Rules for Recovery: Impact of Indexed Disaster Funds on Shock Coping in Mexico

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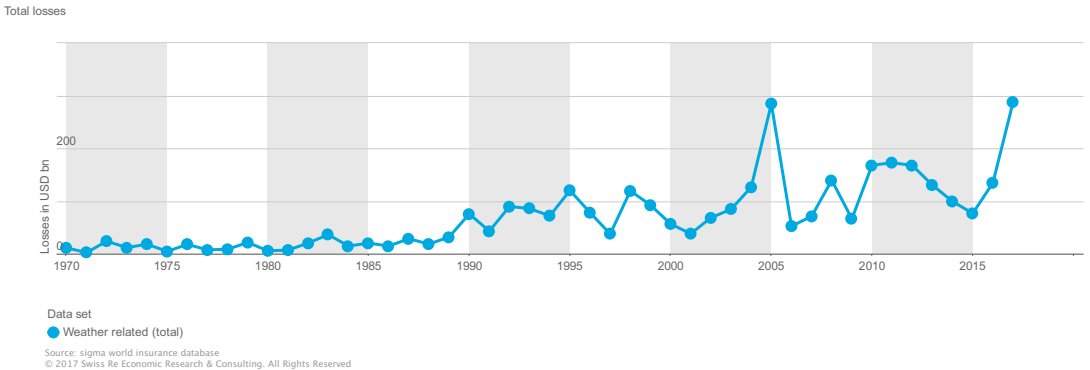
Extreme weather events are one the main channels through which the climate interacts with the economy



Source: sigma world insurance database

Potentially low hanging fruit in the provision of disaster-aid by national governments

There are two key constrains in the provision of disaster-aid in developing economies (Clarke and Dercon, 2016)

1. Reliance on ex-post financing
2. Lack of rules and administrative capacity to execute disaster-aid

In this paper, I study Mexico's Fund for Natural Disasters (Fonden), which is designed to overcome these constraints.

To what extent can Fonden mitigate the economic loses generated by extreme weather?

Overcoming the constrains in the provision of disaster-aid

1. Use of ex-ante risk financing instruments.

	Ex-ante	Ex-post
Risk retention	Budget allocation	Budget reallocation
Inter-temporal transfer	Contingent credit	Tax increase, Post-disaster credit
Risk transfer	Reinsurance, Cat-Bonds	Foreign disaster aid

2. Use and enforcement of rules:
   - Rules defining what hazards and assets are covered.
   - Procedures to verify occurrence of a disaster, assess the degree of damage, and contract, execute, and audit reconstruction projects.
   - Administrative capacity to enforce these rules.

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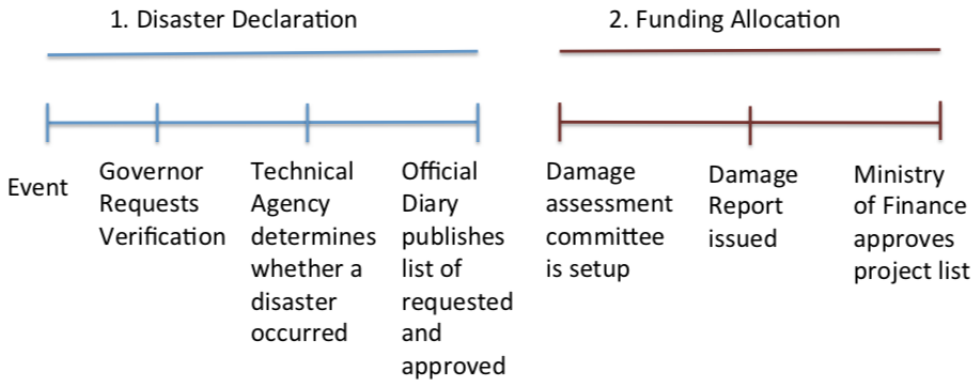
Fonden Mexico's Disaster Fund

Fonden was created in 1996, it became operational in 1999.

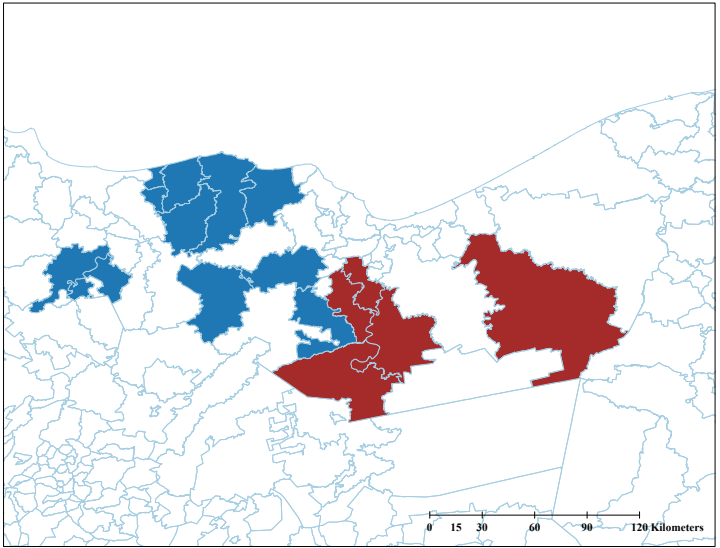
1. Fonden's disaster response is pre-financed
   - Budget allocation (by law) no less than 0.4 percent of federal budget ($\approx$ USD $800 million)
   - Budget is used to pay for reconstruction, to purchase reinsurance and to place catastrophe bonds ($\approx$ USD $700 million in additional coverage).
2. Fonden introduced a rules based system to disaster response
   - Hazards covered include geological and meteorological hazards. Primarily: rainfall, flooding, and hurricanes.
   - Assets covered include public infrastructure (federal and state) e.g., roads, hydraulic infrastructure, schools and hospitals. It also covers low income housing.

Fonden Mexico's Disaster Fund (continued)

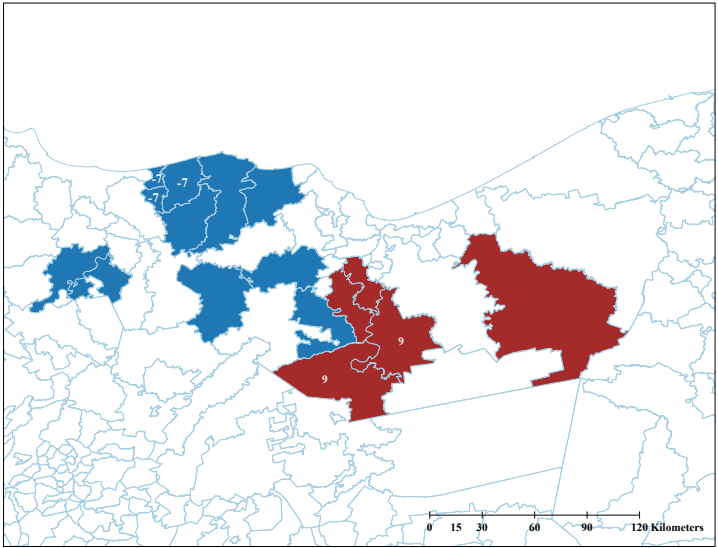
Rules based-system verification, disbursement and reconstruction.



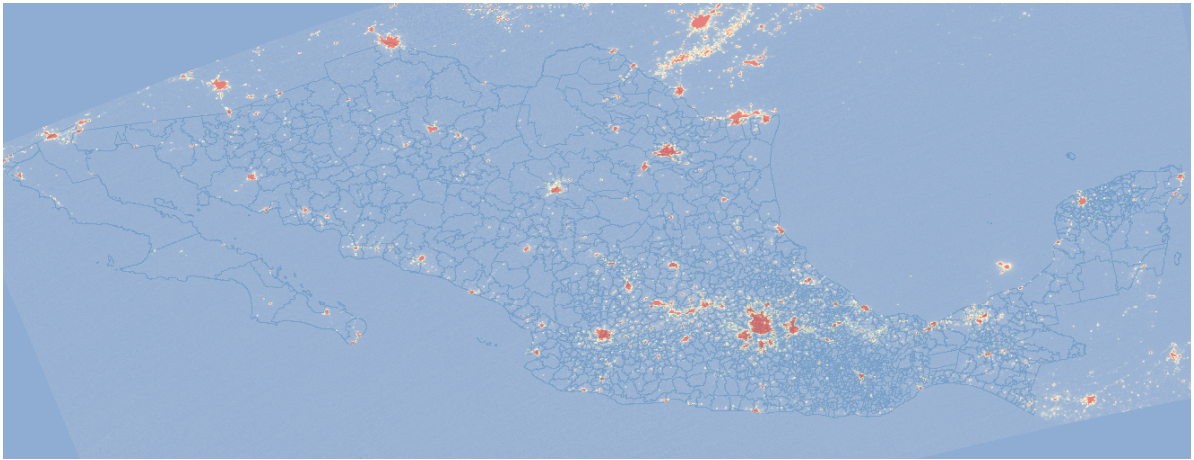
We exploit a nearly ideal research environment: Mexico's FONDEN



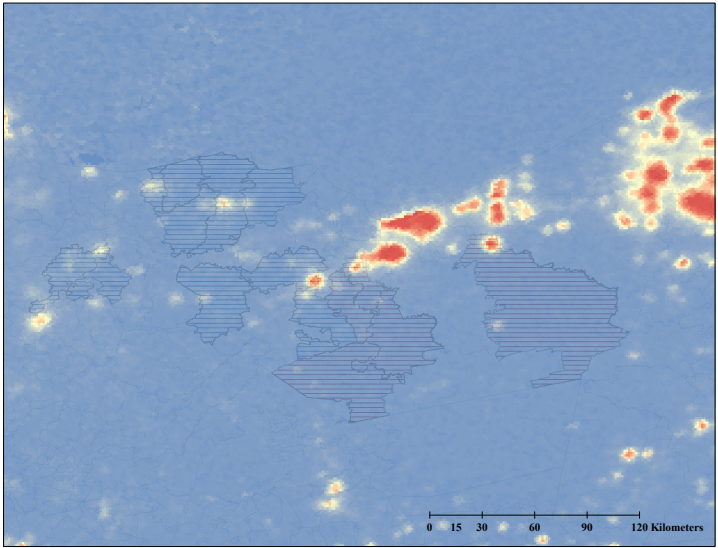
Our source of variation is created by thhe heavy rainfall thresholds



We measure economic activity using night lights



12 months before the disaster



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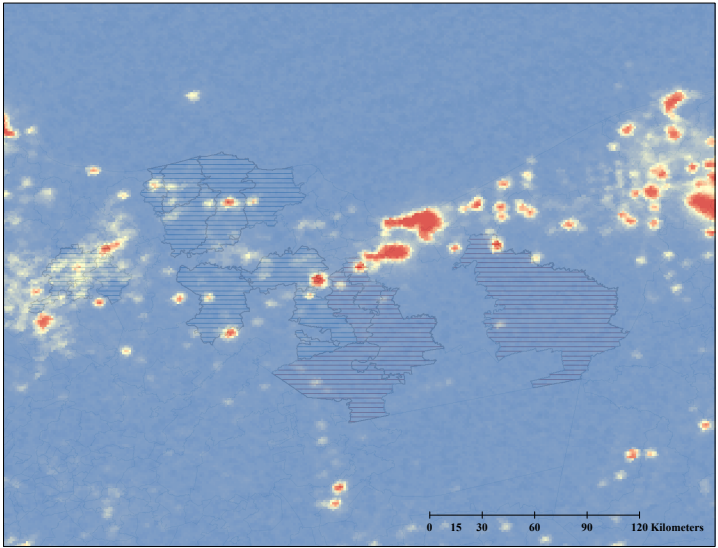


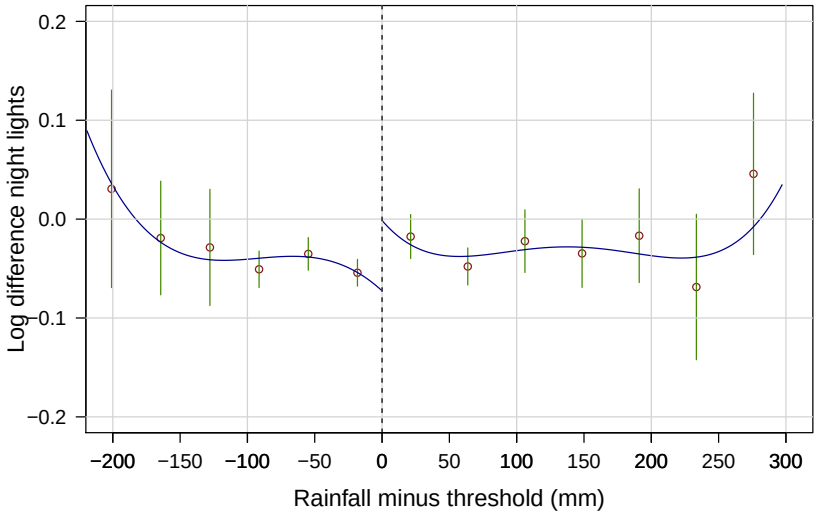
Research Design, fuzzy regression discontinuity

- My unit of analysis is the municipality (district)
- I focus on rainfall, flooding, and hurricanes because these hazards make up 93 percent of program expenditures.
- Since 2004, heavy rainfall occurs in a municipality when rainfall is greater or equal to the percentile 90 of maximum daily rainfall for the month in which the event took place.
- Intuitively the impact of Fonden can be identified because while the average underlying characteristics of municipalities change smoothly with the running variable, assignment to Fonden changes discontinuously at the threshold.
- I use a fuzzy regression discontinuity design because municipalities may also become eligible under Fonden's flooding or hurricane criteria.

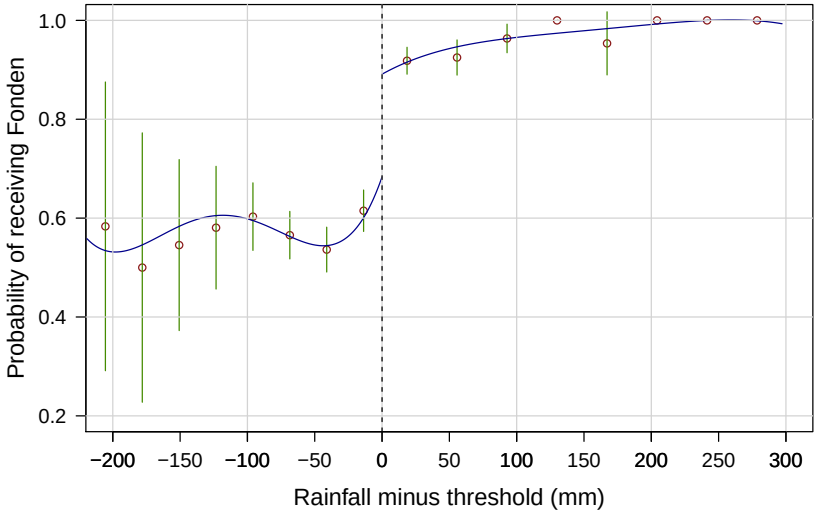
The paper uses several sources of data

- Data on night lights comes from NOAA
- Data on municipal level requests and approval comes from disaster declarations published in the government gazette.
- Rainfall data, percentile 90 thresholds, and identifiers for Fonden weather stations were provided by CONAGUA.
- Fonden administrative records including expenditures comes from the MoF.
- Expenditures and revenues of municipal governments, CENSUS data, and State level GDP comes from INEGI.
- Our dataset is composed of 2707 municipal-year requests for FONDEN made in the time period 2004-2012.

ITT (≈ 0.06 log point increase in growth of night lights)



First Stage (Probability of receiving Fonden)



Fonden mitigates the losses from heavy rainfall events

	(1)	(2)
Panel A. *First Stage* (α_1)	0.227	0.230
p-value	< 0.001	< 0.001
CI 95%	[0.12,0.28]	[0.13,0.31]
Panel B. *Intention-to-Treat* (β_1)	0.059	0.072
p-value	0.010	0.006
CI 95%	[0.02,0.12]	[0.02,0.13]
Panel C. *LATE* (τ_{FRD})	0.260	0.313
p-value	0.009	0.011
CI 95%	[0.08,0.56]	[0.08,0.61]
Bandwidth (mm)	57.9	40.0
Obs (left|right)	1038|525	741|410

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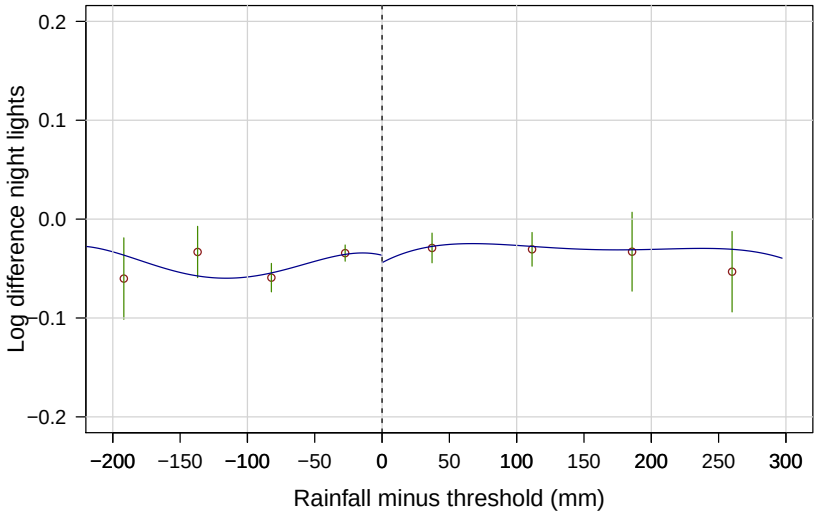
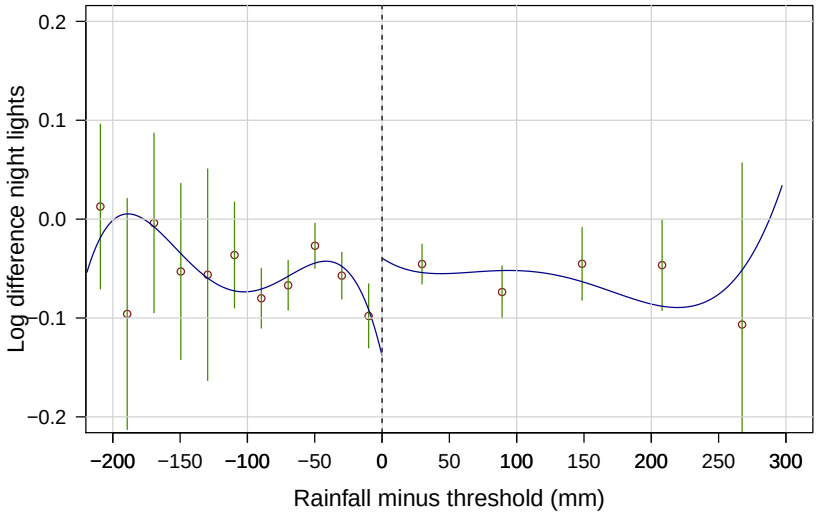
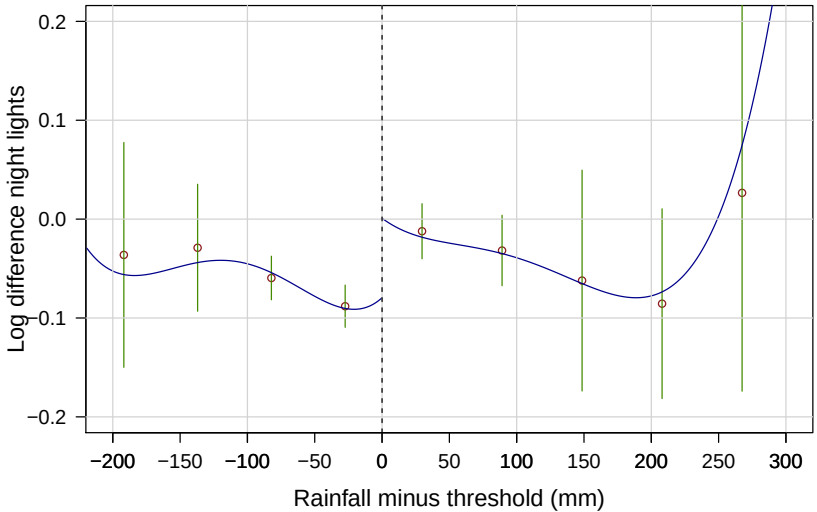
Dynamics ITT 2 months after (just before fund disbursement)



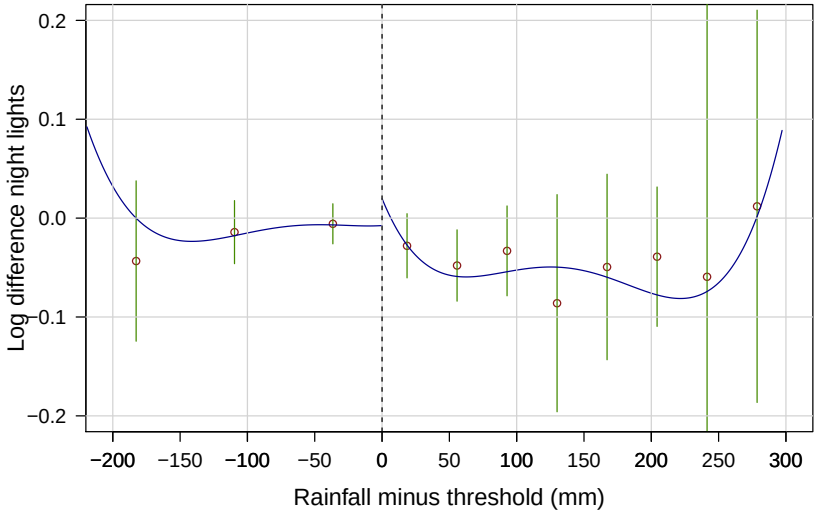
Dynamics ITT 4 months after (first observed Fonden impact)



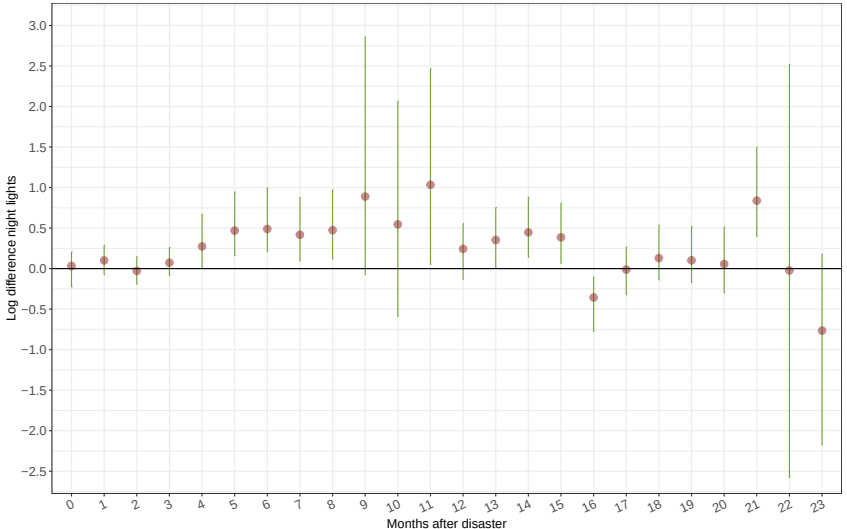
Dynamics ITT 12 months after



Dynamics ITT 18 months after



The impact of Fonden is not permanent (LATE month by month)



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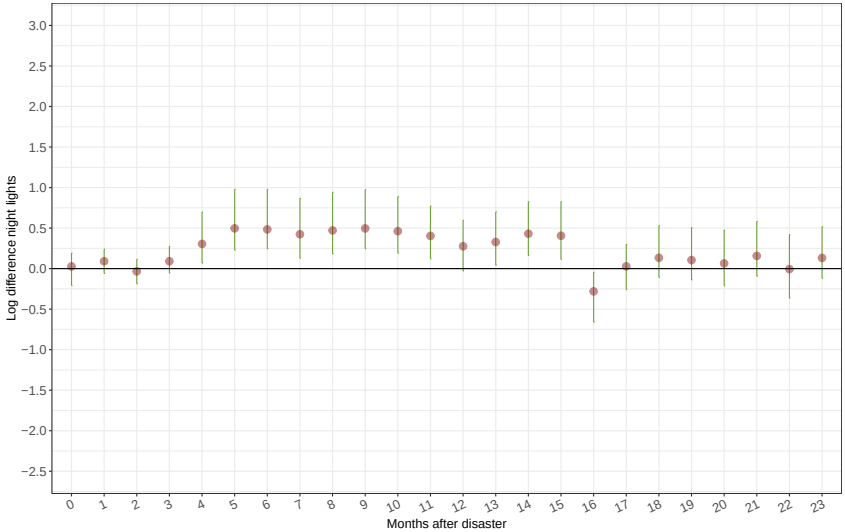

Limited spillover effects

		Spillover Effects	
	Baseline (1)	0 to 20 km (2)	20 to 40 km (3)
LATE (τ_{FRD})	0.260	0.234	0.064
p-value	0.009	0.009	0.694
CI 95%	[0.08,0.56]	[0.05,0.38]	[-0.09,0.13]
Bandwidth (mm)	57.9	57.9	57.9
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Obs (left|right)	1038|525	1038|525	1038|525

We also learn about observations that are farther from the threshhold

	(1)	(2)
Complier Probability Derivative	0.0020	0.0002
p-value	0.640	0.983
Treatment Effect Derivative	0.0028	0.0028
p-value	0.802	0.882
Bandwidth (mm)	74.3	48.7
Obs (left|right)	1287|605	894|460

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Implied fiscal multiplier

(1)	Events	1383	-	-
(2)	Effect of Fonden on night lights	0.260	(0.105)	-
(3)	Inverse elasticity of lights with respect to GDP	0.095	(0.038)	-
(4)	Implied effect on GDP growth	0.025	(0.015)	-
(5)	Mean municipal GDP in 2003 (millions $)	180.160	(7.480)	-
(6)	Gain per municipality (millions $)	4.430	(2.650)	-
(7)	Total gain (millions)	6127.290	(3660.710)	-
(8)	Gain cost ratio	0.959	(0.573)	[0.017,1.901]

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Heterogeneous effects of Fonden

Sample split:	Baseline	Primary Fonden expenditure		Road intersection density		Storm drain coverage	
		Roads	Non-roads	Below Median	Above Median	Below Median	Above Median
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LATE (τ_{FRD})	0.260	0.479	0.173	0.366	0.179	0.553	0.041
p-value	0.009	0.016	0.250	0.053	0.064	0.042	0.622
CI 95%	[0.08,0.56]	[0.11,1.10]	[-0.12,0.48]	[-0.01,0.97]	[-0.01,0.46]	[0.02,1.11]	[-0.19,0.31]
Bandwidth (mm)	57.9	46.8	45.2	61.3	70.4	40.7	48.2
Obs (left|right)	1038|525	569|217	425|131	548|289	623|293	381|193	430|242

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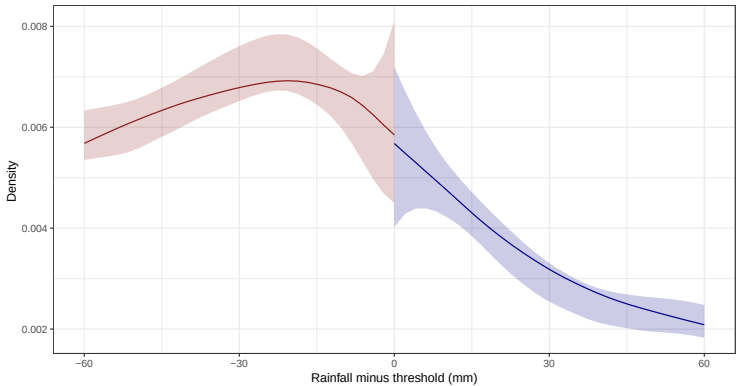
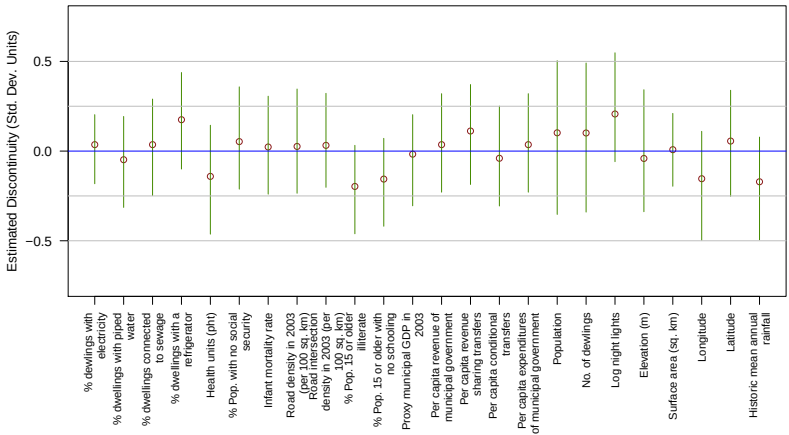
Robustness: No evidence of manipulation



Null hypothesis: density of the running variable is continuous at the threshold. (1) p-value restricted test 0.594, (2) p-value unrestricted test 0.529

Robustness: predetermined municipal characteristics are continuous at the threshold



No evidence of other resource allocation

Dep. Variable:	Total transfers (1)	Revenue sharing (2)	Conditional (3)
Intention to Treat (β_1)	0.011	-0.023	0.008
Robust *p*-value	0.980	0.448	0.888
Robust 95% CI	[-0.08,0.08]	[-0.12,0.05]	[-0.17,0.14]
Bandwidth (mm)	43.5	46.6	45.0
Obs (left|right)	590|320	636|337	604|326
Mean dep. variable	0.125	0.110	0.141

Conclusions

- Fonden considerably increases economic activity, as measured by night lights, in the year after disaster takes place.
- The increase in economic activity is not permanent. After roughly 12 months municipalities without Fonden begin to catch up.
- Our estimates are likely externally valid, and indicate that the value of Fonden is as large as its cost.
- Reconstruction of lifeline communication infrastructure (roads) is particularly important.
- Municipalities that initial lack infrastructure to limit damages benefit disproportionately from Fonden.
- Our estimates likely underestimate the benefits of Fonden
  - Spillover effects
  - Additional direct benefitsts not captured by night lights
- Fonden rules shield resources from political abuse
- Downside basis risk remains a problem