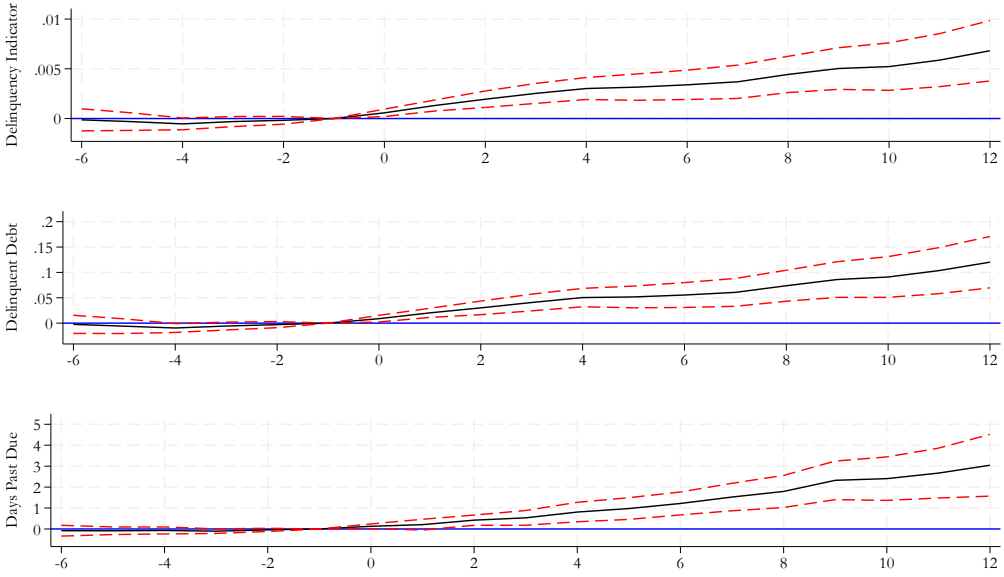
Following Dube, Girardi, Jordà & Taylor (2025):

$$y_{i,b,t+h} - y_{i,b,t-1} \;=\; \alpha_i + \lambda_{b,t} \;+\; \beta_h \,\text{Wildfire}_{i,c,t} \;+\; \rho_h \, y_{i,b,t-1} \;+\; \varepsilon_{i,b,t+h}$$

- $y_{i,b,t}$: delinquency outcome for firm i at bank b, month t; c is firm's county.
- α_i firm FE; $\lambda_{b,t}$ bank$\times$time FE absorb bank supply shocks.
- **Clean treated**: no other large wildfire in prior 12 months.
- **Clean control**: untreated throughout the $[-12, +12]$ window.
- Two-way clustering: county and year-month.

Identifying assumption: parallel pre-trends conditional on FE. Tested formally (no significant pre-coefficients; permutation placebos centered at zero).

Wildfires raise firm delinquency — persistently, modestly



Robustness and Alternative Explanations

- Results are primarily driven by wildfire exposure rather than broader temperature shocks. Controlling for heatwaves leaves the wildfire coefficient virtually unchanged, while heatwave effects are small and statistically insignificant. Heatwave Results
- Our results are robust to alternative wildfire exposure definitions, excluding firms in Greater Santiago, removing the lagged dependent variable, incorporating richer fixed effects, stricter clean-sample definitions, and extending the horizon to 18 months.

Heterogeneity by Firm Size

	Delinquency Indicator	Delinquent Debt	Days Past Due
Panel A. Small Firms			
Treated	0.005***	0.087***	0.776**
	(0.001)	(0.015)	(0.308)
Observations	13,964,905	13,964,905	10,055,433
R-squared	0.363	0.358	0.578
Effect / Pre-mean (%)	5.7	5.9	5.4
Panel B. Medium Firms			
Treated	0.002	0.028	0.957**
	(0.001)	(0.020)	(0.482)
Observations	5,176,513	5,176,513	3,368,481
R-squared	0.275	0.277	0.536
Effect / Pre-mean (%)	2.1	1.9	3.7
Panel C. Large Firms			
Treated	0.001	0.024	1.257
	(0.002)	(0.031)	(0.757)
Observations	4,181,379	4,181,379	2,513,264
R-squared	0.243	0.241	0.513
Effect / Pre-mean (%)	2.7	2.4	14.7
Firm FE	Yes	Yes	Yes
Bank $\times$ Time FE	Yes	Yes	Yes

Heterogeneity by Firm Sector

	Delinquency Indicator	Delinquent Debt	Days Past Due
Panel A. Agriculture, Forestry, Fishing, and Mining			
Treated	0.004***	0.071***	1.220**
	(0.002)	(0.027)	(0.519)
Observations	1,479,737	1,479,737	910,193
R-squared	0.350	0.342	0.572
Effect / Pre-mean (%)	4.8	4.5	10.6
Panel B. Manufacturing			
Treated	0.002	0.036	0.462
	(0.002)	(0.028)	(0.833)
Observations	2,734,020	2,734,020	1,747,278
R-squared	0.320	0.313	0.554
Effect / Pre-mean (%)	1.3	1.4	2.6
Panel C. Utilities and Construction			
Treated	0.003	0.061	-0.285
	(0.003)	(0.042)	(0.712)
Observations	2,723,821	2,723,821	1,850,403
R-squared	0.351	0.344	0.574
Effect / Pre-mean (%)	2.9	3.0	-2.6
Panel D. Commerce, Transportation, and Tourism			
Treated	0.003***	0.052***	1.539***
	(0.001)	(0.017)	(0.422)
Observations	8,837,090	8,837,090	6,241,619
R-squared	0.341	0.334	0.570
Effect / Pre-mean (%)	3.5	3.6	9.4
Panel E. Service			
Treated	0.004***	0.062***	0.618*
	(0.001)	(0.016)	(0.322)
Observations	8,090,596	8,090,596	5,508,122
R-squared	0.328	0.319	0.559
Effect / Pre-mean (%)	7.4	7.1	5.6
Firm FE	Yes	Yes	Yes
Bank × Time FE	Yes	Yes	Yes

Heterogeneity by Bank-Firm Relationship Strength - Small Firms

	Delinquency Indicator	Delinquent Debt	Days Past Due
Panel A. Main bank relationship			
Treated	0.010***	0.175***	2.055***
	(0.002)	(0.029)	(0.699)
Treated × Main bank	-0.006***	-0.109***	-1.573***
	(0.002)	(0.031)	(0.570)
Observations	13,893,222	13,893,222	10,018,863
R-squared	0.362	0.358	0.577
Treated / Pre-mean (%)	9.6	10.2	6.5
Interaction / Pre-mean (%)	-5.9	-6.4	-5.0
Panel B. Bank share of firm's outstanding debt			
Treated	0.013***	0.221***	3.088***
	(0.003)	(0.041)	(0.873)
Treated × Share (%)	-0.010***	-0.167***	-2.886***
	(0.003)	(0.049)	(0.778)
Observations	13,893,222	13,893,222	10,018,863
R-squared	0.363	0.358	0.577
Treated / Pre-mean (%)	11.9	12.9	9.8
Interaction / Pre-mean (%)	-8.9	-9.8	-9.1
Panel C. Number of Bank Relationships			
Treated	0.007***	0.122***	1.863***
	(0.002)	(0.029)	(0.603)
Treated × Single Bank	-0.004*	-0.075*	-1.882***
	(0.002)	(0.040)	(0.561)
Observations	13,893,222	13,893,222	10,018,863
R-squared	0.364	0.360	0.578
Treated / Pre-mean (%)	6.8	7.1	5.9
Interaction / Pre-mean (%)	-4.1	-4.4	-6.0
Firm FE	Yes	Yes	Yes
Bank × Time FE	Yes	Yes	Yes

Heterogeneous Impact of Large Wildfires on Provisions: Firm-level

	Provisioning Ratio	Total Provisions	Delinquent Provisions
Panel All firms			
Treated	0.001***	-0.005	0.056***
	(0.000)	(0.011)	(0.012)
Observations	22,997,764	32,937,805	22,997,764
R-squared	0.286	0.369	0.322
Effect / Pre-mean (%)	0.1	-0.05	4.6
Panel A. Small Firms			
Treated	0.001***	0.004	0.080***
	(0.000)	(0.010)	(0.014)
Observations	13,964,905	20,746,066	13,964,905
R-squared	0.314	0.420	0.356
Effect / Pre-mean (%)	2.2	0.04	6.0
Panel B. Medium Firms			
Treated	0.001	-0.009	0.028
	(0.001)	(0.019)	(0.019)
Observations	5,176,513	7,156,712	5,176,513
R-squared	0.230	0.345	0.275
Effect / Pre-mean (%)	1.4	-0.09	2.2
Panel C. Large Firms			
Treated	0.001	0.009	0.024
	(0.001)	(0.025)	(0.030)
Observations	4,181,379	5,516,898	4,181,379
R-squared	0.200	0.304	0.239
Effect / Pre-mean (%)	0.01	0.09	2.9
Firm FE	Yes	Yes	Yes
Bank × Time FE	Yes	Yes	Yes

Impact of Large Wildfires on Provisioning: Bank-County-Size-Month Level

	Provisioning Ratio	Total Provisions	Delinquent Provisions
Panel A. Small			
Treated	0.000	0.069*	0.174***
	(0.001)	(0.037)	(0.066)
Observations	269,131	284,821	284,821
R-squared	0.225	0.276	0.255
Effect / Pre-mean (%)	0.8	0.5	1.9
Panel B. Medium			
Treated	-0.001	-0.022	-0.172*
	(0.002)	(0.047)	(0.102)
Observations	237,493	252,798	252,798
R-squared	0.320	0.272	0.240
Panel C. Large			
Treated	0.001	-0.005	-0.031
	(0.001)	(0.056)	(0.110)
Observations	229,241	245,014	245,014
R-squared	0.149	0.252	0.233
Effect / Pre-mean (%)	1.4	-0.0	-0.6
County FE	Yes	Yes	Yes
Bank × Time FE	Yes	Yes	Yes

Impact of Large Wildfires on Provisioning: Bank-County-Month Level

Panel A. Bank-County Delinquency Outcomes			
	Delinquent Debt	Ratio Deliquency	% Delinquent Firms
Treated	0.0389	-0.0016	0.0004
	(0.0812)	(0.0024)	(0.0020)
Observations	338,058	326,504	326,504
R-squared	0.243	0.232	0.250
Effect / Pre-mean (%)	0.4	-1.9	0.4
Panel B. Bank-County Provisioning Outcomes			
	Provisioning Ratio	Total Provisions	Delinquent Provisions
Treated	-0.001	0.015	0.044
	(0.001)	(0.037)	(0.077)
Observations	326,504	338,058	338,058
R-squared	0.181	0.255	0.241
Effect / Pre-mean (%)	-1.3	0.1	0.5
County FE	Yes	Yes	Yes
Bank $\times$ Time FE	Yes	Yes	Yes

Empirical Strategy: Repricing of Wildfire Credit Risk

$$y_{i,b,c,t} = \beta \left(\text{Wildfire}_t^k \times \text{HighExposure}_c \right) + \delta X_{i,b,t} + \alpha_i + \lambda_{b,t} + \varepsilon_{i,b,c,t}$$

- $y_{i,b,c,t}$: loan interest rate or loan amount granted to firm i by bank b
- Wildfire_t^k: recent large wildfire event
- HighExposure_c: county-level historical wildfire exposure
- Identification compares lending conditions in high- vs. low-exposure counties after large wildfires
- Specification includes firm FE, bank-time FE, and loan-level controls
- Excludes firms located in directly affected counties

Effects of Large Wildfires on New Lending by Ex ante Exposure

	(1) Exposure p75	(2) Exposure p80	(3) Exposure p90
Panel A: Interest Rate			
0-3 months since WF × High Exposure	0.370***	0.452***	0.463***
	(0.030)	(0.047)	(0.064)
4-6 months since WF × High Exposure	0.327***	0.400***	0.441***
	(0.077)	(0.067)	(0.152)
Observations	712,157	712,157	712,157
R-squared	0.854	0.854	0.854
Panel B: Loan Amount (log)			
0-3 months since WF × High Exposure	-0.175***	-0.327***	-0.288***
	(0.053)	(0.013)	(0.011)
4-6 months since WF × High Exposure	-0.155**	-0.329***	-0.219***
	(0.062)	(0.016)	(0.009)
Observations	712,157	712,157	712,157
R-squared	0.804	0.804	0.804
Firm FE	Yes	Yes	Yes
Bank-Time FE	Yes	Yes	Yes

Conclusions

- Wildfires worsen firm repayment capacity, mainly among small firms and climate-exposed sectors
- Banks increase loan-loss provisions for affected firms, but aggregate effects on bank solvency remain limited
- Exposed borrowers represent a small share of total credit portfolios
- Banks' response to climate risk after large wildfires in unaffected wildfire-prone counties:
  - Higher interest rates
  - Lower lending
- Climate shocks generate borrower-level disruptions even without systemic financial instability

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Wildfires and Heatwaves

Back

	Delinquency Indicator	Delinquent Debt	Days Past Due
Panel A. Baseline			
Treated	0.004***	0.061***	1.032***
	(0.001)	(0.013)	(0.310)
Observations	23,219,668	23,219,668	15,913,073
R-squared	0.334	0.326	0.566
Effect / Pre-mean (%)	4.5	4.5	6.9
Panel B. Baseline + Heatwave P90			
Treated	0.004***	0.061***	1.030***
	(0.001)	(0.013)	(0.310)
Heatwave (P90)	0.001	0.010	0.032
	(0.000)	(0.007)	(0.055)
Observations	23,219,668	23,219,668	15,913,073
R-squared	0.334	0.326	0.566
Effect / Pre-mean (%)	4.5	4.5	6.9
Panel C. Baseline + Heatwave 30 Celsius			
Treated	0.004***	0.061***	1.036***
	(0.001)	(0.013)	(0.308)
Heatwave 30 Celsius	0.000	0.005	0.099
	(0.000)	(0.005)	(0.141)
Observations	23,219,668	23,219,668	15,913,073
R-squared	0.334	0.326	0.566
Effect / Pre-mean (%)	4.5	4.5	6.9
Panel D. Heatwave P90			
Heatwave (P90)	0.001**	0.012**	0.107**
	(0.000)	(0.006)	(0.052)
Observations	23,462,566	23,462,566	16,080,500
R-squared	0.333	0.325	0.565
Effect / Pre-mean (%)	0.8	0.7	0.7
Panel E. Heatwave 30 Celsius			
Heatwave 30 Celsius	0.001**	0.013*	0.225
	(0.000)	(0.007)	(0.144)
Observations	23,293,637	23,293,637	15,957,031
R-squared	0.334	0.326	0.566
Effect / Pre-mean (%)	1.1	1.1	1.4
Firm FE	Yes	Yes	Yes
Bank × Time FE	Yes	Yes	Yes