

# Natural Disasters and Educational Achievement: Evidence from the Chilean Earthquake

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# Motivation

- Natural disasters have different negative effects on welfare
- Among them are:
  - Loss of life.
  - Damage in infrastructure: bridges, roads, buildings and schools.
  - Induced displacement of people from their places of usual residence
  - Job losses, destruction / damage of firms.
  - Change of the students from their schools due to destruction / damage
  - Post-Traumatic Stress Disorder (PTSD) → Effects on productivity



# Motivation: Natural disasters have a significant impact

- Hurricane Katrina left about 2500 dead and damages for \$ 80 billion.
- The earthquake of Haiti (2010) left 250,000 deaths and infrastructure losses estimated at 100% of GDP.
- Chile is a country of earthquakes
- Chile is an interesting case to study the effects of natural disasters on different results.



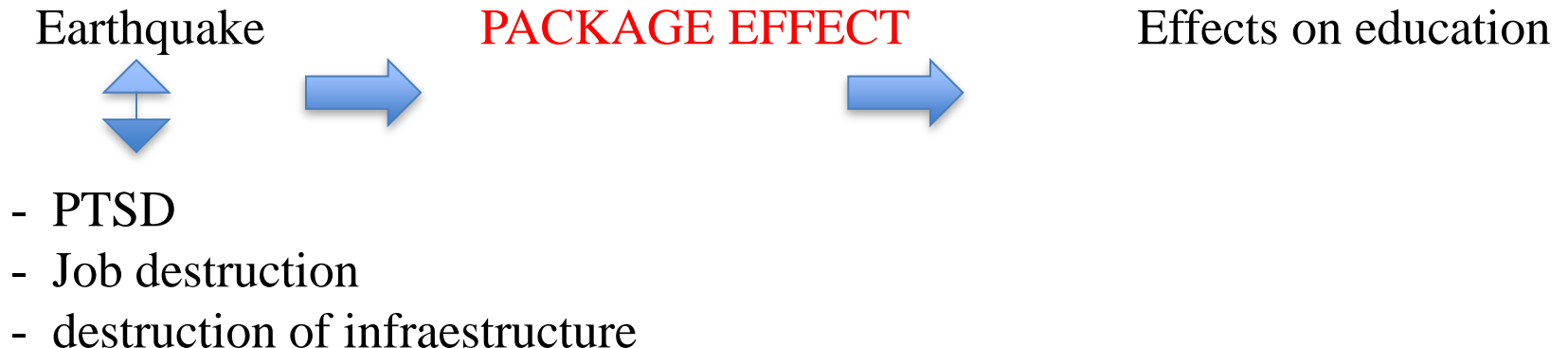
# Previous evidence

- The previous literature shows different effects of natural disasters:
  - Vigdor (2007) finds no significant effects on **labor and health** indicators, about who migrated to other states as a result of Hurricane Katrina
  - Rodriguez-Oreggia al (2008), found a significant deterioration **in human development** index in Mexico as a result of natural disasters.
  - Sacerdote (2008), finds an initial fall in **academic performance** from Hurricane Katrina. However, within 2-3 years there is evidence of improvement, especially for students of poor initial performance (Effects on students forced to change schools).



# This Article...

- The objective is to estimate the impact of the earthquake on the academic performance of students. In particular, we study the effect on students who were forced to change schools as a result of the earthquake.



- There is no previous evidence regarding the effects of earthquakes on educational outcomes.



# Data and Methodology

## Data

- Pre-Earthquake: SIMCE 2008
- Post-Earthquake: PSU 2011
- Records of schools damaged by the earthquake(MINEDUC)
- Observations: 2475 schools-166171 students

## Methodology

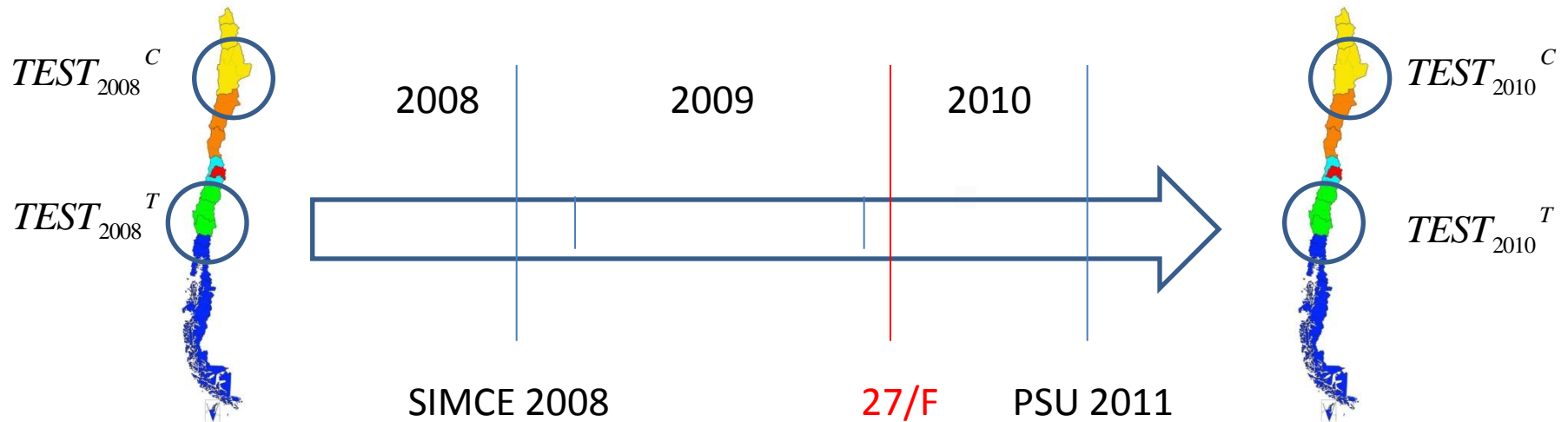
- Earthquake as a exogenous variation
- Difference in difference estimation



# Metodología

Observables are balance through MPS (Kernel) both for students and schools

$$\alpha = \overline{(TEST_{2010} - TEST_{2008})^T} - \overline{(TEST_{2010} - TEST_{2008})^C}$$



# Methodology

Then the equation is

$$\Delta test_{it} = \alpha T_i + \delta X_{it} + \varepsilon_{it}$$

- Where  $\Delta test_{it}$  is the difference of the standardized tests (PSU-SIMCE)
- $T_i$  identifies the observation (school-student) of treatment
- $X_{it}$  control variables of the observation  $i$  in the period  $t$



# Earthquake effects on students and schools: Results



# Results: Impact at the school level

**Treated:** Schools in Region VII and VIII  
**Control:** schools in I, II, III, IV, V, X, XI, XII, XIII

VARIABLES	(1) Matemáticas	(2) Matemáticas	(3) Lenguaje	(4) Lenguaje
Efecto Tratamiento	-0.0372 (0.0712)	0.370*** (0.0435)	-0.0626 (0.0721)	0.361*** (0.0419)
Efecto Temporal	0.172** (0.0708)	0.177*** (0.0420)	0.135* (0.0711)	0.140*** (0.0424)
D-D	-0.0294 (0.0995)	-0.0407 (0.0544)	-0.00885 (0.100)	-0.0204 (0.0533)
$\mathbb{D}_{\{Rural\}}$		0.0171 (0.0508)		-0.0244 (0.0499)
$\mathbb{D}_{\{Subvencionado\}}$		0.0433 (0.102)		0.0882 (0.0901)
$\mathbb{D}_{\{Municipal\}}$		-0.0749 (0.109)		-0.0324 (0.0974)
Ingreso Promedio		7.07e-07*** (1.28e-07)		5.43e-07*** (1.10e-07)
Educación Promedio Padres		-0.0282 (0.0269)		-0.00729 (0.0271)
Educación Promedio Madres		0.261*** (0.0265)		0.272*** (0.0267)
Constant	-0.0246 (0.0515)	-3.099*** (0.148)	-0.0590 (0.0517)	-3.451*** (0.141)
Tratados	399	399	399	399
Controles	337	337	337	337
Adjusted R-squared	0.006	0.710	0.004	0.729

No significant effects

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Cuadro 6: Impacto del Terremoto - Datos Colegios



# Results: Impact student level

**Treated:** Students in Region VII and VIII  
**Control:** Students in I, II, III, IV, V, X, XI, XII, XIII

VARIABLES	(1) Matemáticas	(2) Matemáticas	(3) Lenguaje	(4) Lenguaje
Efecto Tratamiento	-0.0848*** (0.00675)	0.115*** (0.00624)	-0.0784*** (0.00682)	0.106*** (0.00645)
Efecto Temporal	-0.0104** (0.00461)	-0.0434*** (0.00402)	0.00636 (0.00458)	-0.0230*** (0.00412)
D-D	-0.0109 (0.00975)	-0.00754 (0.00871)	-0.0460*** (0.00979)	-0.0467*** (0.00892)
$\mathbb{D}_{\{Rural\}}$		-0.232*** (0.0105)		-0.214*** (0.0112)
$\mathbb{D}_{\{Municipal\}}$		-0.488*** (0.00897)		-0.388*** (0.00910)
$\mathbb{D}_{\{Subvencionado\}}$		-0.373*** (0.00802)		-0.297*** (0.00816)
Ingreso		3.80e-07*** (6.14e-09)		3.21e-07*** (6.23e-09)
Educación Padre		0.0358*** (0.000710)		0.0381*** (0.000731)
Educación Madre		0.0476*** (0.000730)		0.0515*** (0.000755)
Sexo		0.203*** (0.00359)		-0.0521*** (0.00368)
Constant	0.0682*** (0.00315)	-0.823*** (0.0126)	0.0572*** (0.00314)	-0.835*** (0.0129)
Tratados	26,745	26,745	26,745	26,745
Controles	101,406	101,406	101,406	101,406
Adjusted R-squared	0.001	0.263	0.002	0.222

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Cuadro 7: Impacto del Terremoto - Datos Estudiantes



Peer Effects: Who are the students forced to change?  
What are the earthquake effects on them?



# who is changing?

	change of schools/ in Regions VII,VIII		No change of schools/ in regions VII,VIII	
	Observation	Mean	Observation	Mean
<b>Man=1</b>	403	0.52	13601	0.44
<b>Income</b>	403	304714.60	13601	334269.50
Father's schooling	403	11.01	13601	10.61
Mother's education	403	11.20	13601	10.58
<b>Public school</b>	403	0.69	13601	0.46
<b>Voucher school</b>	403	0.31	13601	0.49
<b>Private school</b>	403	0.00	13601	0.05
<b>Size of the household</b>	399	4.60	13477	4.63
<b>Income per capita</b>	399	70171.51	13477	76554.35



# What are the main school characteristics at origin and destination?

Variables	School or origin		School of destination	
	Observations	Mean	Observations	Mean
Father's schooling	402	10.29	402	11.00
Mother's education	402	10.33	402	10.84
Income	402	259.30	402	350860.00
Public school	402	0.73	402	0.45
Voucher school	402	0.26	402	0.51
Private school	402	0.00	402	0.04
SIMCE 2008	402	253.80	402	253.30
SIMCE 2008 Math	402	247.80	402	247.50
PSU 2010	402	467.30	402	466.50
PSU 2010 math	402	469.00	402	470.90



# Effect on students forced to change schools

**Treated:** Students forced to change in Region VII and VIII  
**Control:** Students in I, II, III, IV, V, X, XI, XII, XIII

When we consider as a control group, students in the region VII and VIII who do not change, the effects remain

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Matemáticas	Matemáticas	Matemáticas	Lenguaje	Lenguaje	Lenguaje
Efecto Tratamiento	-0.421*** (0.0466)	-0.216*** (0.0457)	-0.154*** (0.0464)	-0.280*** (0.0464)	-0.0886** (0.0451)	-0.0422 (0.0452)
Efecto Temporal	-0.00917* (0.00472)	-0.0383*** (0.00403)	-0.0616*** (0.00376)	0.00930** (0.00469)	-0.0190*** (0.00412)	-0.0397*** (0.00390)
D-D	0.0422 (0.0672)	0.00548 (0.0652)	0.0438 (0.0631)	-0.0793 (0.0665)	-0.109* (0.0643)	-0.0767 (0.0621)
D <sub>{Municipal}</sub>		-0.454*** (0.00981)	0.429*** (0.0131)		-0.358*** (0.00988)	0.374*** (0.0135)
D <sub>{Subvencionado}</sub>		-0.355*** (0.00871)	0.321*** (0.0121)		-0.283*** (0.00881)	0.259*** (0.0125)
Ingreso		3.86e-07*** (6.70e-09)	5.89e-08*** (6.94e-09)		3.25e-07*** (6.77e-09)	4.67e-08*** (7.14e-09)
Educación Padre		0.0367*** (0.000815)	0.0116*** (0.000788)		0.0389*** (0.000835)	0.0157*** (0.000820)
Educación Madre		0.0486*** (0.000835)	0.0198*** (0.000813)		0.0521*** (0.000864)	0.0260*** (0.000853)
Sexo		0.214*** (0.00405)	0.225*** (0.00378)		-0.0429*** (0.00414)	-0.0343*** (0.00392)
Ed Prom Padres Colegio			0.0199*** (0.00445)			0.0300*** (0.00462)
Ed Prom Madres Colegio			0.226*** (0.00455)			0.211*** (0.00470)
Ingreso Prom Colegio			2.85e-07*** (1.68e-08)			9.85e-08*** (1.74e-08)
Constant	0.0808*** (0.00323)	-0.881*** (0.0140)	-3.785*** (0.0229)	0.0673*** (0.00322)	-0.881*** (0.0144)	-3.586*** (0.0238)
Tratados	398	398	398	398	398	398
Controles	96,667	96,667	96,667	96,667	96,667	96,667
Adjusted R-squared	0.001	0.267	0.365	0.000	0.223	0.306

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Negative and statistically significant effect on language.

The effect disappears when peer effects are included



Cuadro 9: T: Regiones VII y VIII + cambio de colegio + daño severo - C: ~ VI,VII,VIII,IX - Datos Estudiantes



# Why are not effects?

- Did the earthquake do not have a real impact on education?
  - Chile is a seismic country therefore students are not greatly affected by the earthquake
  - Earthquake affects the last year of secondary education, there is already a stock of knowledge from previous years → PSU measured 1st to 4th year of secondary education.
- Only students who are less affected by the earthquake take the PSU?



# Students affected by the earthquake that gave PSU

% of students in the last year of secondary education who give PSU (Language)			
Regions	2009	2010	2011
XV	69%	71%	73%
I	65%	65%	71%
II	69%	71%	72%
III	73%	74%	74%
IV	80%	79%	84%
V	89%	93%	96%
RM	85%	89%	90%
VI	79%	79%	81%
VII	67%	68%	73%
VIII	79%	79%	84%
IX	69%	67%	73%
XIV	65%	62%	69%
X	61%	60%	69%
XI	93%	95%	91%
XII	76%	75%	88%
TOTAL	79%	81%	84%

% of students in the last year of secondary education who give PSU (Math)			
Regions	2009	2010	2011
XV	70%	70%	73%
I	65%	64%	71%
II	68%	70%	71%
III	73%	74%	73%
IV	79%	79%	83%
V	88%	92%	95%
RM	84%	88%	90%
VI	78%	78%	81%
VII	67%	67%	72%
VIII	78%	79%	83%
IX	68%	66%	73%
XIV	65%	61%	68%
X	60%	60%	69%
XI	92%	95%	90%
XII	76%	74%	87%
TOTAL	78%	80%	83%



# Conclusions

- At school level we do not observe impact of the earthquake on academic results.
- At students level there is a significant negative impact for the language test.
- The estimate for students forced to move from damaged schools, indicate a significant negative effect on language which disappears when peer effects are included.

