Unintended Consequences of Government Support: Impact of Pakistan's Flood Relief Program on Adaptation Behavior

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Motivation

- Natural disasters have negative economic and social consequences.
- Increased risk of natural disasters like floods due to climate change.
- Informal community level adaptations are very important.
- Government support after a disaster usually provided in form of geographically tarageted cash transfers (village level), but we do not know how these affect adaptation behaviors.

Argument

– Geographically targeted government relief can discourage community adaptation in communities facing a disaster risk.

Background

- 2010 floods were one of the worst floods in Pak history
  - one fifth of total land area flooded
  - 20 million people affected (11 percent of total population)
  - Overall economic losses about USD 10 billion (6 percent of GDP)
- Government provided cash transfers in form of Watan visa debit cards.
- Transfer amount: 20,000 PKR (around 200 USD) - around two month's median rural income at the time.

Identifying potential beneficiaries

- In Punjab and Sindh, entire villages were identified as calamity affected
  - determined through a visual calculation that **at least 50 percent** of the village is flooded
- In KPK, affected households were identified through in person survey
  - Due to the experience of 2005 earthquake, survey teams were much better prepared.

Data

- Pakistan Rural Household Panel Survey
  - Round 1: March - April 2012
- Covers 76 rural villages in Punjab, Sindh, and KPK a total of 2090 rural households.

Data

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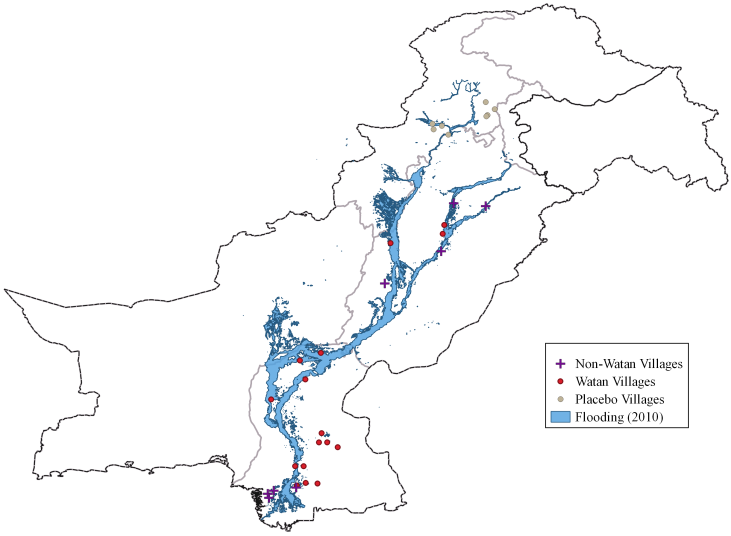
- Covers 76 rural villages in Punjab, Sindh, and KPK a total of 2090 rural households.
- Spatial data on nightlight, population density, ex-ante flood risk from other sources.

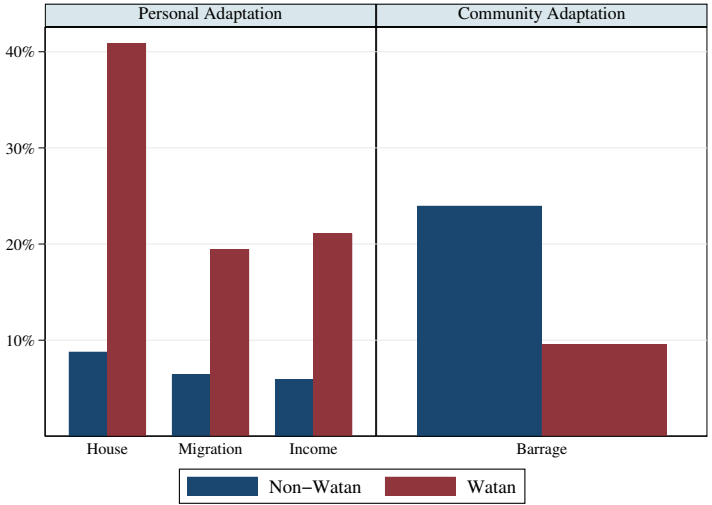
Map - Pakistan



Outcome variables

- Personal Adaptation:
  - Improve house infrastructure
  - Send household members as migrants to other areas with lower flood risk
  - Diversify income sources/move away from farm income
- Community Adaptation
  - Contribute in community efforts to build flood protection i.e. small barrage near a village.

Adaptation in Watan vs Non-Watan Villages



Identification Challenge

- Extent of flooding and thus likelihood of Watan card could be associated with the damage caused by the flood, which could affect adaptation behavior.
- Pre-flood differences in Watan vs non-Watan villages i.e. development.
  - Spatial controls Table
  - Placebo test (KPK province)

Empirical Specification

$$Y_{ik} = \alpha + \beta watan_{ik} + \delta_k + \lambda_i + \epsilon$$

- Y_{ik} is a binary variable for adaptation to floods
- $watan$ is a binary variable for whether individual i resides in a Watan village
- δ_k and λ_i are a range of village level and household level controls

Controls

- Village level controls:
  - Village Damage due to floods (Index)
  - Nightlights (2010)
  - Ex-Ante Flood Risk
  - Elevation (100m)
- Household level controls (for precision):
  - Household Damage (Index)
  - Elite Connectedness
  - Family outside Village
  - Property ownership
  - Education (HH head)

Results - Adaptation

	Personal Adaptation			Community Adaptation		
	(1)	(2)	(3)	(4)	(5)	(6)
Watan	0.186***	0.216***	0.202**	-0.212***	-0.224***	-0.219***
	(0.061)	(0.068)	(0.083)	(0.049)	(0.041)	(0.066)
Village Controls	No	Yes	Yes	No	Yes	Yes
Household Controls	No	No	Yes	No	No	Yes
Observations	634	634	634	634	634	634
Clusters	24	24	24	24	24	24
Non-Watan mean	0.079	0.079	0.079	0.275	0.275	0.275
R-Squared	0.10	0.15	0.22	0.08	0.10	0.13

Results - Adaptation - Placebo Province

– *Potential Worry:* Unobserved pre-treatment differences between villages more than 50 percent flooded (Watan) and those that are less than 50 percent flooded (non-Watan).

	Personal Adaptation			Community Adaptation		
	(1)	(2)	(3)	(4)	(5)	(6)
Watan Eligible	0.229***	0.104***	0.109***	0.631***	0.246***	0.332***
	(0.03)	(0.01)	(0.01)	(0.10)	(0.03)	(0.05)
Village Controls	No	Yes	Yes	No	Yes	Yes
Household Controls	No	No	Yes	No	No	Yes
Observations	224	224	224	224	224	224
Clusters	8	8	8	8	8	8
Non-Watan mean	0.05	0.05	0.05	0.15	0.15	0.15
R-Squared	0.47	0.51	0.56	0.52	0.57	0.59

Mechanism

To understand the mechanism, I do two things:

- Subset households by damage levels and compare those residing in Watan villages with those in non-Watan villages.
- Heterogeneity Analysis: estimate the following equation.

$$Y_{ik} = \alpha + \beta_1 damage_{ik} + \beta_2 watan_{ik} + \beta_3 damage_{ik} \times watan_{ik} + \delta_k + \lambda_i + \epsilon$$

Heterogeneous Effects by Damage

Panel A: Sub-Sample	(1) Personal	(2) Community	(3) Personal	(4) Community
Watan	0.281***	-0.067	0.167**	-0.490***
	(0.064)	(0.041)	(0.072)	(0.123)
Sample	Damaged HHs	Damaged HHs	Non-Damaged HHs	Non-Damaged HHs
Observations	361	361	273	273
Non-Watan mean	0.04	0.15	0.15	0.52
Panel B: Heterogeneity Analysis (Full Sample)				
Watan	0.202**	-0.219***	0.174**	-0.228**
	(0.083)	(0.066)	(0.078)	(0.100)
Household Damage	0.096**	-0.026	-0.081	-0.353*
	(0.038)	(0.076)	(0.082)	(0.189)
HH Damage x Watan			0.224*	0.410*
			(0.112)	(0.205)
Observations	634	634	634	634
Non-Watan mean	0.08	0.27	0.08	0.27
Clusters	24.00	24.00	24.00	24.00

Identification Challenge

– *Potential Worry:* Differences between more and less damaged households might not be the same in Watan and non-Watan villages (parallel trends assumption)

	(1)	(2)	(3)	(4)
	Personal	Community	Personal	Community
Watan Eligible	0.109***	0.332***	0.096***	0.335***
	(0.011)	(0.053)	(0.017)	(0.070)
Household Damage	-0.047	-0.081**	0.081*	-0.020
	(0.058)	(0.025)	(0.042)	(0.088)
HH Damage x Watan Eligible			-0.131	-0.062
			(0.091)	(0.098)
Village Controls	Yes	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes	Yes
Observations	224	224	224	224
Clusters	8	8	8	8
Non-Watan mean	0.05	0.15	0.05	0.15
R-Squared	0.56	0.59	0.55	0.59

Robustness Checks

- Household Characteristics Heterogeneity (Parallel Trends) Table
- Heterogeneity Analyis for Non-Damaged and Slightly Damaged HHs Table
- Construction of Watan Eligible Variable Table
- Non-Damaged HHs in Punjab and Sindh vs KPK Table
- 2011 Floods Table
- Alternate Controls:
  - Household Damage Table
  - Nightlights vs Population Density Table
  - Ex-Ante Flood Risk vs Flood Hazard Table

Alternative Explanation

- Substitution Effect
- Other potential Explanations ?

Model

$$\mathbb{E}(U) = \mathbb{E}(U_0) + \rho\mathbb{E}(U_1)$$

$$\mathbb{E}(U_0) = Y_0 + T - D_0 - qA_p - rA_c$$

Potential States for a Household in Period 1

State	Probability	Utility
(Flood, Damage)	$\pi(A_c)\tau(A_p, D_0)$	$Y_1 + T - D_1$
(Flood, No Damage)	$\pi(A_c)\left(1 - \tau(A_p, D_0)\right)$	$Y_1 + kT$
(No Flood, Damage)	$(1 - \pi(A_c))\,(0)$	$Y_1 - D_1$
(No Flood, No Damage)	$(1 - \pi(A_c))(1)$	Y_1

Model

$$\mathbb{E}(U) = W - \pi(A_c)\tau(A_p, D_0)D_1 - (qA_p + rA_c) + k\pi(A_c)T + (1-k)\pi(A_c)\tau(A_p, D_0)T$$

where $W = Y_0 + Y_1 + T - D_0$

- Assumptions:
  - $\frac{\partial \pi}{\partial A_c} < 0$, $\frac{\partial^2 \pi}{\partial A_c^2} > 0$
  - $\frac{\partial \tau}{\partial A_p} < 0$, $\frac{\partial^2 \tau}{\partial A_p^2} > 0$
  - $\frac{\partial \tau}{\partial A_p}$ is only a function of A_p and not D_0
  - $\frac{\partial \tau}{\partial D_0} > 0$
  - $(\tau(A_p, D_0)D_1 > T)$.

Effect of Cash Transfer on Community Adaptation

– Under village level cash transfer program

$$\implies \frac{\partial A_c}{\partial T} = \frac{\pi'(A_c)\left(1 - \tau_1(A_p, D_0)D_1 \frac{\partial A_p}{\partial T}\right)}{\pi''(A_c)\left(\tau(A_p, D_0)D_1 - T\right)}$$

Effect of Cash Transfer on Community Adaptation

Under household level cash transfer program

$$\frac{\partial A_c}{\partial T} = \frac{\pi'\tau_1\tau_{11} - \pi'\tau_1^2}{\Big(D_1 - T\Big)\Big(\pi''\tau_{11}\tau - \pi'\tau_1^2\Big)}$$

Conclusion & Limitations

- Village level cash transfers or geographically targetted cash transfers can negatively affect community efforts for adaptation to natural disasters.
- Non-damaged households in flooded villages drive this negative effect
- Policy lesson: Geographically targeted cash transfers might incur low administrative cost and can be implemented quickly, they also have unintended consequences.

Extension

- A common adaptation strategy to natural disasters is migration.
- Use satellite imagery data on villages to understand effect of cash transfer program on migration

Thank you!

Appendix

Balance

Back

	Watan		Non-Watan		Difference
	Obs. (Villages)	Mean (SD)	Obs. (Villages)	Mean (SD)	Diff. (SE)
Night Light	441	13.1	193	12.1	0.99
	(16)	(13.6)	(8)	(6.2)	(1.0)
Population Density	441	237.8	193	227.7	10.16
	(16)	(123.6)	(8)	(127.4)	(10.8)
Ex-Ante Flood Risk	441	2.3	193	2.0	0.34***
	(16)	(1.5)	(8)	(1.3)	(0.1)
Flood Hazard 100 yrs	441	107.2	193	84.3	22.95**
	(16)	(129.7)	(8)	(87.7)	(10.2)
Elevation (100 m)	441	0.5	193	0.8	-0.26***
	(16)	(0.5)	(8)	(0.8)	(0.1)

Robustness Check - Heterogeneous Effects Balance

Back

	(1) Elite Connectedness	(2) Relatives out village	(3) Own House	(4) Education
Watan	-0.32***	-129.28***	-0.18**	0.14
	(0.11)	(36.58)	(0.07)	(0.39)
Household Damage	0.10	37.82	-0.02	-1.54*
	(0.34)	(78.65)	(0.07)	(0.81)
HH Damage x Watan	-0.05	-47.09	0.15	1.33
	(0.34)	(77.18)	(0.12)	(1.07)
Village Controls	Yes	Yes	Yes	Yes
Observations	634	634	634	634
Non-Watan mean	0.43	141.84	0.99	2.34

Robustness Check - Flooding (2011)

Back

	(1) Personal	(2) Community	(3) Personal	(4) Community
Watan	0.202**	-0.219***	0.182**	-0.274***
	(0.083)	(0.066)	(0.081)	(0.080)
Floods (2011)			-0.038	-0.108*
			(0.074)	(0.054)
Village Controls	Yes	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes	Yes
Observations	634	634	634	634
Clusters	24	24	24	24
Non-Watan mean	0.079	0.275	0.079	0.275
R-squared	0.22	0.13	0.22	0.14

Robustness Check - House Damage vs Damage (Index)

Back

	(1) Personal	(2) Community	(3) Personal	(4) Community
Watan	0.202**	-0.219***	0.156*	-0.226***
	(0.083)	(0.066)	(0.076)	(0.056)
Village Damage (Index)	0.071	-0.134		
	(0.162)	(0.143)		
Household Damage (Index)	0.096**	-0.026		
	(0.038)	(0.076)		
Village Damage (H)			0.081**	0.168***
			(0.030)	(0.051)
House Building Damage			0.000	-0.108**
			(0.019)	(0.041)
Village Controls	Yes	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes	Yes
Observations	634	634	634	634
Clusters	24	24	24	24
Non-Watan mean	0.079	0.275	0.079	0.275
R-squared	0.22	0.13	0.28	0.19

Robustness Check - Ex-Ante Flood Risk vs Flood Hazard

Back

	(1) Personal	(2) Community	(3) Personal	(4) Community
Watan	0.202**	-0.219***	0.217***	-0.228***
	(0.083)	(0.066)	(0.069)	(0.068)
Ex-Ante Flood Risk	-0.028	-0.013		
	(0.024)	(0.012)		
Flood Hazard (IHS)			0.018**	-0.006
			(0.008)	(0.007)
Village Controls	Yes	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes	Yes
Observations	634	634	634	634
Clusters	24	24	24	24
Non-Watan mean	0.079	0.275	0.079	0.275
R-squared	0.22	0.13	0.23	0.13

Robustness Check - Night Light vs Population Density

Back

	(1) Personal	(2) Community	(3) Personal	(4) Community
Watan	0.202**	-0.219***	0.187**	-0.220***
	(0.083)	(0.066)	(0.081)	(0.065)
Night Light (2010)	-0.001	-0.002		
	(0.002)	(0.001)		
Log(Pop Density)			0.092*	0.018
			(0.047)	(0.052)
Village Controls	Yes	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes	Yes
Observations	634	634	634	634
Clusters	24	24	24	24
Non-Watan mean	0.079	0.275	0.079	0.275
R-squared	0.22	0.13	0.25	0.12

Robustness Check - Construction of Watan Eligible

Back

	(1) Personal	(2) Community	(3) Personal	(4) Community
Watan Eligible	0.24***	-0.18*	0.25***	-0.31**
	(0.06)	(0.10)	(0.05)	(0.11)
HH Damage	0.10**	-0.03	0.12	-0.46**
	(0.04)	(0.08)	(0.07)	(0.18)
HH Damage x Watan Eligible			-0.03	0.57***
			(0.10)	(0.20)
Village Controls	Yes	Yes	Yes	Yes
Household Controls	Yes	Yes	Yes	Yes
Observations	634	634	634	634
Clusters	24	24	24	24
Non-Watan mean	0.08	0.27	0.08	0.27
R-squared	0.23	0.10	0.23	0.14

Heterogenous Effects (Minor Damage vs Damaged)

Back

Panel A: Sub-Sample	(1) Personal	(2) Community	(3) Personal	(4) Community
Watan	0.263**	0.031	0.170**	-0.491***
	(0.113)	(0.075)	(0.064)	(0.123)
Sample	Damaged HHs	Damaged HHs	Non-Damaged HHs	Non-Damaged HHs
Observations	133	133	273	273
Non-Watan mean	0.032	0.200	0.151	0.523
R-squared	0.417	0.203	0.231	0.454
Panel B: Heterogeneity Analysis (Full Sample)				
Watan	0.115	-0.259***	0.049	-0.353***
	(0.093)	(0.072)	(0.100)	(0.081)
Damage	0.100	0.015	-0.129	-0.252
	(0.125)	(0.111)	(0.088)	(0.207)
Damage x Watan			0.379*	0.497**
			(0.203)	(0.228)
Village Controls	Yes	Yes	Yes	Yes
HH Controls	Yes	Yes	Yes	Yes
Clusters	23	23	23	23
Observations	406	406	406	406
Non-Watan mean	0.091	0.362	0.091	0.362
R-squared	0.181	0.292	0.206	0.315

Effect of Watan Card on Adaptation of Non-Damaged Households (Punjab Sindh vs KPK)

Back

	(1) Personal	(2) Community
Punjab, Sindh	-0.028	-0.427**
	(0.183)	(0.148)
Village Controls	Yes	Yes
HH Controls	Yes	Yes
Clusters	13	13
Observations	213	213
Control mean	0.166	0.400
R-squared	0.30	0.08