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

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Abstract

Climate change is associated with an increasing number of extreme weather events, such as extreme heat waves, severe winter weather, more frequent and intensive hurricanes, etc. An emergent literature in climate economics has recently examined the impact of extreme weather events on consumer credit, using data from loan-level credit card transactions and consumer credit panels. One limitation of using traditional credit card data is that the sample analysis is restricted to relatively higher income households who have access to traditional credit lines. So far, little evidence exists for how low-income households who rely on alternative credit products are impacted by extreme weather due to climate change. Our research project fills in this gap using relatively underexplored microdata on payday loans with nationwide coverage in the United States. Our project has three main goals. First, combining satellite data with spatial and temporal granularity, and a new panel on online and storefront payday loan applications, we study how consumption needs during extreme heat waves and extremely cold days affect payday loan application, delinquency, APR, etc. Second, we rely on a regression discontinuity design in the program eligibility rules to causally identify the impact of the Low-Income Home Energy Assistance Program (LIHEAP) on household finances. Third, we shed light on distributional impact and environmental justice issues through heterogeneity analysis.

JEL classification: Q54, G50, D14
Keywords: climate change, alternative credit channels, household finance

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1 Project Description

1.1 Motivation

As extreme weather conditions become more common with climate change, there is an urgent need to understand the impact of these environmental shocks on economic activities, firms, and households. Emergent literature in climate economics recently examined the impact of hurricanes on household finance, using data from consumer credit panels, student loans, and credit card transactions (Gallagher & Hartley 2017, Gavriilidis 2021, Del Valle, Scharlemann & Shore 2022). These studies find that spikes in credit card borrowing after natural disasters are modest and short-lived and that households have reductions in total debt, due to their use of insurance to repay their debts rather than to rebuild.

So far, existing work is limited in external validity to generalize the conclusions to low-income households. In particular, individuals who are not qualified to access traditional credit card lines will not be part of the traditional consumer credit panels and therefore have not been the focus of existing studies. There are many reasons why low-income households may be affected differently by extreme weather conditions, such as constraints in budgets and decision-making time, lack of formal and/or informal insurance, etc. Our research fills in this gap by leveraging a microdata panel on the storefront and online payday loan applications, which is relatively underexplored in the literature. Our research project examines the impact of extreme weather conditions (extreme heat and extremely cold days) on the household finance of low-income individuals. This project sheds light on alternative credit product channels for households who may lack access to traditional credit card lines. Beyond baseline analysis, we also conduct program evaluations for the impact of the Low-Income Home Energy Assistance Program (LIHEAP) on household finances under climate change. Finally, our project speaks to environmental justice issues and the distributional impact of climate change.

1.2 Research Design

The project has three main goals. First, we rely on a fixed-effect temperature-bin regression framework, to examine the impact of extreme heat days and extremely cold days on the payday loan application and approval outcomes. As home energy consumption and health spending needs during extremely cold days and extreme heat waves drastically increase, lower-income households who usually face tighter budget constraints may turn to alternative credit products such as storefront or online payday loans, both of which are captured in our microdata panel. Using spatially and temporally granular satellite data from ERA5-Land, for the period of 2000-2018, we construct monthly weather variables such as mean temperature, cumulative rainfall, wind

speed, snow depth, etc. Our first regression exercise is to determine the effects of temperature exposures on the payday loan market at the ZCTA (ZIP code Tabulation Areas) level. We posit the following form,

$$\text{Outcome}_{it} = \theta T_{it} + \mu_t + \eta_{cy} + \text{Controls} + \varepsilon_{it} \tag{1}$$

where Outcome_{it} measures the outcome variables of interest at ZCTA i in month t; θ is a vector of parameters; T_{it} is a vector of climatic variables that we discuss in detail below; μ_t is year-month fixed effects; η_{cy} is the county-year fixed effects; and ε_{it} is the error term. Standard errors are clustered at the ZCTA level.

The climatic variables in T_{it} include location and time-specific temperature and precipitation measures. We use nine temperature bins: below -10°C, above 25°C, and seven 5°C bins in between. We use 15°C–20°C as the baseline temperature bin. We calculate the number of days during the month that temperatures are in each of the bins. Furthermore, we use a monthly average of on-the-day average precipitation to control for the confounding effect of precipitations.

Our baseline fixed effect framework allows us to control for a wide range of confounding shocks that may correlate with extreme weather shocks, and to causally identify the impact of these environmental shocks on lower-income household payday loan applications and approval. We examine a series of outcomes such as the number of inquiries, highest credit approved, delinquency rates, default rates, etc. Our data also allow us to separately identify the impact on online versus storefront payday loans.

The second part of our research design examines the Low-Income Home Energy Assistance Program (LIHEAP), a policy which has so far received little attention in terms of program evaluation despite its wide reach. Our research design relies on a fuzzy regression discontinuity rule, which sets program eligibility thresholds proportional to the yearly state-level median income, to causally identify the impact of LIHEAP on climate change related payday loan lending. Assuming households just below and above the program cutoffs are similar in other characteristics except for their eligibility for LIHEAP, we estimate the Intention-to-treat effects of LIHEAP on household payday loan borrowing under extreme weather conditions.

The final part of our research aims to shed light on environmental justice issues by linking zipcode-level payday loan application data with neighborhood demographic compositions. We conduct heterogeneity analysis and examine potential distribution effects. For example, we study how payday loan demand and approval under extreme weather conditions differ depending on average community income level, percentages of ethnic minorities, etc. We also examine how these heterogeneity results differ for online versus storefront payday loans.

1.3 Preliminary Findings

Our findings indicate the extreme heat days lead to more payday loan inquiries, higher delinquency rates, and higher default rates. However, we do not see a corresponding increase in the number of total loans approved and the highest credits allocated. This indicates that demand for payday loan borrowing is increasing yet supply is sluggish. As a controversial credit product, and an alternative to other sources of credit, understanding the equilibrium lending rates under extreme weather events would be an additional contribution which we are aiming to make. We also plan to develop a theoretical framework of payday loan lending under extreme weather shocks, to help us better understand the potential mechanisms at work.

1.4 Timeline

- Current - June 2023
  - Cross-validation of key variables in the payday loan data with existing work
  - Complete baseline regression analysis, LIHEAP analysis and heterogeneity analysis
- June - December 2023
  - Develop a model of payday loan supply and demand under extreme weather
  - Analyze potential mechanisms at work
  - Complete preliminary draft and submit to conferences: e.g. Climate finance session at the Stanford SITE, San Francisco Fed Reserve conference on climate change and macroeconomics, etc.
  - Present, circulate draft and gather feedback
- January - April 2024
  - Revise based on feedback and prepare manuscript for journal submission

References

Del Valle, A., Scharlemann, T. C. & Shore, S. H. (2022), 'Household financial decision-making after natural disasters: Evidence from hurricane harvey'.

Gallagher, J. & Hartley, D. (2017), 'Household finance after a natural disaster: The case of hurricane katrina', *American Economic Journal: Economic Policy* **9**(3), 199–228.

Gavriilidis, K. (2021), 'Measuring climate policy uncertainty', *Available at SSRN 3847388* .

2 Itemized Budget

We would like to request $15,000 of funding to cover the following expenses.

1. Travel expenses for visiting collaborators: $6,000
2. Travel expenses for conference presentations: $4,500
3. Data acquisition: $4,500

Last updated: March 2023

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Academic Positions

University of Illinois at Urbana-Champaign
Assistant Professor — Jan 2021 - present
Instructor — Aug 2020 - Jan 2021

Education

Ph.D. in Economics, University of California at San Diego — 2020
B.S. in Mathematics and Economics, Nanyang Technological University — 2013

Publications

"An Estimated Model of Household Inflation Expectations: Information Frictions and Implications", accepted at *Review of Economics and Statistics*

Working Papers

"Macroprudential Policy and Housing Market Expectations" with Pei Kuang, Kaushik Mitra, and Li Tang
"Effects of Monetary Policy on Household Expectations: The Role of Homeownership" with Hie Joo Ahn and Choongryul Yang, *under review*
"Monetary Policy Shocks and Local Housing Prices", *under review*

Work in Progress

"Extreme Weather and Low-Income Household Finance: Evidence from Payday Loan" with Victoria Wenxin Xie and Xu Zhang
"Inflation and Housing Market Expectations" with Wei Cui and Pei Kuang
"Portfolio Driven Households' (In-)attention" with Choongryul Yang
"Migration, Macroeconomic Experiences, and Entrepreneurship" with Remy Levin

Presentations (including scheduled)

2023: Osaka University, Bank of Canada, University of Essex, University of Birmingham, University of Kent, National Institute of Economic and Social Research, China International Conference in Macroeconomics, Asian Meeting of the Econometric Society, SETA
2022: Applied Time Series Econometrics Workshop at St. Louis Fed, Federal Housing Finance Agency
Midwest Macro Meetings Spring & Fall, 4th Behavioral Macroeconomics Workshop
Euro Area Business Cycle Network Conference on "New Challenges to Monetary Policy"
California Macroeconomics Conference, CFE-CMStatistics
2020: University of Arkansas, UIUC, Smith College, Bank of Canada

Before 2020: UC San Diego, Macro Finance Modeling summer session for young scholars (poster)

Teaching

Instructor at UIUC:

Monetary Economics (PhD field)	Spring 2022
Macroeconomics II (PhD core)	Spring 2021, 2022, 2023
Economic Forecasting (Undergrad)	Spring & Fall 2021, 2023

Teaching Assistant at UCSD:

Econometrics D (PhD)	Fall 2019
Econometrics B (PhD)	Winter 2015, 2016
Macroeconomics C (PhD)	Spring 2016 - 2018
Macroeconomics A & B (Undergrad)	2015 - 2019
Monetary Economics (Undergrad)	Fall 2017

Student Advising

Ph.D. students (role, first placement)

- Pedro Simon (3rd year paper advisor, ongoing)
- Minyoung Cho (co-advisor, ongoing)
- Italo Morais Santos (committee member, ongoing)
- Zhendong Sun (committee member, ongoing)
- Hansen Shao (committee member, Guotai Junan Securities)

Undergrad students (first placement)

- Linjia Feng (graduated with distinction, Master of Financial Engineering at Cornell)
- Ju Li (graduated with distinction, Master of Data Science at NYU)

Fellowships and Awards

LAS-OVCDEI Inclusive Pedagogy Certificate	Spring 2023
List of Teachers Ranked as Excellent	Spring 2022
Excellence in Teaching a Ph.D. Field Course, UIUC EGSO	2022
Clive Granger Research Fellowship, UCSD Economics	2016
Walter P. Heller Memorial Prize for Best Third Year Paper, UCSD Economics	2016
TA Excellence Award, UCSD Economics	2016
CPhil Fellowship, UCSD Economics	2016
Graduate Summer Research Fellowship, UCSD Economics	2015 - 2016
Regents Fellowship, UCSD Economics	2013 - 2015
Koh Boon Hwee Scholars Award, NTU	2013
Dean's List, NTU	2009 - 2013
Chen-Ning Yang Scholars Program, NTU	2013

Research Grants

UIUC Campus Research Board (joint with Remy Levin, $26,469)	2023 - 2024
Birmingham-Illinois BRIDGE Seed Fund (joint with Pei Kuang, $6000 and £5000)	2022 - 2023

Referee Service

Review of Economics and Statistics, Review of Economic Dynamics, Journal of Development Economics, Journal of the Association of Environmental and Resource Economists

Department Service

Hiring search committee (2022 - 2023)
Awards Committee (2022 - 2023)
Faculty advisor for Illini Women in Economics Student Group (2021 - present)
Co-organizer of macroeconomics seminar (2020 - present)
Co-organizer of macro student lunch workshop (2020 - present)

Media Interviews

WAND TV News (2023)

Victoria Wenxin Xie

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500 El Camino Real
Santa Clara, CA 95053
Lucas Hall, 316A

Email : wxie@scu.edu

Education

Ph.D. Economics, University of California, San Diego, 2019

Mphil Economics, University of Oxford, 2013

B.B.A. Global Business and Economics (Minor in Math), HKUST, 2011

Academic Positions

Assistant Professor, Department of Economics, Santa Clara University, January 2020 to present.

Research Interests

Environmental Economics, Trade, Development, Labor

Publications

"Heterogeneous Firms under Regional Temperature Shocks: Exit and Reallocation, with Evidence from Indonesia", *Accepted, Economic Development and Cultural Change*

Working Papers

"Labor Market Adjustment under Extreme Heat Shocks: Evidence from Brazil"

"Investor Origin and Deforestation: Evidence from Global Mining Sites", with Ran Goldblatt and Wei You

"Expecting Floods: Firm Entry, Employment, and Aggregate Implications", with Ruixue Jia and Xiao Ma

- NBER Working Paper 30250; CEPR Discussion Paper DP17462

"Resource Rents, Urbanization and Structural Transformation", with Qing Huang and Wei You

Selected Research in Progress

"Do Information and Communication Technologies Empower Female Workers? Firm-level Evidence from Vietnam", with Natalie Chun and Heiwai Tang

"Extreme Weather and Low-Income Household Finance: Evidence from Payday Loans", with Shihan Xie and Xu Zhang

Policy Papers

"Sharing the Burden: Household-Level Evidence on Fiscal Consolidation in the European Union", with Sophia Chen and Deniz Igan

Past Positions

Fund Internship Program, Research Department, International Monetary Fund, Washington. D.C., 2018

Project Officer, Innovation Lab Unit, International Monetary Fund, Washington. D.C., 2018

Research Assistant, UCSD, Big Pixel, 2014-2017

Fellowships and Honors

Leavey Research Grant, SCU, 2021, 2022
Travel and Research Grant, UCSD Economics, 2018
Graduate Student Research Grant, UCSD Economics and UCSD IR/PS, 2014-2017
HKSAR Government Scholarship, 2007-2011
HKUST - University Scholarships, 2007-2011

Teaching

Instructor, Santa Clara University

Introduction to Macroeconomics

Graduate Teaching Assistant, UCSD Economics Department and Global Policy School

Economics of the Environment, International Economics, Economics of Globalization

Presentations

2023 STEG and IGC Conference on Structural Transformation, Growth and Economic Development* (Feb), Pacific Conference for Development Economics 2023 (Mar), Center for Economic Studies - US Census Bureau (Apr), Washington State University (Apr)

2022 ASSA Annual Meetings (Jan), Virtual Seminar on Climate Economics, San Francisco Fed (Jun), Stanford Institute for Theoretical Economics, Housing & Urban (Sep), 23rd Annual CU Environmental and Resource Economics Workshop (Sep), UC San Diego Environmental Seminar (Oct), 29th Annual Empirical Investigations in International Trade Conference (Oct)

2021 Online Summer Workshop in Environment, Energy, and Transportation Economics, OSWEET (May), Urban Economics Association North American Meetings (Oct)

Before 2019 AERE Summer Conference, ASSA Annual Meetings, IMF Research Department, 12th All-CA Labor Economics Conference (Poster), WEAI
*coauthor presentation

Other Information

Skills: Stata, Matlab, Python, ArcGIS, Google Earth Engine

Languages: English (Fluent), Mandarin (Native), Korean (Basic)

XU ZHANG

CONTACT INFORMATION

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Email: XZhang@bank-banque-canada.ca
Website: https://sites.google.com/prod/view/xuzh

Employment

Senior Economist, Bank of Canada, 2020 Jan. –

EDUCATION

Ph.D. Economics, University of California, San Diego, 2019 Sept.
M.A. Economics, Peking University, 2013
B.A. Economics, Central University of Finance and Economics, 2011

FIELDS OF INTEREST

Macroeconomics and Finance

HONORS AND AWARDS

2018 UCSD Travel and Research Grants, GSA Travel Grant
2014 UCSD Graduate Summer Research Fellowship
2012 Excellent Teaching Assistant, Peking University
2011 Excellent Graduate, Central University of Finance and Economics
2011 Excellent graduation thesis, Central University of Finance and Economics

WORKING PAPERS

Evaluating the Effects of Forward Guidance and Large-scale Asset Purchases
Abstract: This paper evaluates the effects of forward guidance and large-scale asset purchases (LSAP) when the nominal interest rate reaches the zero lower bound. I investigate the effects of the two policies in a dynamic new Keynesian model with financial frictions adapted from Gertler & Karadi (2011, 2013), with changes implemented so that the framework delivers realistic predictions for the effects of each policy on the entire yield curve. I then match the change that the model predicts would arise from a linear combination of the two shocks with the observed change in the yield curve in a high-frequency window around Federal Reserve announcements, allowing me to identify the separate contributions of each shock to the effects of the announcement. My estimates correspond closely to narrative elements of the FOMC announcements. My estimates imply that forward guidance was more important in influencing inflation, while LSAP was more important in influencing output.

Disentangling the Information Effects in the Federal Reserve's Monetary Policy Announcements
Abstract: Federal Reserve announcements affect private sector beliefs in two different ways, revealing information about both economic fundamentals and monetary policy. This paper separates the information revelation from the effect of policy by combining the high-frequency multidimensional approach of Gürkaynak et al. (2005) with Greenbook measures of the Fed's information as in Romer & Romer (2004). The new shock series is consistent with the traditional view. In contrast to existing measures, a contractionary shock causes an upward revision in private forecasts of unemployment, a downward revision in private forecasts of inflation, and a decline in stock price.

RESEARCH IN PROGRESS

Monetary Policy and Household Balance Sheet Heterogeneity
Measuring the Effects of Forward Guidance in a Macroeconomic Framework

TEACHING EXPERIENCE

As Teaching Assistant at UC San Diego

Undergraduate Courses: Intermediate Macroeconomics, Intermediate Econometrics, Business Forecasting, Introduction to Operations Research, Financial Markets, Corporate Finance

As Teaching Assistant at Peking University

Undergraduate Courses: Applied Econometrics, Intermediate Microeconomics
Master of Economics: Labor Economics
MBA: Managerial Economics

PROFESSIONAL ACTIVITIES

Invited Presentations

2019 25th International Computing in Economics and Finance Conference (Ottawa), LSU, HKUST, BIS, Bank of Canada

Conference Presentations

2019 The Society for Nonlinear Dynamics and Econometrics (Dallas), Barcelona GSE Summer Forum, North American Summer Meeting of the Econometric Society (Seattle)

2018 AEA Poster Session, 5th International Association for Applied Econometrics Annual Conference (Montreal), Society for Economic Dynamics Annual Conference (Mexico City), 14th annual DYNARE Conference (ECB, Frankfurt), 12th Annual all-CA Labor Economics Conference Graduate Student Poster Session (Los Angeles), Financial Management Association Doctoral Student Consortium (San Diego), Midwest Macroeconomics Meetings (Nashville), Southern Economics Association (Washington DC), RES PhD Meetings (London)

Other Professional Activities

2018 Discussant for "The Differential Industry Level Impact of Monetary Policy" by Sandeep Kumar Rangaraju (Weber State University) and Nazneen Ahmad (Weber State University) in Southern Economics Association Conference

2018 Discussant for "Intertemporal Risk-Return Tradeoff and Investor Overreaction" by Joseph M. Marks (Bentley University) and Kiseok Nam (Suffolk University) in Financial Management Association meeting

2014 "High Pass" (highest grade) in the Econometrics Qualifying Exam at UC San Diego

2012 Course assistant for LSE-PKU summer school for Professor Danny Quah

2012 Participant in Asia Summer Institute in Behavioral Economics, National University of Singapore

2010 Presenter in the 10th China Young Economist Forum, Xi'an Jiaotong University, China

REFERENCES

James Hamilton (Chair)	UC San Diego	jhamilton@ucsd.edu	(858) 534-5986
Johannes Wieland	UC San Diego	jfwieland@ucsd.edu	(510)-388-2785
David Lagakos	UC San Diego	dlagakos@ucsd.edu	(858) 534-3383

OTHER INFORMATION

Citizenship: China
Languages: Mandarin (Native), English (Proficient)