

# Can Extreme Shocks be Mitigated?

Recovery deficits in children after the  
Great Pakistan Earthquake of 2005

IGC Conference, Lahore

March 2014

(with Ben Daniels and Jishnu Das)

# Effects of Shocks during Early Years

- Earlier and later shock have different effects
  - Biological/nutritional shocks vs. shocks that disrupt education
- How much can parental SES compensate for these shocks
- Implications
  - intergenerational transmission of inequality
  - Policy

# What we do

- Look at effect of large earthquake in Pakistan four years after using a cross-section
- Explore if comparisons across villages far from and close to activated fault-line provide a measure of the 4-year impacts of the shock
  - Unexpected shock
  - No associations between large number of village and household covariates and distance to fault-line
  - No attrition due to mortality selection or migration
  - No Aid spillovers

# What we do (2)

- Look at 4-year impacts of shock on consumption, assets, children's schooling outcomes (enrollment and test-scores) and child height and weight
  - Consumption, Assets, Access to infrastructure have recovered
  - No differences in child enrollment
  - Large differences in child height (Ages 0-3 only) Largest in utero, declining till age 0-3, none ages 4 onwards )
  - Large differences in child test-scores (all subjects, ages)
    - Cognitive deficits exist in children who suffered no height shock

# What we do (3)

- Can parental SES mitigate these shocks
  - Find that children whose mothers had some education were completely protected on test-score losses
  - No mitigation for shocks in height
- What is maternal education capturing?
  - Instrument for maternal education using availability of schooling options in birth-village of mother
  - Protective effects remain for test-scores
  - But, also consistent with assortative matching
- Warning: Very difficult to identify channels with these data

# **THE EARTHQUAKE**

# The Context

- October 2005: Large earthquake hit Northern Pakistan
  - Left 80,000 dead
  - Most homes in area destroyed
- Himalayan Frontal Thrust Activated Faultline
- November 2005: Set up Riseapak, a relief website that crowd-sourced information from those affected
- First visits to affected areas
- December 2005: Extended trip to affected areas
- March 2005: Another trip to affected areas
- June 2009: Census of 126 villages in affected areas (28,000 households)
- By December 2009: Household survey of 2500 (approx) households

# Some pictures



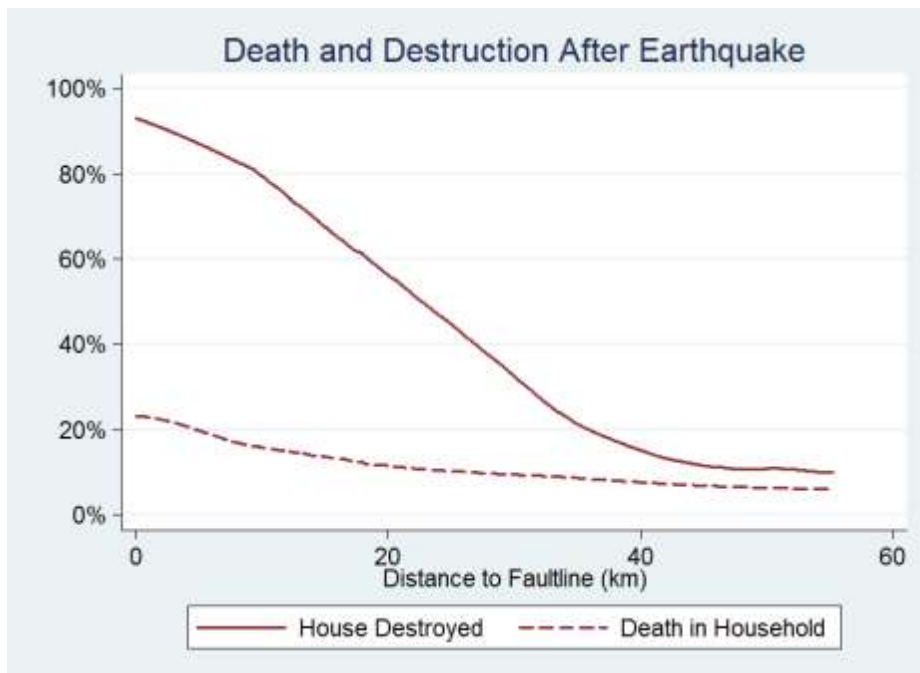


# More pictures



# The Faultline Instrument

Strongly associated with death and destruction



## Regression results

	Family Member Died?	House Destroyed?
Distance to Faultline (km)	-0.002* (0.001)	-0.017*** (0.002)
Distance to Epicenter (km)	-0.001 (0.001)	0.002 (0.002)
Mean Slope of UC	0.001 (0.002)	0.014*** (0.003)
District: Bagh	0.042 (0.055)	0.091 (0.092)
District: Mansehra	-0.040* (0.022)	0.099* (0.056)
District: Muzaffarabad	0.010 (0.031)	0.143** (0.064)
District: Neelum	0.057 (0.041)	-0.012 (0.085)
Constant	0.188*** (0.052)	0.433*** (0.105)
Number of observations	2,439	2,439

note: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

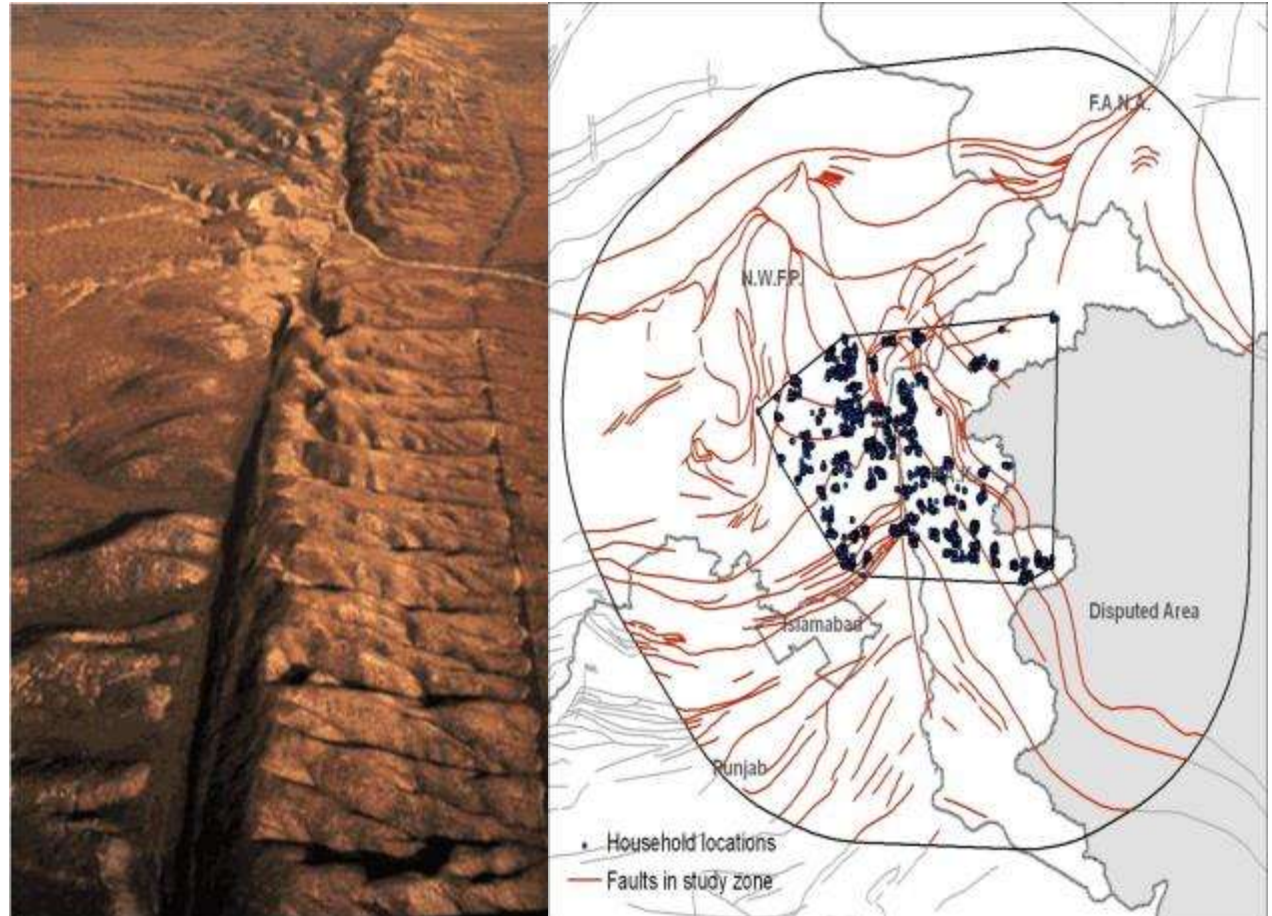
Standard errors clustered by village.

## More on Faultlines

No visible, single fault-line, unlike San Andreas (left)

Many fault-lines in affected areas, each of which had ex ante similar likelihoods of being hit

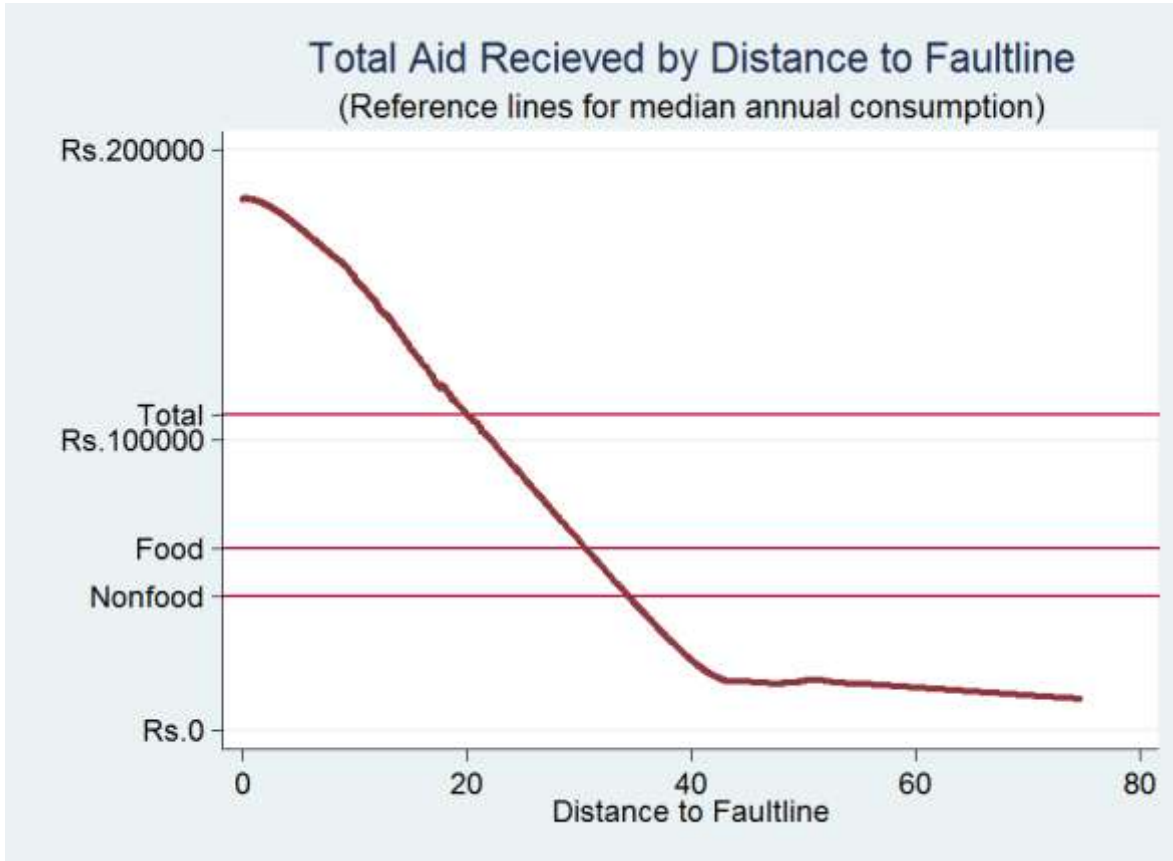
Results always robust to controlling for where a person lives in terms of distance to closest fault-line and number of fault-lines within X KM



# Migration

- Household survey enumerates all members before earthquake and after
  - No evidence of differential movements by distance to fault-line
    - Most people own land with insecure property rights within extended family—very tied to land
    - Very few even went to “tent cities”
  - Anecdotal evidence of households not moving outside the region
    - Housing reconstruction money required surviving head presence

# Aid



- Substantial compensation
  - Rs.25,000 immediately (everyone got it)
  - Rs.175,000 for housing (over 2 years, in tranches)
  - Rs.18,000 cash-grant (started after 6 months, in tranches)
    - Supposed to be for families with  $\geq 5$  kids

**BEFORE AND AFTER:  
RECOVERY TO PARITY**



## After the Quake: Households

After the quake, we found that households had recovered to parity on every dimension of infrastructure, and in some areas now outperformed unaffected areas.

This finding sets a context of full surface recovery in affected villages.

Household Characteristics (Post-Quake), per km from fault			
	Base	Base + Nearest Fault	Base + Elevation
<b>Asset Index (PCA) (Post-Quake)</b>	-0.011	-0.010	-0.016
	<i>0.006</i>	<i>0.006</i>	<i>0.005</i>
<b>Electricity</b>	-0.006	-0.006	-0.006
	<i>0.003</i>	<i>0.003</i>	<i>0.003</i>
<b>Household Infrastructure Index</b>	-0.020*	-0.020*	-0.022*
	<i>0.007</i>	<i>0.007</i>	<i>0.007</i>
<b>Log HH Food Consumption</b>	0.006	0.006	0.006
	<i>0.003</i>	<i>0.003</i>	<i>0.003</i>
<b>Log HH Nonfood Consumption</b>	0.007	0.007	0.006
	<i>0.005</i>	<i>0.005</i>	<i>0.006</i>
<b>Log Dist to Gov't School (min)</b>	-0.002	-0.002	-0.001
	<i>0.004</i>	<i>0.004</i>	<i>0.004</i>
<b>Log Dist to Market (min)</b>	0.004	0.004	0.009
	<i>0.007</i>	<i>0.007</i>	<i>0.006</i>
<b>Log Dist to Distr Office (min)</b>	0.004	0.003	0.007
	<i>0.005</i>	<i>0.005</i>	<i>0.005</i>
<b>Log Dist to Medical (min)</b>	-0.003	-0.003	0.001
	<i>0.007</i>	<i>0.008</i>	<i>0.008</i>
<b>Log Dist to Private School (min)</b>	-0.009	-0.009	-0.005
	<i>0.008</i>	<i>0.008</i>	<i>0.008</i>

## After the Quake: Full Enrollment

Enrollment of children fully recovered after the earthquake, with no differences at the individual level due to proximity to the earthquake.

	Base	Base + Nearest Fault	Base + Elevation
Distance from Faultline (km)	-0.001	-0.001	-0.002
	<i>0.001</i>	<i>0.001</i>	<i>0.001</i>
Mother Completed Primary School?	0.089***	0.089***	0.083***
	<i>0.014</i>	<i>0.014</i>	<i>0.015</i>
Male	0.101***	0.101***	0.102***
	<i>0.014</i>	<i>0.014</i>	<i>0.014</i>
Mother Completed Primary School?	0.089***	0.089***	0.083***
	<i>0.014</i>	<i>0.014</i>	<i>0.015</i>
(log) Consumption per Capita	0.036***	0.036***	0.034***
	<i>0.010</i>	<i>0.010</i>	<i>0.009</i>
Number of observations	4,327	4,327	4,260



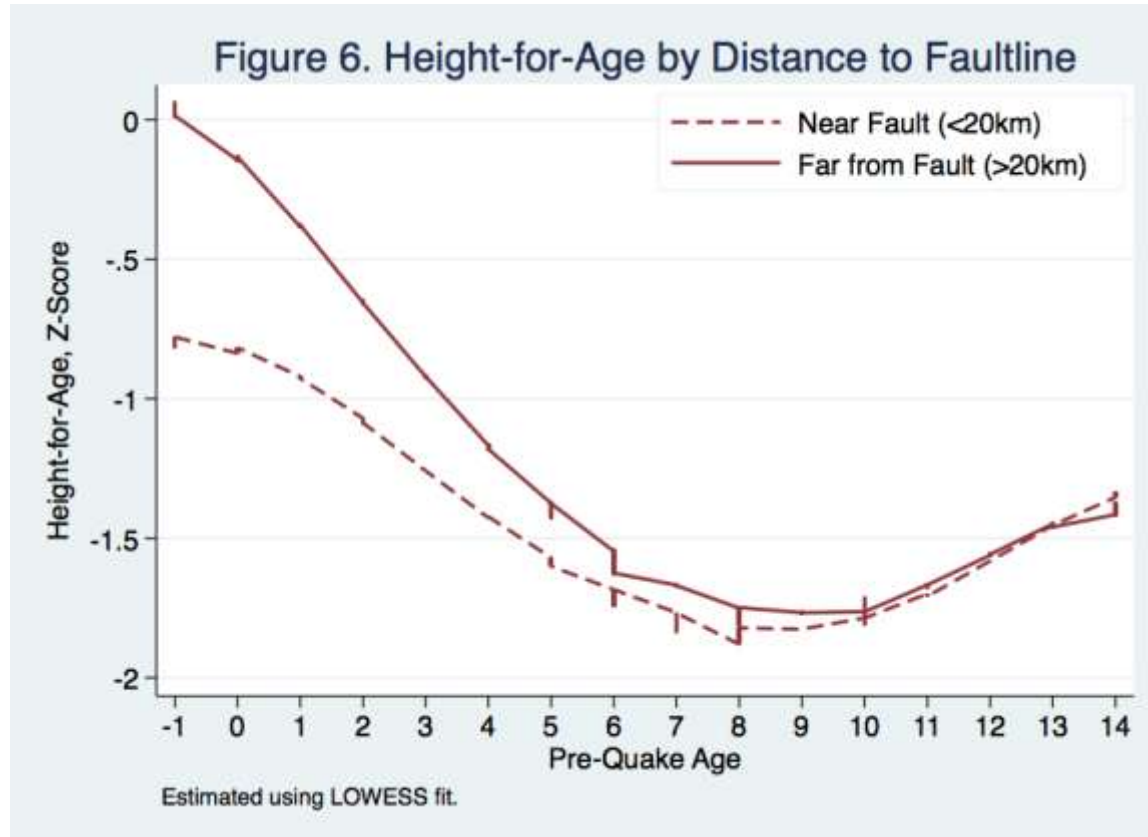
**COMING UP SHORT:  
RECOVERY DEFICITS IN CHILDREN**

## Physical Development

Regression results indicate that this effects is strongest for children in utero at the time of the disaster, and that the difference remains significant for children aged 1-3.

- The height shock is large and significant for kids in utero and newborns at the time of the earthquake pointing to large biological/nutritional shocks as a result of the earthquake.

	Weight-for-age (Continuous distance)	Height-for-age (Continuous distance)
<b>Distance * Unborn/Newborn</b>	0.004	0.025***
	0.005	0.008
<b>Distance * Age 1-3</b>	0.003	0.011*
	0.004	0.006
<b>Distance * Age 4-6</b>	-0.004	0.001
	0.004	0.004
<b>Distance from Faultline (km)</b>	-0.006*	0.000
	0.003	0.003
<b>Mother Completed Primary School?</b>	0.055	-0.005
	0.066	0.074
<b>Male</b>	-0.062	-0.107**
	0.038	0.044
<b>(log) Consumption per Capita</b>	0.014	0.019
	0.035	0.045
<b>Number of observations</b>	4,532	3,913



## Physical Development

However, children under the age of 6 at the time of the earthquake show severe height lags relative to their unaffected peers that persist to the present day.

## Cognitive Development

- Large earthquake shock effect on cognitive outcomes
  - 0.32 SD differential 40 km away.
  - equivalent to getting a extra teacher helper in classroom
  - Maternal education and consumption come in expected direction
  - No differential effect with age.
- Discussion:
  - Cognitive shocks occur even in children that did not suffer a biological (height) shock.
  - Note kids seven years and older at the time of the test were greater than three years old at the time of the earthquake.

	Continuous (km from fault)	SES Controls	Age Heterogeneity
Distance from Faultline (km)	0.008**	0.008**	0.010**
	0.003	0.003	0.005
Male	0.079**	0.072*	0.070*
	0.039	0.038	0.038
Mother Completed Primary School?		0.298***	0.298***
		0.047	0.047
(log) Consumption per Capita		0.114***	0.113***
		0.037	0.037
Distance * Age 8			-0.002
			0.006
Distance * Age 9			0.000
			0.005
Distance * Age 10			-0.003
			0.004
Distance * Age 11			-0.002
			0.004
Distance * Age 12			-0.006
			0.004
Distance * Age 13			0.006
			0.005
Distance * Age 14			-0.007
			0.005
Distance * Age 15			-0.007
			0.006
Number of observations	2,452	2,386	2,386

## Mitigation of Cognitive Deficit

Maternal Education mitigates about a third of the earthquake shock as seen by the maternal education-distance interaction.

The IV regression validate the OLS results.

The IV coefficients as is common with such First stage specifications is a lot higher

	OLS Continuous Distance	(Ever Enrolled Only)	Consumption Interaction	IV Continuous Distance	IV Continuous Distance
<b>Distance from Faultline (km)</b>	0.016**	0.019***	0.007**	0.016***	0.028***
	0.006	0.007	0.003	0.006	0.009
<b>Male</b>	0.074*	0.026	0.072*	-0.001	-0.011
	0.038	0.036	0.038	0.042	0.048
<b>Mother Completed Primary School?</b>	0.395***	0.404***	0.305***	1.456***	3.585**
	0.077	0.073	0.048	0.501	1.537
<b>Mother's Education * Distance</b>	-0.006	-0.007**			-0.092*
	0.004	0.003			0.048
<b>(log) Consumption per Capita</b>	0.113***	0.102***		-0.019	-0.069
	0.037	0.037		0.058	0.094
<b>Lowest Consumption Half</b>			-0.172**		
			0.070		
<b>Distance * Lowest Consumption Half</b>			0.002		
			0.003		
<b>Number of observations</b>	2,386	2,300	2,386	2,105	2,105

## Maternal Education Mitigation for Physical Development

No strong evidence for maternal education with distance to the fault line.

Mother's Education * Distance	0.002
	0.007
Mother's Education * Distance * Unborn/Newborn	-0.006
	0.012
Mother's Education * Distance * Age 1-3	-0.012
	0.008
Mother's Education * Distance * Age 4-6	0.004
	0.006
Number of observations	3,913

## Channels for Maternal Education

Several important socioeconomic indicators are strongly correlated with the presence of an educated mother, even after applying the IV specification.

In particular, we find that a more educated father and enrollment in a private school are more common in households where the mother completed her primary education.

However, we find strong mitigation effects even in villages that have no private schools and only one public school available to a child, indicating that the effect is not due primarily to school choice.

Mitigation: Children without school choice			
	Continuous (km from fault)	(Ever Enrolled Only)	Consumption Interaction
Distance from Faultline (km)	0.019*	0.019	0.004
	0.012	0.013	0.006
Male	0.051	0.039	0.053
	0.075	0.077	0.074
Mother Completed Primary School?	0.544***	0.612***	0.155*
	0.152	0.149	0.094
Mother's Education * Distance	-0.022***	-0.023***	
	0.007	0.007	
(log) Consumption per Capita	0.136**	0.122**	
	0.061	0.057	
Lowest Consumption Half			-0.323**
			0.130
Distance * Lowest Consumption Half			0.008
			0.006
Number of observations	720	688	720

## Channels for Maternal Education

Several important socioeconomic indicators are strongly correlated with the presence of an educated mother, even after applying the IV specification.

In particular, we find that a more educated father and enrollment in a private school are more common in households where the mother completed her primary education.

Table 5a. Effect Channels of Maternal Education

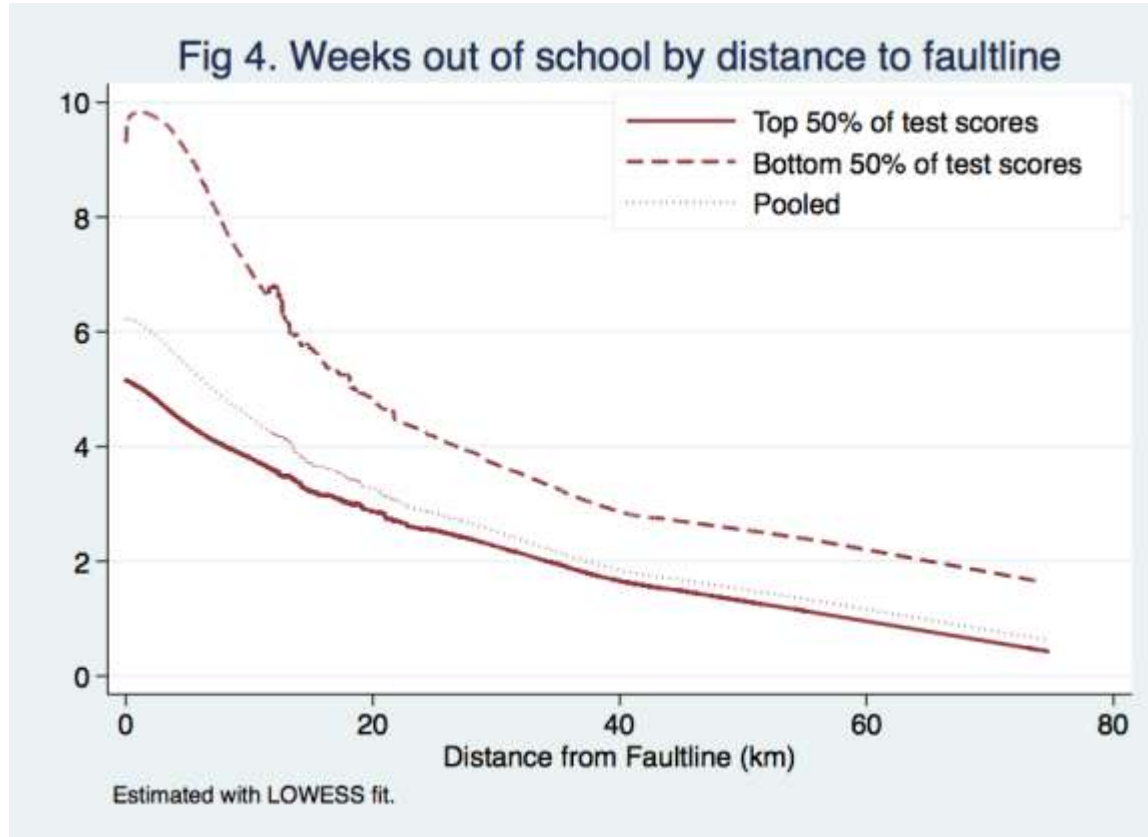
	OLS	IV	N
<b>Father Completed Primary School?</b>	0.353***	0.640**	1,087
	0.025	0.262	.
<b>Permanent House, (Post-Quake)?</b>	0.114***	0.324	1,139
	0.027	0.271	.
<b>Electricity in House?</b>	0.048**	0.552**	1,139
	0.020	0.254	.
<b>Log Household Consumption Rs/yr</b>	0.077	-0.324	1,139
	0.050	0.444	.
<b>Received Housing Grant?</b>	-0.032	-0.189	1,139
	0.022	0.266	.
<b>Received LCGS Grant?</b>	-0.071***	0.266	1,139
	0.025	0.256	.
<b>Child in Private School?</b>	0.106***	0.642**	3,123
	0.029	0.280	.
<b>Weeks Out of School</b>	-1.286***	-1.133	5,588
	0.344	3.516	.



## After the Quake: Educational Disruption

Disruption in education was very common after the earthquake, since the long winter prevented significant rebuilding for several months and relegated formal schooling to temporary shelters until reconstruction was completed.

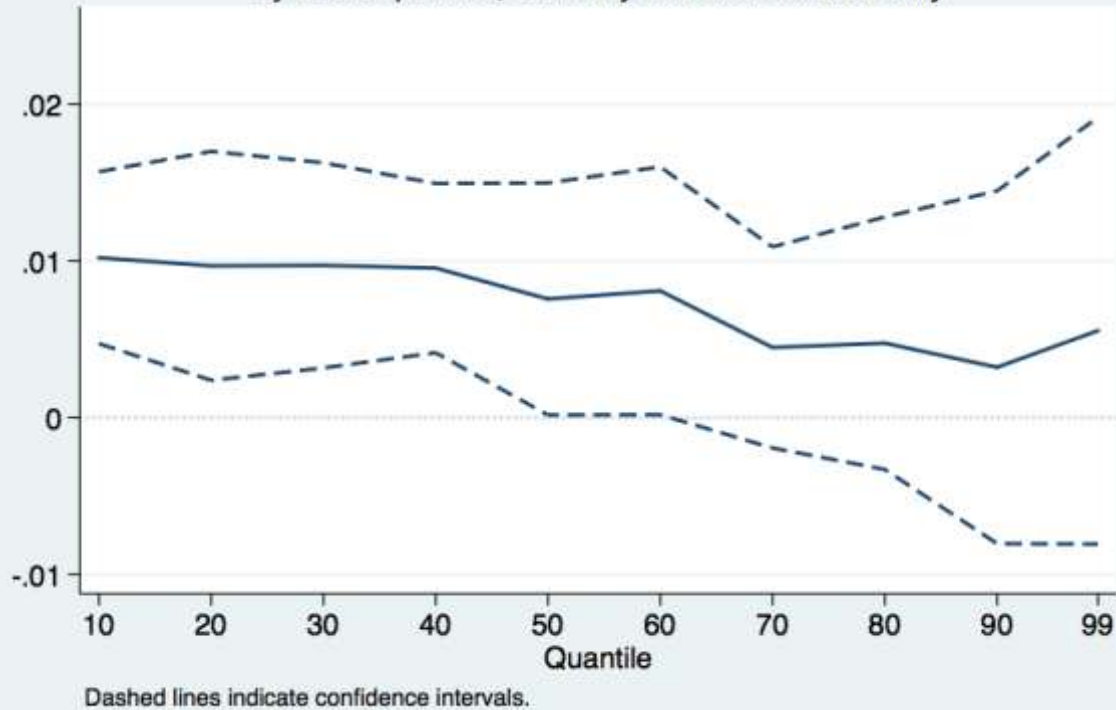
	OLS Continuous Distance	SES Controls	Maternal Education Interaction
<b>Distance from Faultline (km)</b>	-0.146***	-0.133***	-0.141***
	0.050	0.050	0.051
<b>Mother Completed Primary School?</b>		-0.285	-1.326
		0.743	1.220
<b>Mother's Education * Distance</b>			0.065
			0.043
<b>Male</b>	-0.189	-0.239	-0.236
	0.383	0.390	0.388
<b>(log) Consumption per Capita</b>		-0.835	-0.836
		0.646	0.645
<b>Number of observations</b>	2,503	2,446	2,446



## After the Quake: Educational Disruption

We also find that children who scored lower on our academic evaluation were those who spent the most time out of school, and that that gap widened with the severity of the shock. This result indicates the potential for the disaster to reinforce existing performance inequalities.

**Fig 3. Distance-to-Faultline Test Score Coefficients**  
By score quantile; currently enrolled children only



## Inequality in cognitive deficits

By estimating the impact of distance-to-faultline in a series of quantile regressions, we find that the impact of the earthquake is greatest in the lowest performing children while top performers are largely protected from the impact. In this way the shock also increases inequality in academic achievement.

# Conclusion

- After four years, access to infrastructure, PCE, assets no different between villages close to and far from fault-line
- No difference in child enrollment
- But
  - Test-scores for children lower
  - Children 0-3 at time of quake significantly shorter
- Fungible aid was not sufficient to mitigate effects on very young children
- Mother's with some education fully protected children from test-score losses, but not height losses

# Policy Implications

- Special targeting for children
- Poverty Traps