Does Federal Disaster Assistance Affect Private Protection Behavior: An Empirical Analysis of Household Purchase of Flood Insurance

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Motivation

- Natural disasters cause substantial social and economic losses across Globe and the United States (Kousky, 2014)
- Flooding is the most prevalent and has resulted in the largest amount of damages only second to hurricanes (Perry, 2000).
- Given the growing costs of weather-related disasters and ongoing climate change, how to effectively manage disaster risks is a critical question concerning both policy makers and researchers.

Motivation

In the United States disaster policy builds on three primary focal points:

- (1) Federal government provides disaster support to states and localities for mitigation and recovery activities, primarily triggered after a major disaster declaration;
- (2) Private disaster insurance (e.g. National Flood Insurance Policy (NFIP)) provides a unique mechanism to manage disaster risk;
- (3) Local/state mitigation activities that are often tied to private hazard insurance through the incentives such as reduced insurance premiums for resilient communities (e.g. Community Rating System of the NFIP).

Research Question & Motivation

- What is the effect of FEMA public assistance (PA) program on flood insurance take-up (extensive margin) and amount of coverage per policy (intensive margin)
 - While PA program does not directly help private individuals it may
 - Signal of a federal bailout when a disaster strikes thereby reducing private incentives to invest in risk transfer and mitigation measures.

Or

- May alter perception about status of community resilience after rebuilding
- The increasing and large scale of PA program expenditure merits a deeper assessment of its potential unintended consequences.

Literature

- Crowding-out effect (Kousky et al., 2013) or moral/charity hazard related private disaster adaptation (Raschky et al., 2013; Raschky and Weck-Hannemann, 2007).
 - individuals underinvest in self-protection (Lewis and Nickerson 1989), foresee government as an "insurer of last resort" (Deryugina and Kirwan, 2015).
- At the state level, federal disaster aid is shown to increase households flood insurance purchases (Browne and Hoyt, 2000)
- Kousky et al. (2013) suggest "crowding out" effect of housing assistance across intensive margin (i.e. coverage per policy holder) in Florida
 - Did not account for physical hazard incidents as well as primary premise of the NFIP → disaster insurance is required by federally backed mortgage companies
- Other studies have looked at insurance take up in response to local mitigation programs (Attrey et al., 2014; Michel-Kerjan and Kousky, 2010), and recent significant flooding events (Gallagher, 2014).

National Flood Insurance Program (NFIP)

- NFIP is a federally backed insurance program initiated by the U.S. Congress in 1968, primarily to address the growing financial concerns of existing flood mitigation programs.
- The mandatory requirements for participating communities included:
 - Identify and map flood-prone communities
 - Adopt and enforce floodplain management ordinances
 - Provide flood insurance

NFIP: main reforms and amendments

- Flood Disaster Protection Act (1973) \rightarrow
 - Require insurance for property owners with a mortgage from a federally backed or regulated lender in a 100-year floodplains
 - Restrict disaster assistance for acquisition or construction of buildings and disaster assistance programs for communities that did not participate in the NFIP.
 - Require mandatory flood insurance purchase for all grants and loans issued for acquisition or construction of buildings in the Special Flood Hazard Areas in NFIP communities
- National Flood Insurance Reform Act (NFIR) enforced in 1994.
 - Allow increased amount of flood insurance coverage.
 - Supplementary financial assistance in the form of Flood mitigation assistance grants to develop hazard mitigation plans and implement measures to reduce flood damages to structures.
 - Community Rating System (CRS)

NFIP Policies in Force as of 6/30/2016

Total number of policies in force nation-wide is 5,058,771, of which:

Florida	35.23%
Texas	11.74%
Louisiana	8.89%
California	5.95%
New Jersey	4.57%
South Carolina	3.95%
New York	3.69%
North Carolina	2.54%
Virginia	2.06%
Georgia	1.74%
Maryland	1.33%
Mississippi	1.29%
Massachusetts	1.29%
Pennsylvania	1.26%
Hawaii	1.17%
Alabama	1.08%

Public Assistance (PA) of FEMA

- Disaster declaration and aid in the United States is governed by the Robert T. Stafford Disaster Relief and Emergency Assistance Act enacted in 1988 (McCarthy, 2011).
- Various disaster programs are available through FEMA including HMGP, PA, IHA
- PA is the largest recovery programs that aids local, tribal, and state governments and to a limited extend to non-government organizations and private individuals, to address both long-term as well as immediate disaster recovery needs (FEMA, 2016).
- Two broader categories of projects are supported (a) Emergency Work (i.e. debris removal and emergency protective measures) and (b) Permanent work (i.e. restoration of roads and bridges, utilities, water control facilities, public parks, recreational activities and many more) (Brown and Richardson, 2015).

Distribution of Average Public Assistance Grants Per Capita



Model

Unbalanced panel model specified as :

$$y_{ct} = X_{ct}\alpha + (PA_{ct-1})\beta + \gamma D_{ct} + \lambda_t + \mu_c + \varepsilon_{ct}$$

$y_{ct} \rightarrow$

- # of insurance policies in force per capita (a.k.a take-up rate)
- total \$ coverage divided by the total number of policies in force (log).

 $D_{ct} \rightarrow$

- contemporaneous rainfall anomaly (# of st. dev. of a county's annual precipitation (in year *t*) from its long-run historic average over the period between 1950 and 2000
- Rainfall anomalies, t-1
- Average insurance claims, t-1 (i.e. \$ insurance payments per claim, log);

 $X_{ct} \rightarrow$

- Insurance premiums paid per \$ coverage (proxy for a price of insurance, log);
- Per capita income (log)
- Residential mortgage loans per capita (log)

 $PA_{ct-1} \rightarrow$

- Public Assistance Program spending per capita (log)
- Individual Housing Assistance per capita (log)

Identification

- Disaster aid may itself be determined by the extend of insurance penetration and coverage.
- We implement instrumental variable estimation approach

$$PA_{ct} = X_{ct}\alpha + (Z_{ct})\beta + \gamma D_{ct} + \lambda_t + \mu_c + \varepsilon_{ct}$$

Z_{ct} - instruments for PA

- % voting for independent candidate in the most recent presidential election Dummy if the county's winning party in a state senate election is the same as the party of an incumbent president
- Agricultural federal disaster aid per capita → crop-related disaster payments from the United States Department of Agriculture (USDA) Farm Service Agency (FOIA).

Data

- Flood insurance data (i.e. policies in force, total coverage, insurance claims and payments)
 → FOIA from FEMA
- PA, IHA project amounts were obtained from the FEMA
- Precipitation data obtained from the National Climate Data Center (NCDC) Global Historical Climatology Network
- Income and population series \rightarrow Bureau of Economic Analysis
- Residential Mortgage Loan Amounts → the Federal Deposit Insurance Corporation (FDIC); Statistics on Depository Institutions Reports
- Presidential and State Senate Election data → Dave Leip's Atlas for U.S. Presidential Election <u>http://uselectionatlas.org/</u>

Summary Statistics (sample period: 1992-2010)

	Mean	Std. Dev	Min	Max
take up rate	0.01	0.03	0.00	0.79
coverage per policy holder	126,935.50	63,704.54	2,025.57	1,430,814.00
total number of policies	1,586.94	12,760.58	1.00	434,982.00
total dollar coverage, \$1,000	290,000.00	2,480,000.00	2.03	95,200,000.00
Insurance payments per claim	4,564.52	12,814.07	0	762,589.00
PA per capita	9.81	224.89	0	28,479.04
IHA per capita	4.54	59.98	0	3,376.57
log, residential loans per capita	7.64	2.46662	0	15.29433
log, Average premiums, \$	-5.33	0.45	-7.03	-2.60
Log, income per capita	10.30	0.22	9.29	11.77
Rainfall anomalies	0.15	1.05	-9.88	24.16
Rainfall anomalies, t-1	0.14	1.05	-11.48	24.16
Log agricultural aid per capita, t-1	3.33	2.12	-2.76	9.51
% voting for independent candidate, t-2	0.07	0.08	0	0.40
Dummy if president party =state senate party	0.51	0.50	0	1

IV Results (PA)

	Take up rate	Log, insurance	Log, coverage	Log, number of
		coverage per		policies
		policy holder		
Log of PA per capita, t-1	-0.0089***	-0.0293	-0.4336***	-0.4030***
	(0.0029)	(0.0363)	(0.1096)	(0.1022)
Log, premiums paid per \$ coverage	-0.0012***	-0.6595***	-0.9020***	-0.2403***
	(0.0004)	(0.0135)	(0.0330)	(0.0294)
Log, income per capita	0.0286***	0.1114**	0.6432***	0.5420***
	(0.0081)	(0.0536)	(0.1448)	(0.1340)
Rainfall anomaly, t	0.0003**	0.0021	0.0236***	0.0216***
	(0.0001)	(0.0019)	(0.0056)	(0.0053)
Rainfall anomaly, t-1	0.0012***	0.0059	0.0674***	0.0615***
	(0.0004)	(0.0057)	(0.0171)	(0.0160)
Log, residential loans per capita	0.0002	0.0024	0.0112*	0.0088
	(0.0002)	(0.0031)	(0.0063)	(0.0065)
Log, insurance payments per claim, t-1	0.0005***	0.0012	0.0290***	0.0276***
	(0.0001)	(0.0017)	(0.0053)	(0.0049)
Log, population			0.6479***	0.6972***
			(0.1113)	(0.1083)
N	50,648	50,648	50,648	50,648
County and Year FE	Y	Y	Y	Y
Hansen J	1.81	1.41	17.40***	24.47***
First stage F-statistics	17.94***	17.94***	18.30***	18.30***

IV Results (IHA): 2005-2010

	Take up rate	Log, insurance	Log, coverage	Log, number of
		coverage per		policies
		policy holder		
Log of IHA per capita, t-1	-0.0022**	-0.0233	-0.0052	0.0189
	(0.0011)	(0.0174)	(0.0366)	(0.0329)
Log, premiums paid per \$ coverage	-0.0008**	-0.5807***	-0.7299***	-0.1491***
	(0.0004)	(0.0283)	(0.0562)	(0.0430)
Log, income per capita	0.0277**	0.0824*	0.4738***	0.3952***
	(0.0139)	(0.0442)	(0.1040)	(0.0913)
Rainfall anomaly, t	0.0001	0.0028*	0.0123***	0.0095***
	(0.0001)	(0.0016)	(0.0034)	(0.0030)
Rainfall anomaly, t-1	0.0000	0.0003	0.0103***	0.0100***
	(0.0000)	(0.0017)	(0.0036)	(0.0032)
Log, residential loans per capita	0.0003	0.0077**	0.0120*	0.0043
	(0.0002)	(0.0036)	(0.0068)	(0.0058)
Log, insurance payments per claim, t-1	0.0001**	0.0014	0.0032	0.0018
	(0.0001)	(0.0010)	(0.0021)	(0.0019)
Log, population			0.7519***	0.7783***
			(0.1573)	(0.1433)
N	16,716	16,716	16,716	16,716
County and Year FE	Y	Y	Y	Y
Hansen J	4.17	1.64	11.67***	12.44***
First stage F-statistics	28.05***	28.05***	27.41***	27.41***

Qualitative Summary of Results

- Increasing spending in programs targeting at rebuilding public goods and recovery as well as individual housing assistance reduce insurance take up rates
- PA programs significantly reduce total dollar coverage and total number of policies in force
- No significant effects were estimated for the average coverage per policy holder →
 Public assistance may affect the extensive margin rather than intensive margin.
- Flood insurance take-up rates and coverage are higher in wealthier counties
- Insurance take-up and coverage are highly responsive to current and prior year's flooding shocks and extent of damages.
- Increase in residential loans per capita significantly increase total insurance coverage, no significant effects on take-up rates or average coverage per policy holder

Implications for US Disaster Policy

- Different policy instruments may provide conflicted incentives for private efforts of mitigating and transferring hazard risks.
- Current federal disaster policy is primarily responsive and focuses on recovery activities \rightarrow no cap on PA spending
 - To minimize households' under-protection, federal post-disaster public assistance to localities should be limited or tied to insurance requirements
 - A changing climate, including projected sea level rise and increasing exposure to coastal hazards imply more financial burden on taxpayers.
- Low take up rates still remain a concern across many communities exposed to frequent floods and inundation risk (Dixon et al., 2006; Kriesel and Landry, 2004; Kousky and Michel-Kerjan, 2012).
- If flood insurance take-up decisions are crowded out by federal disaster assistance, this suggests we should re-evaluate the real costs of federal assistance by accounting for the implicit losses due to flood insurance dropout.

Thank You!

Questions?

First Stage Results

Dep. Variable: Ln(PA per capita)	Coef
Premium per \$ coverage, log	-0.028597
	(0.0238)
Per capita income, log	1.20623***
	(0.1092)
Rainfall anomaly, t	0.1566974***
	(0.0064)
Rainfall anomaly, t-1	0.0467348***
	(0.0045)
Residential loans per capita, log	0.0043308
	(0.0079)
Average insurance payments per claim, t-1 log	0.0470307***
	(0.0017)
Agricultural Disaster Aid, t-1 log	-0.0383741***
	(0.0078)
% voting for independent candidate in presidential election, t-2	-0.666463***
	(0.1585)
Dummy if president party and senate are the same, t-1	0.0168321*
	(0.0099)





