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Do Natural Disasters Affect Household Savings? Evidence From A Natural Experiment In A Highly Developed Country

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Motivation

- Climate change influences extreme weather events and natural disasters
  - E.g. increasing precipitation volume raises probability of river flooding (Hirabayashi et al., 2013)
- Growing literature on the growth effects of extreme weather events and climate-related natural disasters (Felbermayr and Gröschel, 2014; Hsiang and Jina, 2014; Berlemann and Wenzel, 2016,2018)
- Less is known about climate risks and behavioral channels

Contribution

- Improve the understanding of adaption behavior in context of a natural disaster
- Saving behavior of central interest
  - Consumption in retirement phase
  - Buffer for income shocks
- Exploiting a natural experiment
  - August 2002 flood in Saxony
  - Geo-coded household data from German Socio-Economic Panel
  - Difference-in-Difference
- Households reduced their savings in aftermath of the flood
- Most likely explanation: Samaritan's Dilemma

Outline

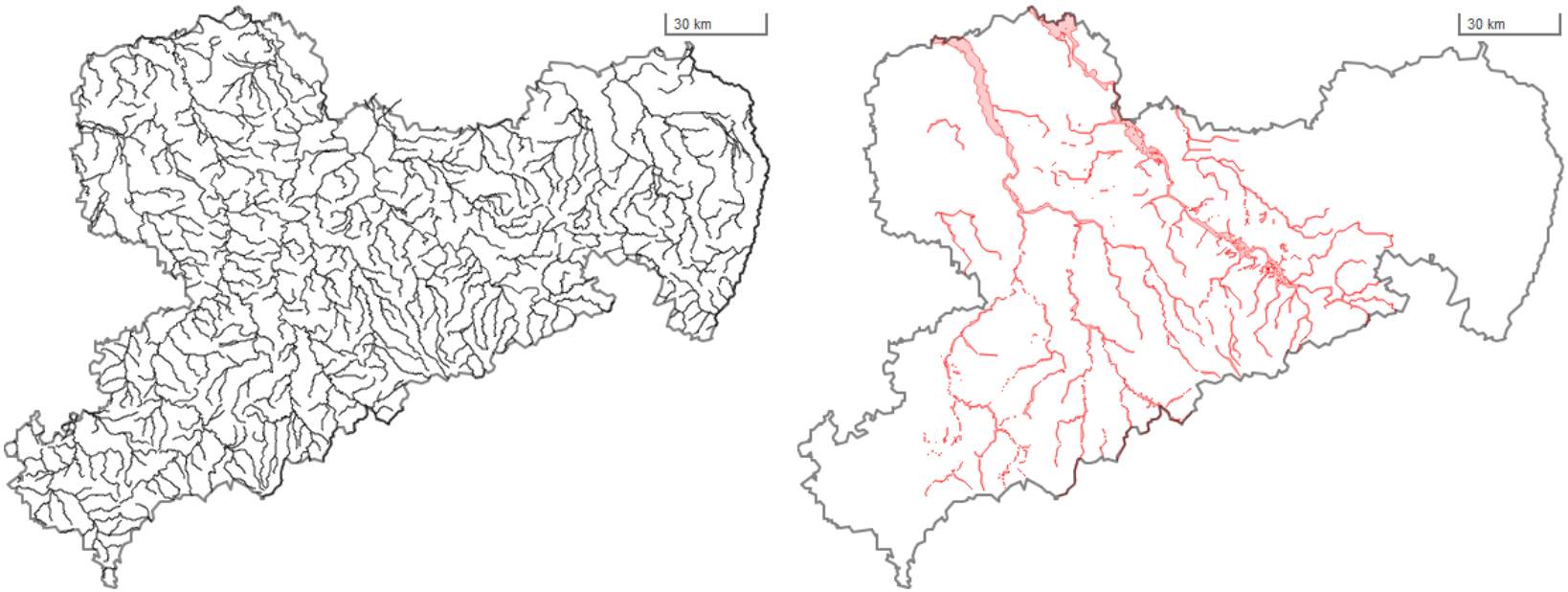
Literature

- Consumption smoothing over the life cycle
  - Anderhub et al. (2000); Noussair and Matheny (2000); Berlemann and Michailova (2019)
- Individual risk preferences
  - Eckel et al. (2009); Page et al. (2014); Cameron and Shah (2015); Brown et al. (2018)
- Current and future income loss
  - Vigdor (2007); Deryugian et al. (2018)
- Income uncertainty
  - Leland (1968); Skidmore (2001)
- Enforced Consumption

The August 2002 Flood in Saxony

- Central Europe experienced multiple heavy rainfalls and thunderstorms
- Record breaking rainfalls in the *Erzgebirge*
- Reason: 5B-weather constellation
- Direct damages of €9.068 billion (Bundesministerium der Justiz, 2002)

Watercourses and Flooded Areas in Saxony in August 2002



Source: *Sächsisches Amt für Umwelt, Landwirtschaft und Geologie* and *Amt für Umweltschutz, Landeshauptstadt Dresden*.

Data

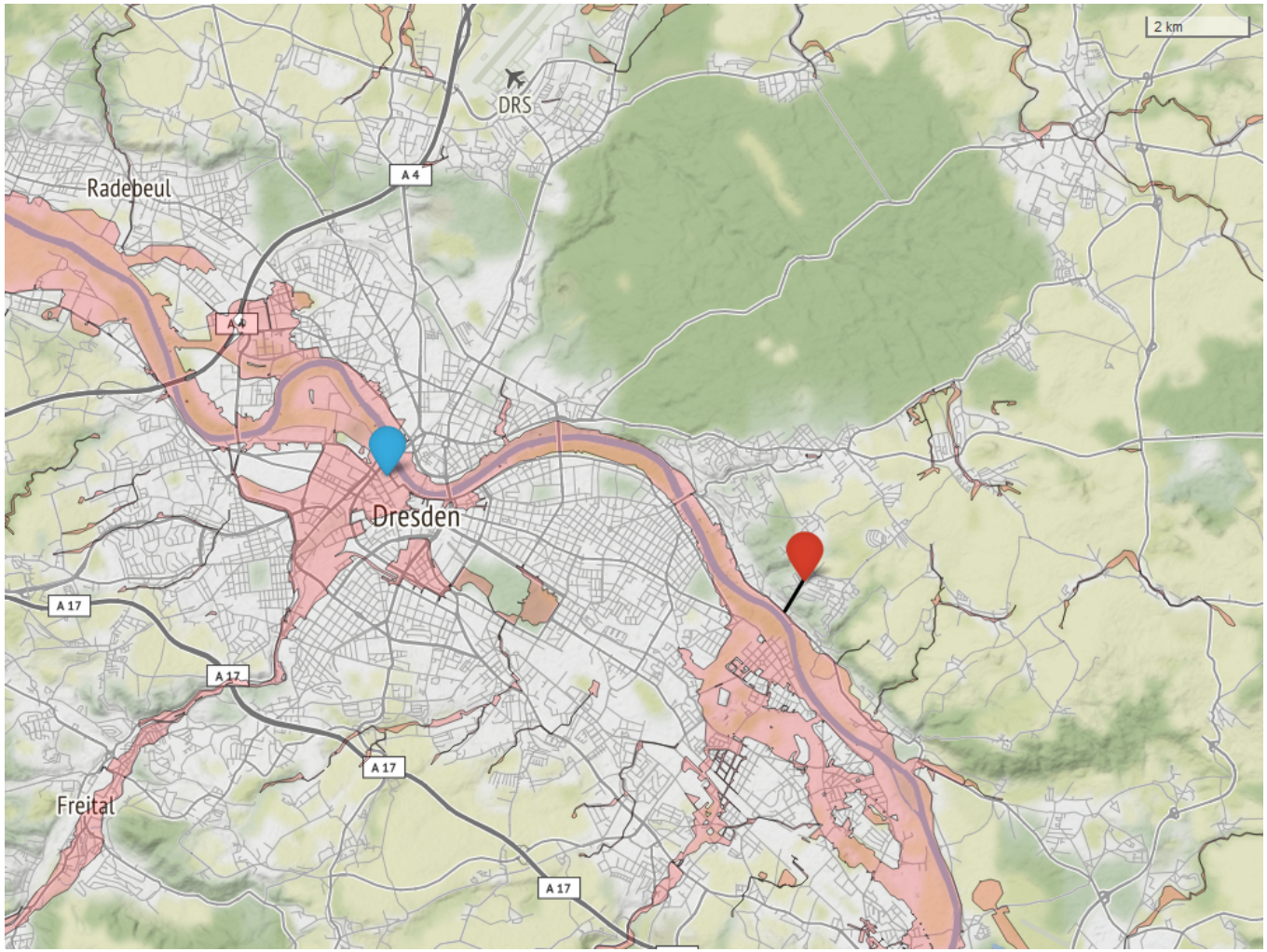
- German Socio-Economic Panel (SOEP)
- Annual survey
- Approx. 150 questions (socio-economic factors, assets, income, employment, health)
- In 2002, SOEP surveyed 20,033 people living in 12,692 households $\Rightarrow$ 864 in Saxony

Information about Saving

"Do you usually have an amount of money left over at the end of the month that you can save for larger purchases, emergency expenses or to acquire wealth? If yes, how much?"

- S_{it}: monthly savings of household i in point in time t in €
- $S_{it}^{E} = \begin{cases} 1, \text{if } S_{it} > 0€. \\ 0, \text{otherwise.} \end{cases}$
- $S_{it}^{E'} = \begin{cases} 1, \text{if } S_{it} > 50€. \\ 0, \text{otherwise.} \end{cases}$

Geo-Information



Empirical Strategy

- Use difference-in-difference approach
- Two treatment variables
  - Broad treatment: $0m < distance < 75m$
  - Narrow treatment: distance $= 0m$
- Control group: $500m < distance < 3000m$
- Post-disaster period: 2003-2005

Empirical Model

$$S_{i,t} = \alpha + \lambda * TREAT_i + \sum_{j=2003}^{2005} \gamma_j * YEAR_{j,t} + \sum_{j=2003}^{2005} \delta_j * YEAR_{j,t} * TREAT_i + \bar{X}'_{i,t}\beta + \epsilon_{i,t} \quad (1)$$

- $S_{i,t}$: saving variable
- $TREAT_i$: treatment indicator
- $YEAR_t$: indicator variable for year t with 2002 as base year

Effect of the Flood Event on Household Saving Volume (Tobit Model)

	Broad Treatment S (1)	Narrow Treatment S (2)
Year 2003	22.916	23.259
	(24.549)	(24.392)
Year 2004	-2.631	-2.386
	(33.546)	(33.245)
Year 2005	15.405	16.212
	(32.267)	(32.056)
Treated	4.921	-5.405
	(79.336)	(111.656)
Year 2003 × Treated	-76.830	-101.163
	(78.176)	(100.582)
Marginal Effect $[E(S\|S>0)]$	-29.46	-37.93
	(30.22)	(38.16)
Percent Change	-6.607	-8.719
	(6.461)	(8.215)
Year 2004 × Treated	-128.327*	-276.523**
	(72.321)	(116.747)
Marginal Effect $[E(S\|S>0)]$	-46.54*	-91.11**
	(26.37)	(39.91)
Percent Change	-10.44*	-20.95**
	(5.789)	(8.134)
Year 2005 × Treated	-145.770**	-240.784***
	(66.736)	(91.046)
Marginal Effect $[E(S\|S>0)]$	-53.40**	-82.73***
	(24.44)	(31.55)
Percent Change	-11.98**	-19.02***
	(5.090)	(6.307)
Controls	yes	yes
Log Pseudolikelihood	-6868.148	-6105.021
Left Censored Obs.	447	389
Observations	1301	1150

Note: We report conditional marginal effects on factual saving. Marginal effects are computed for households with median characteristics. All regressions include the full set of control variables. Standard errors are clustered on the household level and reported in paren-

Effect of the Flood Event on Households' Propensity to Save (Linear Probability Model)

	Broad Treatment		Narrow Treatment	
	S^E	$S^{E'}$	S^E	$S^{E'}$
	(1)	(2)	(3)	(4)
Year 2003	0.001	0.015	0.002	0.015
	(0.024)	(0.024	(0.024)	(0.024)
Year 2004	-0.027	-0.011	-0.026	-0.010
	(0.027)	(0.026)	(0.027)	(0.026)
Year 2005	-0.026	-0.031	-0.024	-0.031
	(0.029)	(0.030)	(0.029)	(0.030)
Treated	-0.014	0.039	0.050	0.100
	(0.062)	(0.062)	(0.104)	(0.103)
Year 2003 × Treated	0.000	-0.046	-0.026	-0.082
	(0.069)	(0.072)	(0.105)	(0.113)
Percent Change	0.0262	-6.811	-3.361	-11.03
	(9.951)	(10.24)	(13.49)	(14.46)
Year 2004 × Treated	-0.101	-0.169**	-0.209*	-0.271**
	(0.069)	(0.069)	(0.123)	(0.127)
Percent Change	-14.42	-24.87***	-27.32*	-36.45**
	(9.504)	(9.476)	(14.82)	(15.48)
Year 2005 × Treated	-0.079	-0.078	-0.178*	-0.174*
	(0.065)	(0.066)	(0.100)	(0.102)
Percent Change	-11.29	-11.42	-23.17*	-23.45*
	(9.100)	(9.484)	(12.40)	(13.06)
Controls	yes	yes	yes	yes
Adjusted R^2	0.122	0.136	0.114	0.126
Observations	1301	1301	1150	1150

Note: All regressions include the full set of control variables. Reported marginal effects refer to the change in the likelihood to save any money, caused by the occurrence of the flood event. Standard errors are clustered on the household level and reported in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Why Did Affected Households Reduce their Savings?

- Life expectancy channel highly unlikely due to very low risk of death due to a flood event
- Risk preference channel
  - "Worries about general/own economic development" insignificant
- Income channel
  - Labor income and prob. of unemployment insignificant
- Income uncertainty channel
  - Theory predicts increase capital accumulation
- Enforced Consumption
  - No reduction in unnecessary consumption expenses

Why Did Affected Households Reduce their Savings?

Most likely explanation

- August 2002 flood occurred in final phase of the election campaign for the German general election
- "citizens expect governments to act vigorously when these contingencies occur, and to restore the status quo ante as much as possible" (Bytzek, 2008)
- In total funds available €9.6 billion exceededing total direct damages of €9.1 billion
- Most likely explanation: precautionary savings reduced due to moral hazard behavior $\Rightarrow$ "Samaritan's Dilemma"

Conclusion

- Increasing economic literature analyzing micro- and macro economic impacts of extreme weather events
- We analyzed the saving response to a natural disaster exploiting the August 2002 flood in Germany
- The flood significantly depressed saving volumes and reduced the the probability to save
- Effect more pronounce for households who have lived closed to the flood line
- Most likely explanation so called "Samaritan's Dilemma"
- Policy perspective underlines the necessity to consider incentives when designing disaster aid packages

Summary Statistics for treatment and control group

	Broad Treatment Group					Control Group					T-Test
	N	Mean	Std.Dev.	Min	Max	N	Mean	Std. Dev.	Min	Max	Difference
Saving Volume (S)	61	272.024	417.133	0	2418.171	279	248.803	408.638	0	3869.074	-23.221
Binary Saving (S^E) (Yes = 1)	61	0.656	0.479	0	1	279	0.677	0.468	0	1	0.022
Binary Saving ($S^{E'}$) (Yes = 1)	61	0.656	0.479	0	1	279	0.627	0.484	0	1	-0.028
Controls (Household Head):											
Male	61	0.557	0.501	0	1	300	0.577	0.495	0	1	0.019
Age	61	48.049	13.414	27	82	300	51.937	15.861	21	87	3.887
Highest Education Primary	61	0.082	0.277	0	1	299	0.043	0.204	0	1	-0.038
Highest Education Secondary	61	0.623	0.489	0	1	299	0.585	0.493	0	1	-0.038
Highest Education Tertiary	61	0.295	0.460	0	1	299	0.371	0.484	0	1	0.076
Employed	61	0.656	0.479	0	1	300	0.503	0.501	0	1	-0.152*
Unemployed	61	0.115	0.321	0	1	300	0.090	0.287	0	1	-0.025
Non-Working	61	0.230	0.424	0	1	300	0.407	0.492	0	1	0.177**
Single	61	0.148	0.358	0	1	299	0.171	0.377	0	1	0.023
Married	61	0.705	0.460	0	1	299	0.582	0.494	0	1	-0.123
Other	61	0.148	0.358	0	1	299	0.247	0.432	0	1	0.100
No Children	61	0.623	0.489	0	1	300	0.717	0.451	0	1	0.094
1 Child	61	0.197	0.401	0	1	300	0.190	0.393	0	1	-0.007
2 Children	61	0.131	0.340	0	1	300	0.080	0.272	0	1	-0.051
3 or More Children	61	0.049	0.218	0	1	300	0.013	0.115	0	1	-0.036
Homeowner	61	0.410	0.496	0	1	300	0.347	0.477	0	1	-0.063
Living in Urban Area	61	0.459	0.502	0	1	300	0.410	0.493	0	1	-0.049
N	61					300					361

Effect of the Flood Event on Economic Worries (OLS)

	Broad Treatment		Narrow Treatment	
	Overall Eco.	Own Eco. Sit.	Overall Eco.	Own Eco. Sit.
	(1)	(2)	(3)	(4)
Year 2003	0.202***	0.079	0.202***	0.080
	(0.045)	(0.052)	(0.046)	(0.052)
Year 2004	0.125***	0.155***	0.124***	0.157***
	(0.046)	(0.053)	(0.046)	(0.053)
Year 2005	0.237***	0.072	0.236***	0.072
	(0.047)	(0.054)	(0.047)	(0.054)
Treated	-0.002	-0.079	-0.081	-0.180
	(0.078)	(0.090)	(0.124)	(0.142)
Year 2003 × Treated	0.085	0.072	0.070	0.145
	(0.110)	(0.127)	(0.174)	(0.200)
Year 2004 × Treated	0.001	-0.101	0.169	0.087
	(0.111)	(0.128)	(0.176)	(0.202)
Year 2005 × Treated	0.063	0.129	0.160	0.335
	(0.112)	(0.129)	(0.179)	(0.205)
Controls	yes	yes	yes	yes
Adjusted R^2	0.053	0.093	0.057	0.108
Observations	1378	1376	1225	1223

Note: All regressions include the full set of control variables. Standard errors are clustered on the household level and reported in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Effect of the Flood Event on Labor Income and Employment Status (OLS)

	Broad Treatment		Narrow Treatment	
	Labor Income	Unemployed	Labor Income	Unemployed
	(1)	(2)	(3)	(4)
Year 2003	-123.364	0.016	-121.218	0.016
	(86.684)	(0.017)	(85.257)	(0.017)
Year 2004	-102.170	-0.001	-97.069	-0.001
	(85.336)	(0.016)	(85.656)	(0.016)
Year 2005	-182.869	0.005	-176.818	0.005
	(117.399)	(0.021)	(117.103)	(0.021)
Treated	-346.804*	0.008	-439.781	0.021
	(179.774)	(0.045)	(337.790)	(0.078)
Year 2003 × Treated	212.564	0.006	277.739	-0.015
	(170.025)	(0.024)	(304.666)	(0.020)
Year 2004 × Treated	114.157	-0.035	191.618	-0.035
	(119.261)	(0.032)	(195.322)	(0.048)
Year 2005 × Treated	273.590	-0.013	335.855	-0.131
	(188.898)	(0.046)	(339.740)	(0.081)
Controls	yes	yes	yes	yes
Adjusted R^2	0.148	0.043	0.153	0.033
Observations	662	1378	566	1225

Note: All regressions include the full set of control variables except the working status indicators. Standard errors are clustered on the household level and reported in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Effects of the Flood Event on Food Consumption, Financial Reserves and Maintenance Costs (OLS)

	Food Consumption	Narrow Treatment Financial Reserves	Maintenance Costs
	(1)	(2)	(3)
Year 2003	-1.365	-0.047**	-747.799
	(17.423)	(0.021)	(685.692)
Year 2004	-	-	-324.849
			(799.748)
Year 2005	14.386	-0.049*	-1449.417**
	(18.623)	(0.026)	(683.072)
Treated	-2.949	-0.133	5713.615
	(34.191)	(0.104)	(3605.200)
Year 2003 × Treated	6.063	0.186*	1266.551
	(34.349)	(0.103)	(3269.707)
Year 2004 × Treated	-	-	-5109.814
			(4763.675)
Year 2005 × Treated	-34.867	-0.040	-6035.113
	(51.458)	(0.120)	(3855.470)
Controls	yes	yes	yes
Adjusted R^2	0.160	0.142	0.046
Observations	422	905	406

Note: All regressions include the full set of control variables. Standard errors are clustered on the household level and reported in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Triple DiD Effects for Homeownership on Food Expenses and Financial Reserves (OLS)

	Narrow Treatment	
	Food Expenses	Financial Reserves
	(1)	(2)
Year 2003	-18.137	-0.041
	(20.026)	(0.028)
Year 2005	28.626	-0.058*
	(21.930)	(0.033)
Treated	20.119	0.050
	(46.130)	(0.116)
Homeowner	43.661	0.051
	(33.403)	(0.050)
Treated × Homeowner	-52.054	-0.357*
	(56.525)	(0.194)
Year 2003 × Homeowner	46.447	-0.015
	(38.742)	(0.044)
Year 2005 × Homeowner	-35.506	0.024
	(43.041)	(0.053)
Year 2003 × Treated	75.223	0.150
	(55.617)	(0.101)
year3 × Treated × Homeowner	-119.077*	0.072
	(69.539)	(0.207)
Year 2005 × Treated	7.335	0.075
	(49.772)	(0.190)
Year 2005 × Treated × Homeowner	-13.224	-0.134
	(89.655)	(0.245)
Controls	yes	yes
Adjusted R^2	0.160	0.149
Observations	422	905

Note: All regressions include the full set of control variables. Standard errors are clustered on the household level and reported in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$