

IMPACT OF EXTREME CLIMATE EVENTS ON EDUCATIONAL ATTAINMENT: EVIDENCE FROM CROSS SECTION DATA AND WELFARE PROJECTION

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Overview and Literature

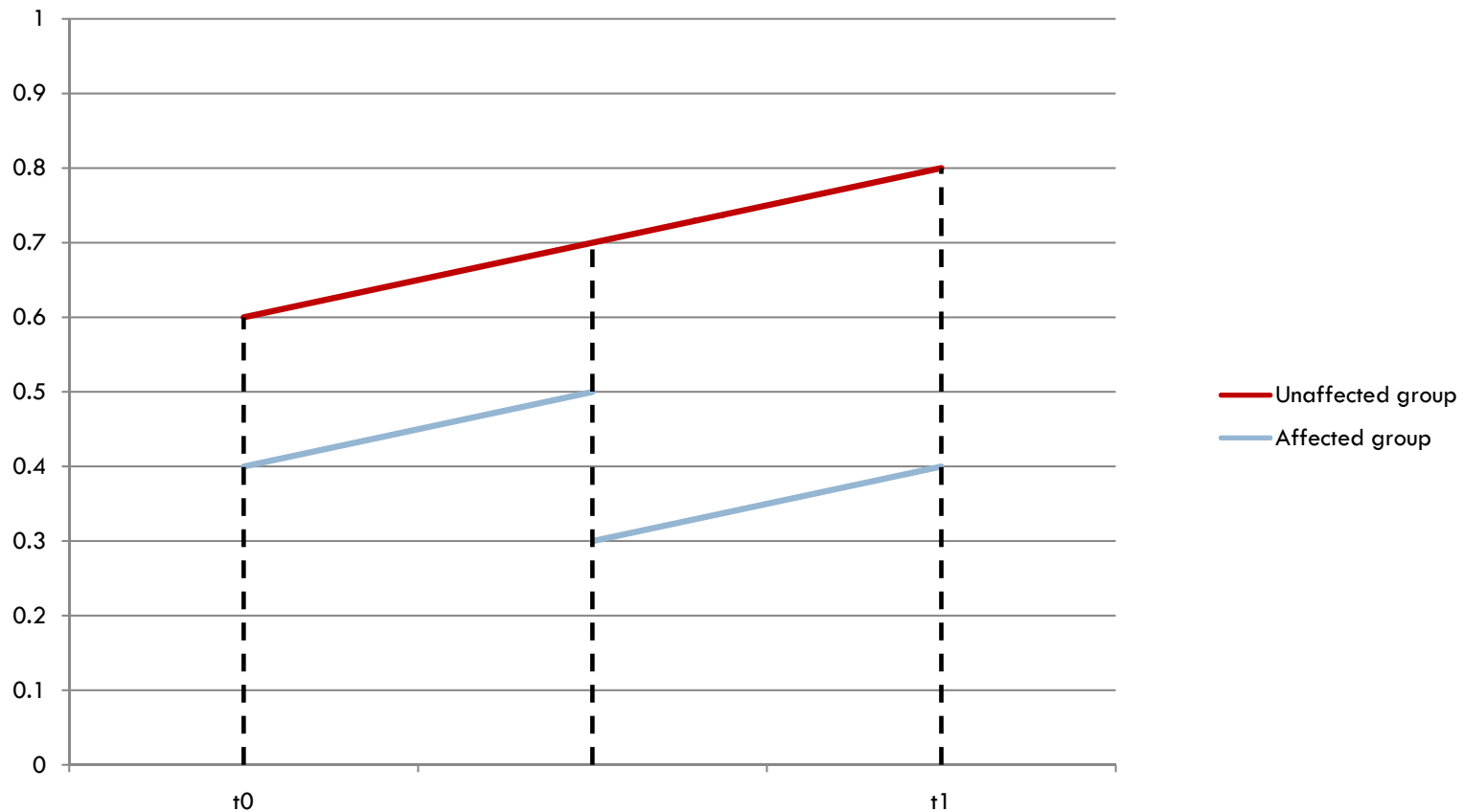
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- **Risk and human welfare** – Dercon (2005)
- **Natural disaster and poverty** - Skoufias (2003), Dercon and Hoddinott (2003)
- **Natural disaster and health**- Buttonheim (2006), Chrisaensen and Alderman (2001)
- **Risk and education:**
 - **Short term income shock on education** – Jensen (2000), Jacoby and Skoufias (1997), Duryea (1998)
 - **Financial crisis on education** - Ablett and Slengesol (2000)
 - **Child labor** - Sedlacek et al (2003), Rosati and Rossi (2001), Psacharopoulos (1997) Ilahi et al (2003). Singh and Ozturk (2000)
 - **Parental death and children’s education** - Gertler, Levine, and Ames (2004)
 - **Conditional Cash Transfer** - Rawlings and Rubio (2003)
- **Natural disaster and education** – Fuentes and Seck (2007), Maccini and Yang (2008)

Method: Difference-in-difference

Primary school enrollment rate in two cross section data

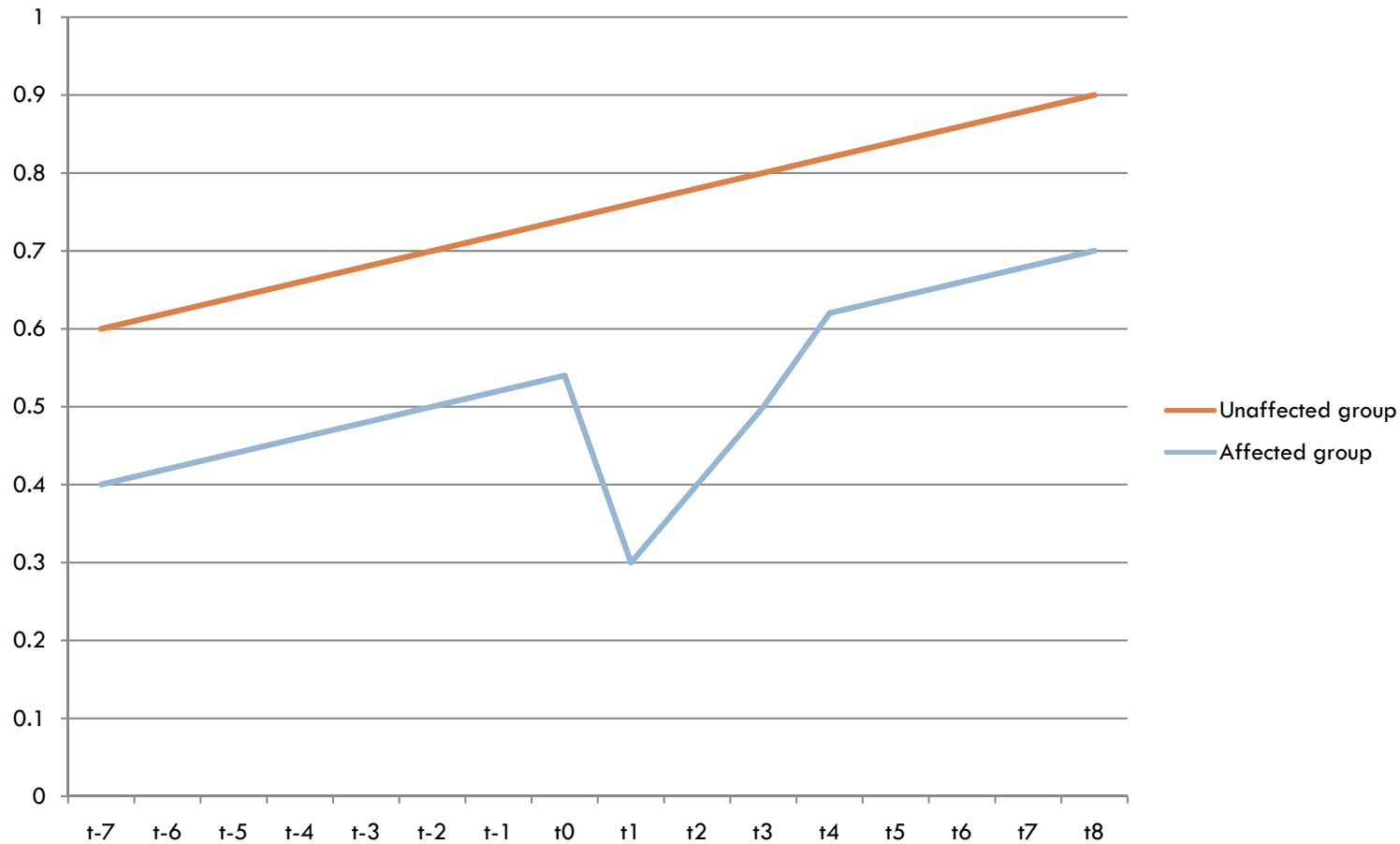
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Dream: Time series from longitudinal dataset

Primary school enrollment rate in repeated cross section or panel data

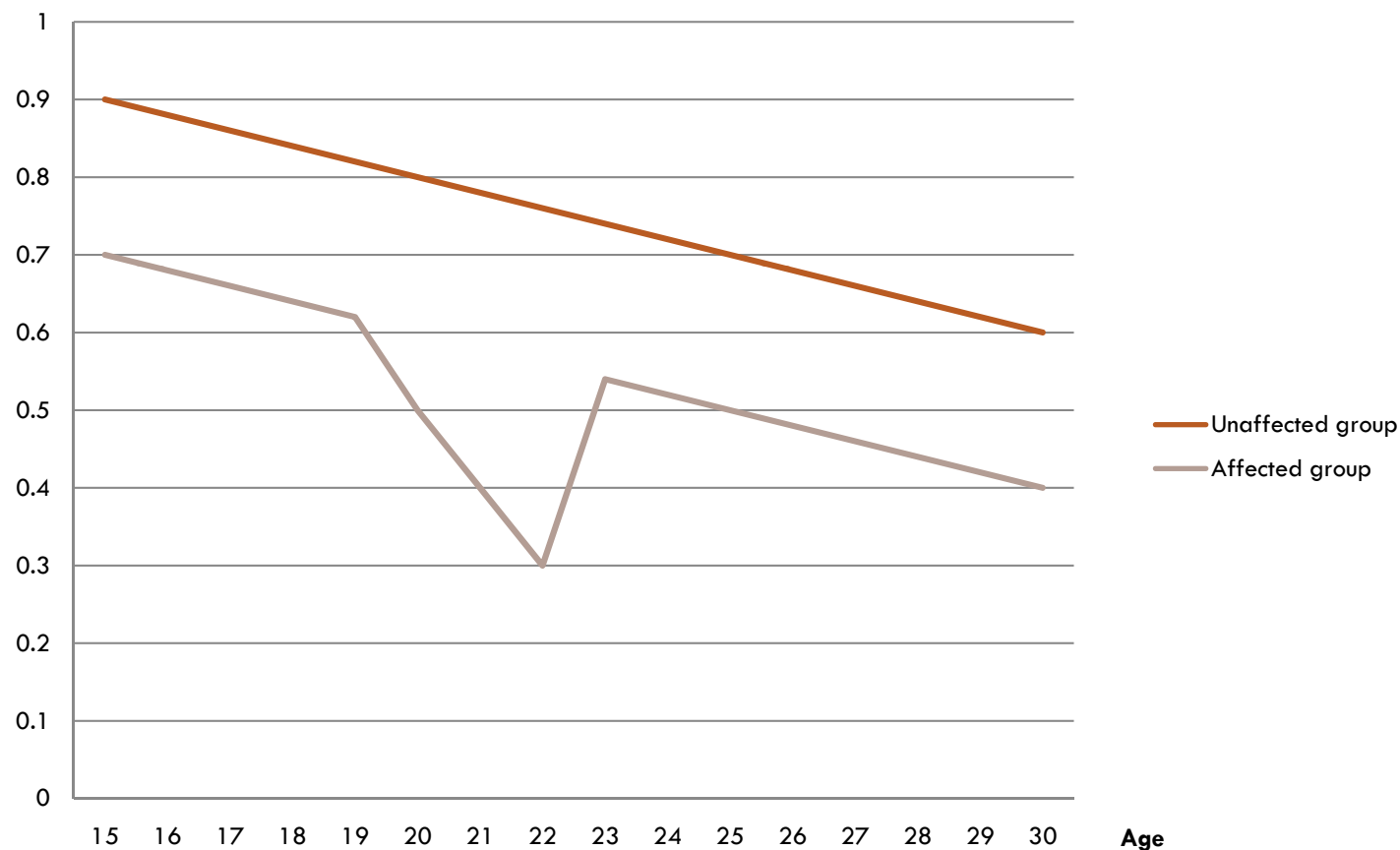
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Method: Education profile in one cross section

Primary education completion rate by age group

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Methodology

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Typical Difference in Difference	Education profile in a cross section
2 data	1 data
One time clean shock	Shocks in multiple years
Shock on confined region	Shocks on multiple regions
Migration ruled out	Migration included
Immediate impact	Longer term impact
Live impact	Worn out impact

Specification

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$$\text{(Eq 1) } S_i = \beta_0 + \vec{\beta}_1 \mathbf{D}_i + \beta_2 G_i + \beta_3 G_i^2 + \vec{\beta}_4 \mathbf{X}_i + \varepsilon_i \quad \text{for } i = 1, \dots, N$$

where

$$S_i = \begin{cases} 1 & \text{if } i \text{ completed primary education} \\ 0 & \text{else} \end{cases}$$

$$\mathbf{D}_i = (D_{i1}, \dots, D_{ij}, \dots, D_{iJ})'$$

$$D_{ij} = \begin{cases} 1 & \text{if } i \text{ was affected by } j\text{th disaster, } D_j \\ 0 & \text{else} \end{cases}$$

G_i = Age of i

\mathbf{X}_i = Individual characteristics of i

ε_i = idiosyncratic random error, $E(\varepsilon_i) = 0$

Specification (cont')

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- Omitted variable: schooling vs poverty, current income or parent's income (instrumental variable)
- Heteroskedasticity: larger variance of error term for the poor (Robust std for test)
- Selection bias: decreasing number of old people (restrict age group)
- Multicollinearity: correlated disasters (number of disaster dummies)
- Measurement error: poor data quality (developed country data)

Data (Extreme climate events)

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- Emergency Events Database (EM-DAT)
- WHO collaborating Centre for Research on the Epidemiology of Disasters (CRED)
- Data on the occurrence and effects of over 16,000 mass disasters in the world from 1900 to present

Year	Group	Type	Country	Location	Killed	Affected
1969	Natural	Drought	Burkina Faso	East, North	0	975000
1977	Natural	Flood	Burkina Faso		0	900
1988	Natural	Flood	Burkina Faso	Comoe, Houet, Soum	16	23324

Data (human development)

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- Demographic and Health Survey (DHS)
- Living Standard Measurement Survey (LSMS)
- Labor Force Survey (LFS)
- Census

- Cameroon, Burkina Faso - DHS
- Mongolia – LSMS

Descriptive statistics

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Table 2 Summary Statistics

Country	Cameroon	Burkina Faso	Mongolia
Data	DHS	DHS	LSMS
Year	2004	2003	2002
Number of observation	10,656 adult women	10,307 adult women	14,789 individuals
Primary school completion (average)	.65	.11	.96
Primary school completion (standard deviation)	.47	.31	.19
Secondary school completion (average)	.11	.03	.54
Secondary school completion (standard deviation)	.32	.18	.49

Descriptive statistics (Mongolia 2002)

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Table 3 School dropouts in Mongolia, 2002

Reason for leaving school		
	Not interested	35.1
	Parents not interested	9.8
	School too difficult	2.1
	Lack of budget	12.4
	Required to work	12.4
	Sick	13.7
	Required to look after others	4.2
	School too far	3.8
	Teachers not good	0.4
	Migration	0.8
	No place in school dormitory	1.2
	Too old	3.4
Would you like to go back to school		
	Yes	38.7
Why not possible to go back to school		
	Parents not interested	3.4
	Lack of budget	49.9
	Not qualified	18.9
	Busy	10.3
	School too far	1.7
	Physically mentally disabled	1.7
	Sick	6.8
	Too old	1.7
	Other	5.1

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Source: Mongolia LSMS 2002, author's calculation

Regression Result

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Table 4 Probit regression results for Cameroon (2004), Burkina Faso (2003) and Mongolia (2002), Age under 35

	Cameroon	Burkina Faso	Mongolia
Dependent variable	Primary school completion	Primary school completion	Secondary school completion
<i>Disaster</i>			
Drought1990	-.0876* (.0490)		
Drought1988		-.0193 (.0262)	
Fire1996			-.1437** (.0513)
<i>Other control</i>			
Age	.0311** (.0099)	.0012 (.0092)	.1144** (.0166)
Age ²	-.0007** (.001)	-.0001 (.0001)	-.0018** (.0003)
Sex			-.1720** (.0161)
Number of observation	8261	7925	4673
R ²	.5197	.1869	.1335

Note: * significant at 5%. ** significant at 1%. Robust standard errors in brackets.

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Cost of foregone education

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Step 1:

From (Eq 1) $S_i = \beta_0 + \beta_1 \mathbf{D}_i + \beta_2 G_i + \beta_3 G_i^2 + \beta_4 \mathbf{X}_i + \varepsilon_i$,

get $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, \hat{\beta}_3, \hat{\beta}_4$

$\hat{S}_i = \hat{\beta}_0 + \hat{\beta}_2 G_i + \hat{\beta}_3 G_i^2 + \hat{\beta}_4 \mathbf{X}_i$ (counterfactual probability of schooling, no shock)

$S_i^c = \begin{cases} 1 & \text{if } \hat{S}_i > \bar{C} \\ 0 & \text{else} \end{cases}$ (counterfactual schooling dummy)

Step 2:

(Eq 2) $W_i = \alpha_0 + \alpha_1 S_i + \alpha_2 \mathbf{Z}_i + \mu_i$ where $W_i = \log(\text{wage of } i)$, $\mathbf{Z}_i = \text{control variables}$, $\forall i, E(\mu_i) = 0$

get $\hat{\alpha}_0, \hat{\alpha}_1, \hat{\alpha}_2$,

$W_i^c = \hat{\alpha}_0 + \hat{\alpha}_1 S_i^c + \hat{\alpha}_2 \mathbf{Z}_i$ (counterfactual wage)

Step 3:

(Eq 3) $L = \frac{1}{N} \sum_i (W_i^c - W_i)$

Loss function determinants

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By adding and subtracting,

$$L = \frac{1}{N} \sum_i \{(\hat{\alpha}_0 - \alpha_0) + (\hat{\alpha}_1 S_i^c - \hat{\alpha}_1 S_i) + (\hat{\alpha}_1 S_i - \alpha_1 S_i) + (\hat{\alpha}_2 \mathbf{Z}_i - \alpha_2 \mathbf{Z}_i) - \mu_i\}$$

By some arithmetics and using $E(\hat{\alpha}_\bullet - \alpha_\bullet) = 0$, $E\mu_i = 0$, and $E(S_i^c - S_i) = f(D, \beta_1, \dots)$

$$\begin{aligned} E(L) &= \frac{1}{N} \sum_i \{E(\hat{\alpha}_1 (S_i^c - S_i)) + E((\hat{\alpha}_1 - \alpha_1) S_i)\} \\ &= \frac{1}{N} \sum_i \{E(\hat{\alpha}_1) \bullet E(S_i^c - S_i) + Cov(\hat{\alpha}_1, S_i^c - S_i) + E(\hat{\alpha}_1 - \alpha_1) \bullet E(S_i) + Cov(\hat{\alpha}_1 - \alpha_1, S_i)\} \\ &= \frac{1}{N} \sum_i \{\alpha_1 E(S_i^c - S_i) + Cov(\hat{\alpha}_1, S_i^c - S_i) + Cov(\hat{\alpha}_1 - \alpha_1, S_i)\} \\ &= \frac{1}{N} \sum_i \{\alpha_1 f(D, \beta_1, \dots) + \dots\} \end{aligned}$$

α_1 = return to edu, $S_i^c - S_i$ = function of β_1 (edu loss by disaster), D (prob of disaster), \dots

Wage regression and loss of income, Mongolia 2002

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Table 5 Wage regression (Eq 2) and Loss of income (Eq 3), Mongolia 2002		
Equation (2)	All	Male only
Secondary education	.2498** (.0309)	.2271** (.0427)
Age	.0179* (.0070)	.0221* (.0101)
Age ²	-.0002* (.0000)	-.0003* (.0001)
Constant	10.36** (.1358)	10.41** (.1970)
Number of observation	2400	1137
R ²	.30	.37
Equation (3)		
	$\bar{C} = .4$	$\bar{C} = .4$
Log (monthly wage)	10.94621	11.01804
Log (monthly wage) counterfactual	10.97284	11.04517
Wage, yearly in current US\$		
	\$613	\$659
Wage, counterfactual, yearly in current US\$		
	\$630	\$677
Loss of income (counterfactual wage-wage)		
	\$17 (2.69%)	\$18 (2.75%)

Summary

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- Use educational attainment profile in a cross section data set
- Extreme climate events have negative long term net impact on educational attainment: Women affected by a drought during school age are 8.7 percentage point less likely to complete primary school in Cameroon. Wild fire reduced the probability to complete secondary school by 14.4 percentage point in Mongolia.
- Welfare impact projection: If there had been no wild fire in Mongolia, or if households had been completely protected from it, the average wage per work per year would have been about 2.8% (2.1 to 3.5) higher.