

Extreme Weather and Low-Income Household Finance: Evidence from Payday Loan

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NEADA Spring Meetings: The Increasing Unaffordability of Home Energy

April 10, 2024

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Climate change and household finance

- Extreme weather shocks are increasing in frequency and intensity with climate change
 - potentially more financial hardship for lower-income households
- Existing papers using data on traditional consumer credit products Literature review
 - find short-lived impacts on credit scores and reductions in total debt
 - offer little evidence on alternative credit products accessed by lower-income households
 - focus on FEMA declared natural disasters and less on weather shocks
- **Research Questions:**
 - How do weather shocks affect the payday loan market, and through what channels?
 - Could public policies such as the Low Income Household Energy Assistance (LIHEAP) program mitigate such effects?

In this paper

- Data
 - an **applicant-level payday loan** dataset covering 2012 to 2019 from *Clarity*
 - a **loan-level** dataset covering 2013 to 2019 referred to as *tradeline*
 - monthly weather variables constructed from ERA5-Land reanalysis archive
- Empirical design
 - fixed effects **temperature-bin** approach
 - controls for seasonality, general warming trend, regional business cycles, etc.
- Outcomes
 - **demand for** versus **access to** payday loan products
 - online versus storefront

What we find

- Extreme temperature shocks significantly impact payday loan market outcomes
- **Overall Effects:**
 - extreme heat shocks **increase** payday loan demand, default rate, delinquency rate and **reduces** credit approval
 - A one standard deviation increase in the number of extreme hot days per month
⇒ 0.4% increase in total inquiries and 0.4% drop in credit issued
- **Online versus Storefront:**
 - effects mostly driven by changes in **online** payday loan markets

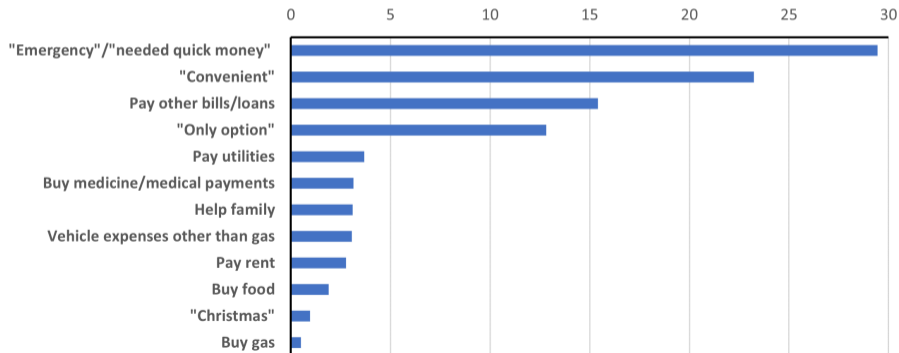
Payday loan background

- Short-term source of liquidity with two to four-week maturities
- Interest rate can be as high as 400 to 600 APR
- Access to cash or equivalent (*important for utility payment*)

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Distribution of Reasons for Payday Loan Usage in Percentage



Source: Survey of Consumer Finances, 2013, 2016, 2019.

Payday loan dataset

Geographical distribution

- Source: lender reported database from *Clarity*
- *Inquiries* dataset:
applicant ID, application date, loan type, income, age, months at address, ZIP code
- *Tradelines* dataset:
applicant ID, origination date, loan type, loan terms, performance

Weather Data

ERA5-Land: hourly temperature and precipitation with $0.1^\circ \times 0.1^\circ$ horizontal resolution

We use the number of days in a month in which falls within a specified range

Baseline: daytime (between 8am and 8pm local time) average temperature: **below -9°C** , **above 33°C** , and 14 bins for every 3°C in between

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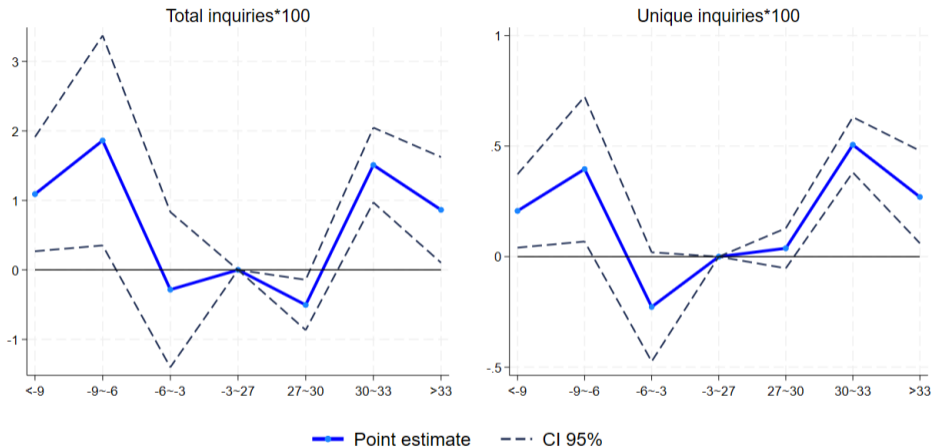
- 24-hour average temperature
below -12°C , **above 30°C** , and 14 bins for every 3°C in between
- daily maximum temperature
below -6°C , **above 36°C** , and 14 bins for every 3°C in between
- daytime mean temperatures
below the 5th percentile and below -9° , **above the 95th percentile and above 33°** , and the number of days with daytime mean temperature in between

Empirical Strategy

$$\text{Outcome}_{it} = \theta T_{it} + \mu_t + \eta_{cy} + \text{Controls} + \varepsilon_{it}$$

- Outcome_{it} : payday loan-related outcome variables of interest at ZCTA i in month t
- T_{it} : numbers of days in month t that ZCTA i fall into each temperature bin
 - Construct bins based on daytime (between 8am and 8pm) mean temperature
 - below -9°C , above 33°C , and 14 bins for every 3°C in between
 - Use -3°C to 27°C as the omitted baseline
- μ_t : year-month fixed effects; η_{cy} : county-year fixed effects

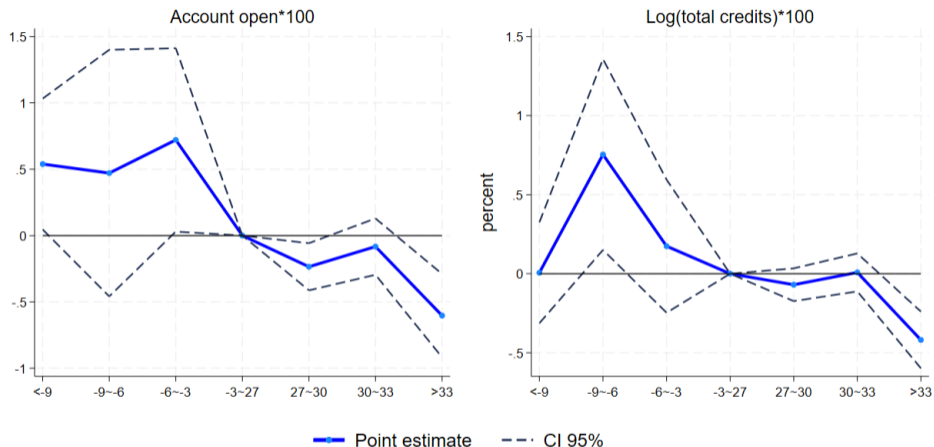
Payday Loan Demand: Inquiries



A one standard deviation increase in the number of extreme hot or cold days per month

⇒ 0.4% increase in total inquiries relative to the baseline

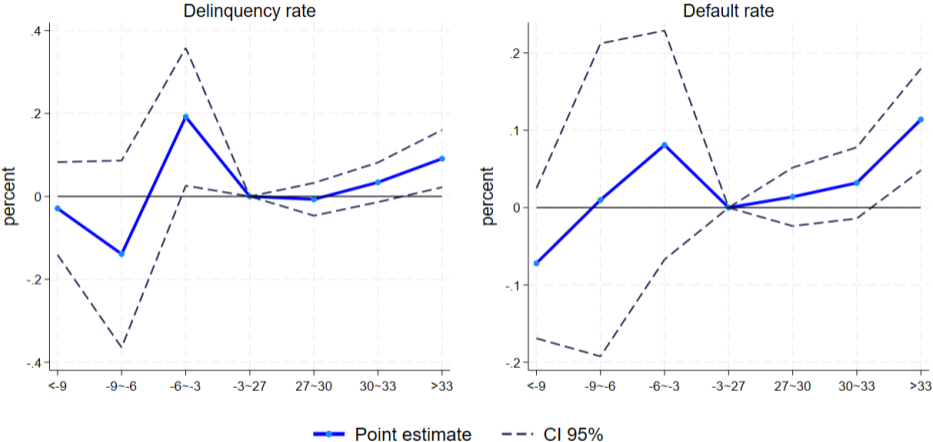
Equilibrium: Accounts Opened and Total Credits



A one standard deviation increase in the number of extreme hot days per month

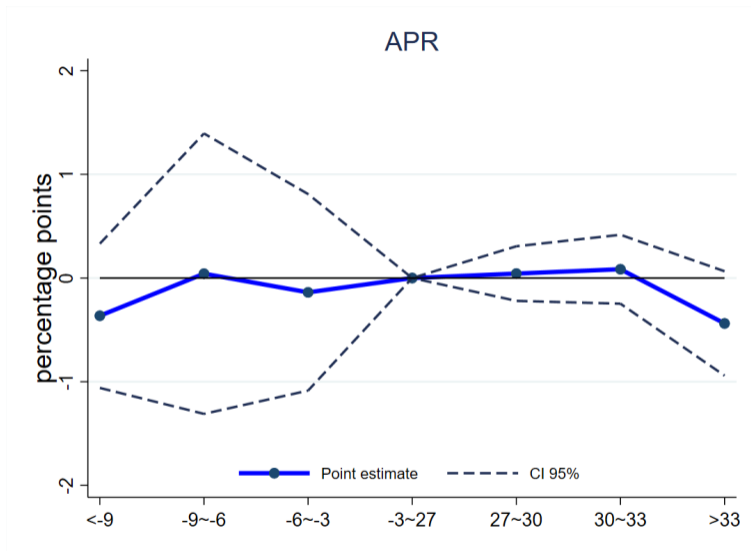
⇒ 0.7% decrease in accounts open and 0.4% drop in credit issued relative to the baseline

Loan Performance: Delinquency and Default Rates



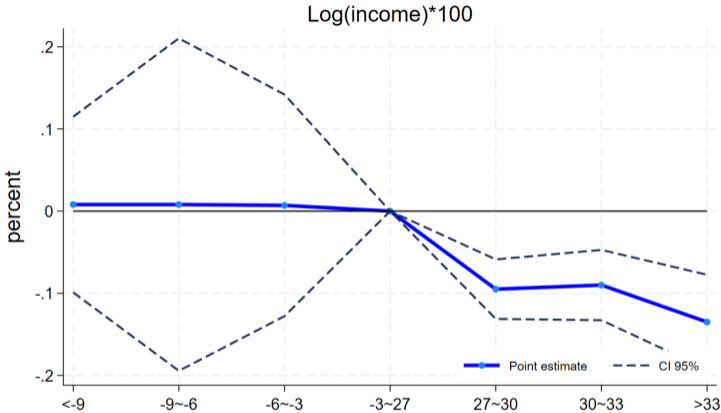
A one standard deviation increase in the number of extreme hot days per month
⇒ 3% increase in default rates relative to the baseline

APR



There is no significant impact on the APR.

Borrower Income



A one standard deviation increase in the number of extreme hot days per month
⇒ 0.14% decrease in monthly income relative to the baseline

Robustness and placebos

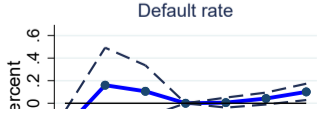
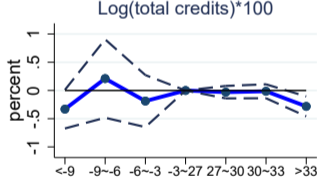
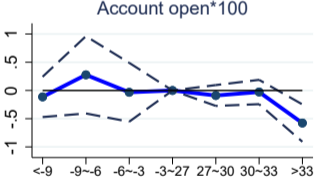
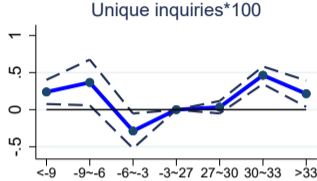
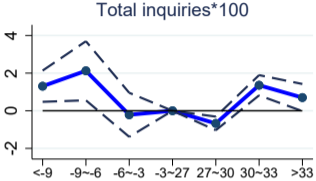
Robustness:

- various definitions of temperature bins
- add the lags of the dependent variable
- add the lags of the temperature variables
- ZCTA fixed effects, region by quarter fixed effects

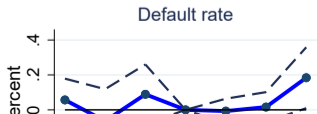
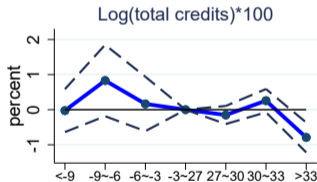
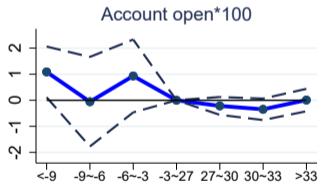
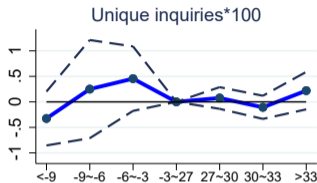
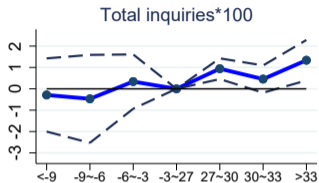
Placebos:

- Shuffle the temperature variables for the same month nation-wide
- Shuffle the temperature variables for the same month region-wide

Effects mostly driven by changes in online payday loan markets



Storefront payday loans market less responsive to weather shock



- LIHEAP assists eligible low-income households with their heating and cooling energy costs, bill payment assistance, energy crisis assistance, weatherization, and energy-related home repairs
- Eligibility: income less than (whatever is greater):
 - 150% of the Federal poverty line
 - 60% of the state's median income

$$\text{Outcome}_{jt} = \theta T_{it} + \beta \text{Treat}_{jt} + \mu_t + \eta_{cy} + \varepsilon_{jt}$$

- Outcome_{jt} : payday loan-related outcome variables for borrower j in month t ;
- Treat_{jt} : consider borrowers within small income bands around LIHEAP eligibility, takes the value 1 if borrower j is eligible in month t
- T_{it} : numbers of days in month t that ZCTA i fall into each temperature bin
- μ_t : year-month fixed effects
- η_{cy} : county-year fixed effects

	(1)	(2)	(3)	(4)	(5)
	total inquiries*100	days inquired*100	log(credits)*100	delinquency rate	default rate
Treat	-17.49*** (5.564)	-3.235** 1.477	-5.749 (4.208)	1.171 (1.940)	2.789 (1.838)
Observations	32,555	32,555	2,156	2,170	2,170
R-squared	0.221	0.178	0.5	0.402	0.351
Year-month FE	X	X	X	X	X
County*Year FE	X	X	X	X	X
Renter FE	X	X	X	X	X
Age group FE	X	X	X	X	X

Low-Income Home Energy Assistance Program (LIHEAP)

- Sources of measurement errors
 - LIHEAP eligibility defined for household income
 - Fuzzy RDD is limited due to missing individual treatment status
- Compared to the bulk of work on FEMA aid programs
 - Less work on program evaluation for LIHEAP, especially in the context of rising energy demand due to climate change
- We are interested in future collaboration with better LIHEAP data
 - microdata on individual applications and approval
 - historic changes in program accessibility and methods of applications across states
 - RCT or adding survey questions within application forms

Conclusions

Provide novel evidence on the effects of extreme weather on low-income household finances using data on the payday loan market

- Extreme temperature leads to **increases in demand** for payday loans.
 - In particular, extreme **heat** days lead to
 - **decreases** in the number of accounts opened or the total amount of loans taken
 - **increases** in default rates and delinquency rates of existing loans
 - **no** impact on APR
 - **decreases** in borrower income
- ⇒ consistent with a **contraction in loan supply** to screen borrowers

References

- Addoum, Jawad M, David T Ng, and Ariel Ortiz-Bobea**, "Temperature shocks and establishment sales," *The Review of Financial Studies*, 2020, 33 (3), 1331–1366.
- Allcott, Hunt, Joshua Kim, Dmitry Taubinsky, and Jonathan Zinman**, "Are high-interest loans predatory? theory and evidence from payday lending," *The Review of Economic Studies*, 2022, 89 (3), 1041–1084.
- Blonz, Josh, Brigitte Roth Tran, and Erin E Troland**, "The Canary in the Coal Decline: Appalachian Household Finance and the Transition from Fossil Fuels," Technical Report, National Bureau of Economic Research 2023.
- Correia, Filipe, Peter Han, and Jialan Wang**, "The Online Payday Loan Premium," *Working Paper*, 2022.
- Deschênes, Olivier and Michael Greenstone**, "Climate change, mortality, and adaptation: Evidence from annual fluctuations in weather in the US," *American Economic Journal: Applied Economics*, 2011, 3 (4), 152–185.
- Dobridge, Christine L**, "High-cost credit and consumption smoothing," *Journal of Money, Credit and Banking*, 2018, 50 (2-3), 407–433.
- Gallagher, Justin and Daniel Hartley**, "Household finance after a natural disaster: The case of Hurricane Katrina," *American Economic Journal: Economic Policy*, 2017, 9 (3), 199–228.
- Gathergood, John, Benedict Guttman-Kenney, and Stefan Hunt**, "How do payday loans affect borrowers? Evidence from the UK market," *The Review of Financial Studies*, 2019, 32 (2), 496–523.
- Melzer, Brian T**, "The real costs of credit access: Evidence from the payday lending market," *The Quarterly Journal of Economics*, 2011, 126 (1), 517–555.
- Morse, Adair**, "Payday lenders: Heroes or villains?," *Journal of Financial Economics*, 2011, 102 (1), 28–44.
- Park, R Jisung, Joshua Goodman, Michael Hurwitz, and Jonathan Smith**, "Heat and learning," *American Economic Journal: Economic Policy*, 2020, 12 (2), 306–39.
- Valle, Alejandro Del, Therese C Scharlemann, and Stephen H Shore**, "Household Financial Decision-Making After Natural Disasters: Evidence from Hurricane Harvey," 2022.
- Wilson, Daniel J**, "Clearing the fog: The predictive power of weather for employment reports and their asset price responses," *American Economic Review: Insights*, 2019, 1 (3), 373–388.

Appendix

- **Alternative credit markets:** *e.g.* Allcott et al. (2022); Correia et al. (2022); Dobridge (2018); Gathergood et al. (2019); Melzer (2011); Morse (2011), etc.

Our contributions: instead of evaluating the impact of payday loan access, we show extreme weather shocks directly worsen payday loan market performance

- **Climate change and household finance:** *e.g.* Blonz et al. (2023); Del Valle et al. (2022); Gallagher and Hartley (2017)

Our contributions: show alternative credit markets operate differently

- **Extreme temperature exposures in the United States:** *e.g.* Deschênes and Greenstone (2011); Wilson (2019); Addoum et al. (2020); Park et al. (2020), etc.

Our contributions: document large negative financial impacts for low-income households through worsening credit cycles in payday loan markets

Summary Statistics of ZCTA Daily Temperatures

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	All ZCTAs								
	mean	sd	p99	p95	p90	p50	p10	p5	p1
Daytime mean	14.80	11.18	33.28	29.95	28.07	16.39	-0.56	-4.79	-13.38
24-hour mean	12.92	10.72	30.59	27.56	25.78	14.34	-1.61	-5.79	-14.49
Maximum	18.19	11.02	36.90	33.14	31.11	19.95	2.40	-1.23	-9.07

	ZCTAs with payday loan inquiries								
	mean	sd	p99	p95	p90	p50	p10	p5	p1
Daytime mean	17.55	10.32	34.38	31.04	29.28	19.45	2.72	-1.04	-9.18
24-hour mean	15.65	9.91	31.64	28.58	27.08	17.34	1.50	-2.01	-10.19
Maximum	20.90	10.20	38.17	34.36	32.34	22.89	5.92	1.81	-5.34
