Climate Variability, Child Labour and Schooling: Evidence on the Intensive and Extensive Margin

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Aims and Objectives

- Are economic outcomes affected by *ex ante* expectations about the likelihood of future shocks in addition to the *ex post* realisation of shocks?

- How does climate variability affect the allocation of time among child labour activities (intensive margin) and participation in education and labour activities (extensive margin)?

Motivation

- Climate change is likely to increase the incidence of environmental disasters, as well as increasing the variability of rainfall, temperature and other climatic parameters IPCC(2007, 2012)
- The impact of climate variability on household welfare is not well understood.
  - Previous studies have investigated climatic influence on agriculture, and other social and economic outcomes (Burgess et al. 2011; Deschenes and Greenstone, 2007; Dell et al,. 2012; Hsiang, 2010; Graff Zivin and Neidell, 2013; Guiteras, 2009; Kudumatsu, 2011; Schlenker and Roberts, 2009).
  - The World Bank (2010) argue that climate change will disproportionately affect poor households, especially women and children. Evidence to support this claim?
  - The literature has primarily focussed on the ex post impact of, and responses to, weather shocks.

Climatic Influence on Child Labour

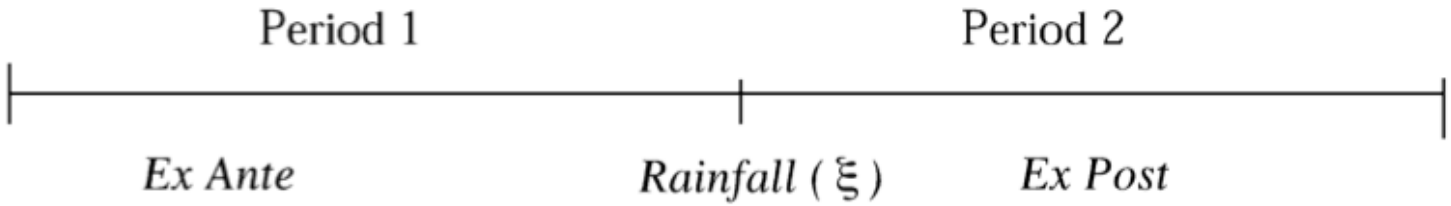
- Again, the literature has mainly focussed on the impact of climate-related shocks on child labour, schooling and other outcomes related to tiny-humans.
- Jacoby & Skoufias, 1997; Jensen, 2000; Portner, 2001; Ranjan, 2001; Sawada & Lokshin, 2001; Bhalotra & Heady, 2003; Thomas et al., 2004; Beegle et al., 2006
- There are a couple of papers that explore the ex ante considerations (Fitzsimons, 2007; Kazianga, 2012).
  - Cross-sectional data = time-invariant unobserved heterogeneity e.g. riskier villages may have lower preferences for education.
  - Only look at educational outcomes OR educational outcomes + participation in any child labour.

Overview of Results

- Using a fixed-effects framework, while controlling potentially confounding time-varying factors, we find evidence in support of a causal relationship between increased climate variability and:
  - Increased child labour on the farm (Intensive Margin)
  - Decreased child labour in the home (Intensive Margin)
  - Increased participation in child labour on the farm (Extensive Margin)
- We find no effect of climate variability on school attendance or enrolment.
- There is supporting evidence to suggest that households spread the burden across children in order to mitigate the impact of child labour on education.

A Simple Two-Period Model

- Two periods to allow for explicit consideration of ex ante and ex post decision making a la Rose (2001).



- In both periods, the household makes decisions regarding time-allocation for children between labour supply on the farm (L_t^F), in the home (L_t^H), and schooling ($E_t = 1 - L_t^F - L_t^H$).

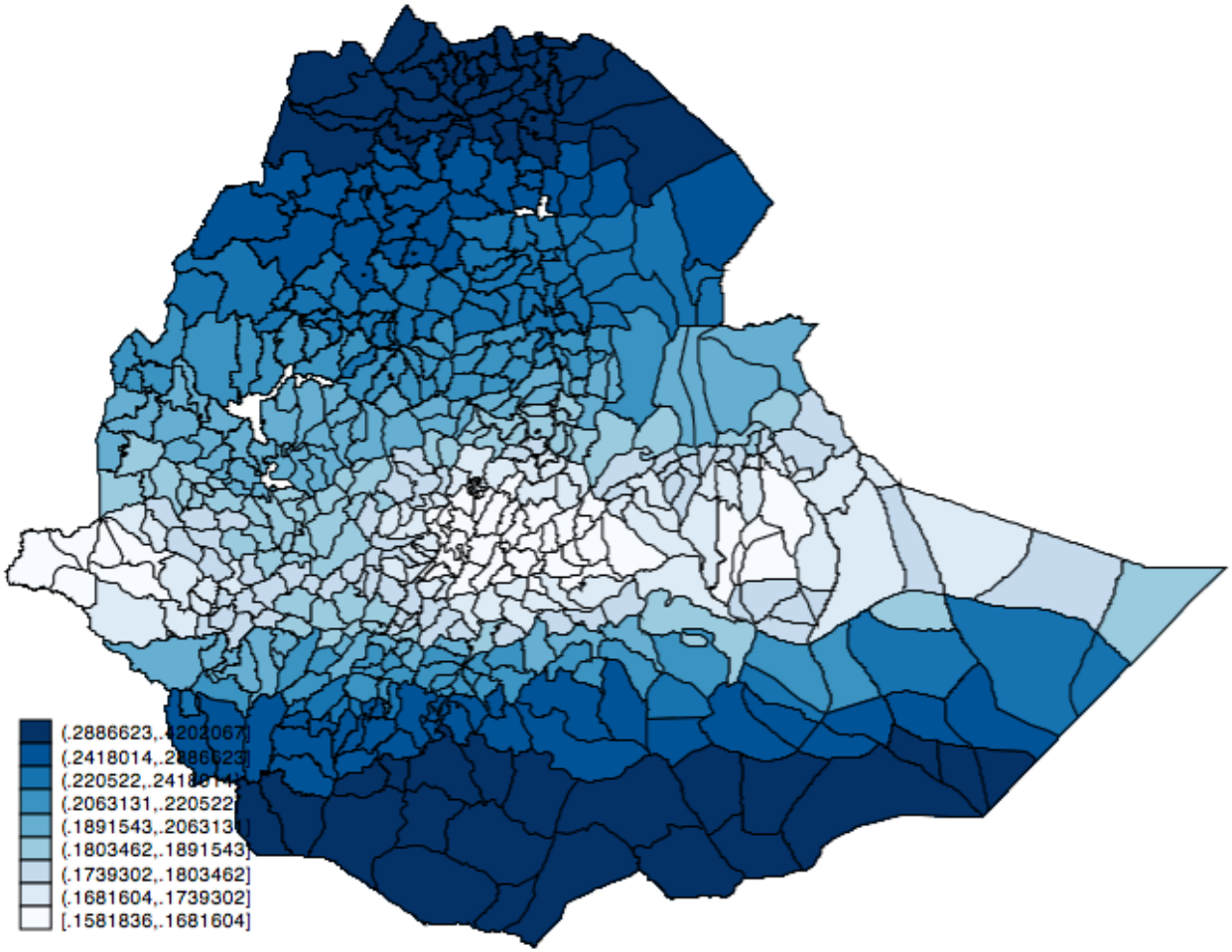
The Ex Ante Effect

- Prior to the realisation of rainfall there are two competing effects that could be observed:
  - The Portfolio Effect - The household will adjust the time-allocation away from risky activities, towards less risky investments.
    - $\frac{\partial L_1^F}{\partial \varphi} < 0$
    - $\frac{\partial L_1^H}{\partial \varphi} > 0$
    - $\frac{\partial E_1}{\partial \varphi} > 0$
  - The Precautionary Motive - Households allocate more time to child labour on the farm to mitigate the effects of a shock in the event that it is realised.
    - $\frac{\partial L_1^F}{\partial \varphi} > 0$
    - $\frac{\partial L_1^H}{\partial \varphi} < 0$
    - $\frac{\partial E_1}{\partial \varphi} < 0$

The ERU-Interim

- High-resolution daily climate reanalysis provided by the European Centre for Medium-Term Weather Forecasting (ECMWF).
- Previous studies have used the Ethiopian Meteorological service.
  - Missing observations and observations recorded as zero on days that there are no records.
  - Lorenz and Kuntsman (2012) show that since 1990 the number of reporting weather stations in Africa has fallen from around 3,500 to 500!
- NOAA's NCDC Historical Observing Metadata Repository lists 18 reporting quality controlled stations for Ethiopia!
- Reanalysis data combines observational data with global climate models to provide a more consistent quality of data than observational data alone, and a more realistic measure than any model alone.
- Results in a consistent measure of atmospheric parameters over time and space.

Climate Variability within Ethiopia (1979-2011)



Dependent Variables

- Child Labour
  - Intensive Margin = The total hours spent working in economic activities and chores per week.
  - Extensive Margin = Dummy variable for participation in different activities = 1 if Intensive margin > 0.
  - Important to distinguish between activities.
- Education
  - No Intensive Margin unfortunately
  - Extensive Margin = Dummy variable = 1 if child did not attend school.
  - Results are robust to alternative definitions e.g. Dummy variable = 1 if child did not attend school AND attained grades = 0.

Explanatory Variables

- Climate Variability - Our variable of concern.
  - Defined as the coefficient of variation of annual rainfall for the previous 10 years.
  - Robust to alternative measurement, or specification e.g. standard deviation of rainfall.
  - Exogenous proxy for expectations about future income uncertainty.
- Potential confounding factors
  - Drought shock - Dummy variable = 1 if the village experienced a negative rainfall shock in the previous 5 years (Robust to shock during the last agricultural year).
  - Remittances received - (Rosenzweig & Stark, 1989; Bryan, Chowdhury & Mobarak, 2012)
  - Days worked off-farm - (Jayachandran, 2006; Macours et al., 2012)

Empirical Specification

- Poisson QMLE fixed-effects model.

$$\mathbb{E}(\mathrm{Y}_{ihvt}) = \mu_v(\exp(\beta_1 \mathrm{CV}_{vt} + \beta_2 \mathrm{SHOCK}_{vt} + \phi \mathrm{X}'_{iht} + \alpha_t + \alpha_m) \quad (1)$$

- Village fixed effects (μ_v), Year fixed effects (α_t), and Survey fixed effects (α_m).

- Bootstrapped cluster-robust Huber-White standard errors at the village level (1000 replications)).

Child Labour - Intensive Margin

Table: Number of Hours Worked by Children

	(1) farming	(2) chores	(3) total
CV	0.042***	-0.030***	0.008
	(0.014)	(0.009)	(0.010)
Village Shock (past 5 years)	-0.001	0.038	0.024
	(0.105)	(0.057)	(0.065)
Village FE	YES	YES	YES
Year FE	YES	YES	YES
Month FE	YES	YES	YES
Observations	3,212	3,213	3,222
Log-Likelihood	-25,145.945	-20,179.375	-21,639.531

*** $p < 0.01$, ** $p < 0.05$, * $p<0.1$

Child Labour - Extensive Margin

Table: Participation in Child Labour Activities

	(1) FE LPM Child Labour (farm)	(2) FE LPM Child Labour (chores)	(3) FE LPM Child Labour (total)
CV	0.017**	-0.003	-0.000
	(0.006)	(0.049)	(0.002)
Village Shock (past 5 years)	-0.001	-0.065	0.013
	(0.030)	(0.231)	(0.048)
Village dummies	YES	YES	YES
Year dummies	YES	YES	YES
Month dummies	YES	YES	YES
Observations	3,222	3,221	3,221
R^2	0.2155	0.2684	0.044

*** $p < 0.01$, ** $p < 0.05$, * $p<0.1$

School Attendance

Table: Child has not attended school

	(1) FE LPM Not Attended	(2) FE Logit Not Attended	(3) Marginal Effects Not Attended
CV	0.001	0.053	0.003
	(0.007)	(0.065)	(0.004)
Village Shock (past 5 years)	-0.026	-0.503	-0.033
	(0.030)	(0.389)	(0.025)
Village FE	YES	YES	YES
Year FE	YES	YES	YES
Month FE	YES	YES	YES
Observations	3,222	3,217	3,217
Log-Likelihood	-	-951.314	-
R^2	0.079	-	-

$p < 0.01$, ** $p < 0.05$, * $p<0.1$

School Attendance - Siblings Interaction

Table: Do families smooth the costs of child labour across children?

	(1) FE LPM Not Attended	(2) FE Logit Not Attended	(3) Marginal Effects Not Attended
CV	0.000	0.045	0.003
	(0.005)	(0.039)	(0.002)
CV x No Siblings	0.005**	0.041**	0.002**
	(0.002)	(0.019)	(0.001)
No Siblings	-0.108*	-0.717	-0.047
	(0.062)	(0.497)	(0.033)
Village FE	YES	YES	YES
Year FE	YES	YES	YES
Month FE	YES	YES	YES
Observations	3,222	3,217	3,217
Log-Likelihood	-	-949.304	-
R^2	0.081	-	-

[c] $p < 0.01$, ** $p < 0.05$, * $p<0.1$

The Importance of Fixed Effects

Table: Cross-Sectional Results

	2004	2009
	(1) FE LPM Not Attended	(2) FE LPM Not Attended
CV	0.039***	0.010***
	(0.002)	(0.001)
Village Shock (past 5 years)	–	0.005
	–	(0.024)
Village dummies	YES	YES
YES		
Year dummies	YES	YES
YES		
Month dummies	YES	YES
YES		
Observations	1,615	1607
R^2	0.092	0.071

In 2004 village shocks in the previous 5 years was omitted as all villages had experienced at least one shock.
*** $p < 0.01$, ** $p < 0.05$, * $p<0.1$

Robustness Tests and Extenstions

- Results are robust to:
  - Changes in the time dimension of CV e.g. CV measured over 5 years.
  - Within-year measures of CV e.g. Planting seasons and growing seasons.
  - Placebo test - No effect from variability outside of the agriculturally important season!
  - Alternative definitions of climate variability e.g. the log of the std. dev. of rainfall.
  - Mechanical tests such as the removal of outliers in the dependent variable and explanatory variable.
- We don't find much evidence of a differential impact of climate variability on different ages or genders.
- The effect appears to be pretty linear.

Conclusions

- Important to consider ex ante factors as well as ex post factors when trying to understand the consequences of and responses to risk and uncertainty.
- There appears to be substitution of time across labour activities to mitigate impacts on education - Importance of distinguishing between activities.
- Households may smooth the burden of labour across children to minimise impacts on education.
- Work going forwards - Expected vs. Unexpected shocks.

Thank you for your attention!
All comments, questions, and suggestions gratefully received!