Climate change, conflicts and policies

Highlights from the research project
Climate Change, Violent Conflicts, and Welfare
CC2C https://www.cc2conflicts.unifi.it/

PRIN 2022
Climate Change, Violent Conflicts and Welfare: A Multi-Scale Investigation of Causal Pathways in Different Institutional Contexts (CC2C)

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Climate Change, Violent Conflicts and Welfare: A Multi-Scale Investigation of Causal Pathways in Different Institutional Contexts (CC2C)

The research project on "**Climate Change, Violent Conflicts, and Welfare: A Multi-Scale Investigation of Causal Pathways in Different Institutional Contexts (CC2C**)" delves into the dynamics between climate change and violent conflicts across various institutional landscapes. This study particularly investigates how climate-related agrifood disruptions contribute to social unrest in Less Developed Countries (LDCs). The research employs a multi-scale analytical approach and examines macro, meso, and micro-level interactions, applying these insights across distinct regions (Sub-Saharan Africa and South-East Asia).

Research Team

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Climate Change, Violent Conflicts and Welfare: A Multi-Scale Investigation of Causal Pathways in Different Institutional Contexts (CC2C)

#1 - Vulnerability to Climate Change and Communal Conflicts: Evidence from Sub-Saharan Africa and South/South-East Asia *Journal of Development Studies*, https://doi.org/10.1080/00220388.2024.2374072

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We investigate how **variations in vulnerability to climate hazards affect the likelihood and severity of communal violence.**

Vulnerability measures the propensity or predisposition of human societies to be negatively impacted by climate hazards (ND-GAIN, which measures it as the intertwined connection between **exposure**, **sensitivity**, and **adaptative capacity** across six life-supporting sectors).

Communal violence refers to armed events involving non-state groups that are organized along **collective identity lines**, such as ethnic or tribal (UCDP-PRIO).

We analyse **Sub-Saharan Africa** and **Southern/South-Eastern Asia during the period 1995 – 2021.**

We found evidence that **greater vulnerability increases communal violence in SSA**, whereas other dynamics are likely to shape the likelihood of communal conflict **in S-SEA, where current climate variability** seems to play a major role.

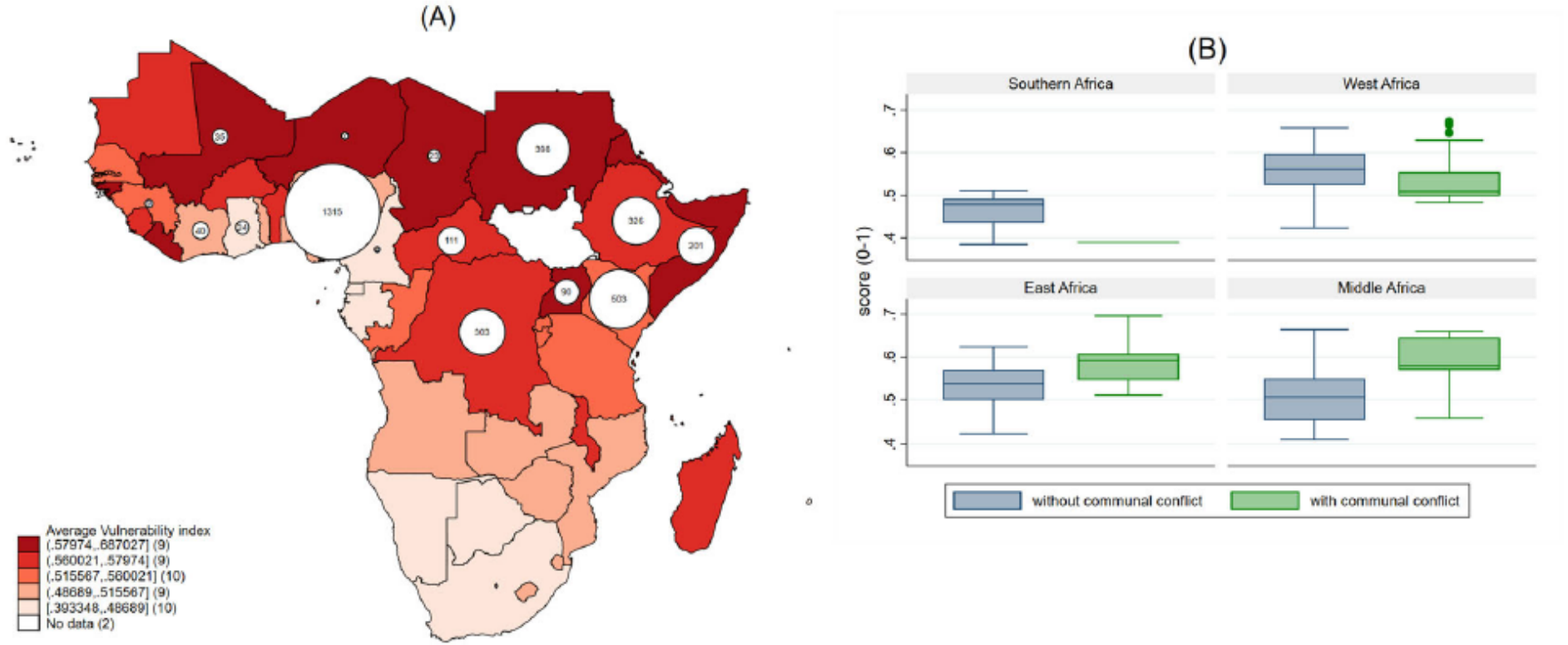

Figure 2. Vulnerability index and incidence of events of communal violence in Sub-Saharan Africa. Left-hand panel (A) illustrates average vulnerability country levels over the period 1995–2021 and the occurrence of events of communal violence. Darkest shades refer to greater vulnerability and circles are proportional to the absolute number of reported events. Right-hand panel (B) shows median, 1st and 3rd quantiles of the vulnerability index by SSA sub-regions for respectively countries not characterised by communal conflicts (blue) and experiencing communal violence (green). The two groups are significantly different in East and Middle Africa at prob$|z|$ <0.000.

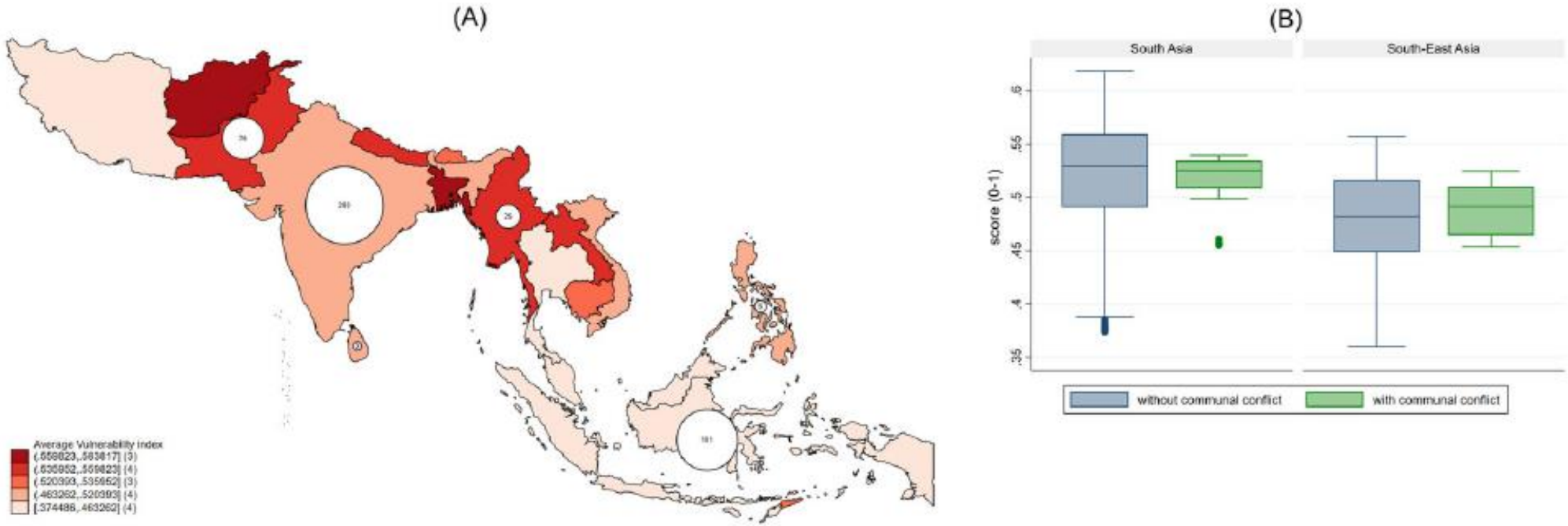

Figure 3. Vulnerability index and incidence of events of communal violence in South/South-East Asia. Left-hand panel (A) illustrates average vulnerability country levels over the period 1995–2021 and the occurrence of events of communal violence. Darkest shades refer to greater vulnerability and circles are proportional to the absolute number of reported events. Right-hand panel (B) shows median, 1st and 3rd quantiles of the vulnerability index, by Asian sub-regions for respectively countries not characterised by communal conflicts (blue) and experiencing communal violence (green). The two groups are not statistically different.

Empirical analysis of likelihood and severity of communal violence across the two selected regions. Estimation technique: **panel probit** and **panel negative binomial** for count data, both with robust errors.

Explanatory variables of interest are:

- Vulnerability index
- Rainfall Deviation

$$P(confl = 1|X_{i,t}) = \alpha + \beta_1 Vulner_{i,t} + \beta_2 RainfDev_{i,t} + \beta_3 SocioEcon_{i,t,t-1} + \beta_4 PastConf\ l_{i,t-1} + \epsilon_{i,t}$$

$$severity_{i,t} = \alpha + \beta_1 Vulner_{i,t} + \beta_2 Rain\,f.Dev._{.i,t} + \beta_3 SocioEcon_{i,t,t-1} + \beta_4 PastConf\,l_{i,t-1} + \epsilon_{i,t}$$

Table 1. Likelihood of events of communal violence (1995–2021)

	Sub-Saharan Africa			South/South-East Asia		
	(1)	(2)	(3)	(4)	(5)	(6)
Vulnerability$_{(t-1)}$	1.423***	1.371***	1.489***	1.822	2.040	−0.851
	(0.503)	(0.524)	(0.565)	(2.107)	(2.469)	(0.895)
Negative rainfall dev.	−0.182	−0.168	−0.140	0.446***	0.445***	0.552***
	(0.132)	(0.130)	(0.148)	(0.160)	(0.159)	(0.197)
Forest share	−0.047***	−0.064***	−0.063***	0.007	−0.006	−0.030
	(0.013)	(0.016)	(0.016)	(0.022)	(0.034)	(0.022)
Pc agricultural land$_{(t-1)}$	−0.019***	−0.021**	−0.020**	−0.282***	−0.315**	−0.289**
	(0.007)	(0.008)	(0.009)	(0.108)	(0.145)	(0.125)
GDP growth$_{(t-1)}$	−2.857**	−2.905**	−2.454*	−2.217	−2.312	−5.711
	(1.301)	(1.338)	(1.285)	(3.954)	(3.946)	(4.373)
Incidence comm. violence$_{(t-1)}$	0.087***	0.088***	0.093***	0.102***	0.102***	0.091***
	(0.020)	(0.020)	(0.019)	(0.022)	(0.022)	(0.029)
Sub-regional fixed effects	No	Yes	Yes	No	Yes	Yes
Time fixed effects	No	No	Yes	No	No	Yes
Obs	1181	1181	1181	453	453	453
Pseudo-R^2	0.1758	0.1831	0.2092	0.1751	0.1771	0.2873
AIC	397.07	399.68	403.60	175.91	177.53	172.17
BIC	437.66	455.49	500.00	208.84	214.57	242.14

Significance levels: *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.
Note: Panel probit regression coefficients with standard errors clustered at country level in parentheses.

Table 2. Number of events of communal violence (1995–2021)

	Sub-Saharan Africa			South/South-East Asia		
	(1.1)	(2.1)	(3.1)	(4.1)	(5.1)	(6.1)
Vulnerability$_{(t-1)}$	0.706**	0.618*	0.733**	1.571*	1.501	−1.124
	(0.290)	(0.340)	(0.363)	(0.935)	(0.940)	(1.298)
Negative rainfall dev.	0.041	0.053	0.088	0.544***	0.547***	0.556**
	(0.116)	(0.115)	(0.124)	(0.208)	(0.209)	(0.251)
Forest share	−0.030***	−0.013	−0.004	0.053***	0.061***	0.039
	(0.007)	(0.010)	(0.011)	(0.017)	(0.023)	(0.031)
Pc agricultural land$_{(t-1)}$	−0.019***	−0.015**	−0.013*	−1.123***	−1.027***	−1.503***
	(0.006)	(0.006)	(0.007)	(0.315)	(0.348)	(0.434)
GDP growth$_{(t-1)}$	−6.158***	−5.210***	−5.122**	−5.338	−5.222	−12.185***
	(1.615)	(1.795)	(2.009)	(4.434)	(4.458)	(4.109)
Incidence comm. violence$_{(t-1)}$	0.010***	0.010***	0.010***	0.050***	0.050***	0.045***
	(0.001)	(0.001)	(0.002)	(0.013)	(0.013)	(0.014)
Sub-regional fixed effects	No	Yes	Yes	No	Yes	Yes
Time fixed effects	No	No	Yes	No	No	Yes
Obs	1181	1181	1181	453	453	453
Pseudo-R^2	0.0620	0.0657	0.0744	0.0854	0.0860	0.1336
AIC	1749.23	1748.43	1748.27	460.54	462.27	455.21
BIC	1794.9	1809.32	1849.75	497.59	503.43	529.30

Significance levels: *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

Note: Panel negative binomial regression coefficients with standard errors clustered at country level in parentheses.

Some conclusions

Greater levels of vulnerability are associated to higher communal violence severity.

Regional contexts matter: on the other hand, S-SEA results suggest that current climate variability (measured as negative rainfall deviations within the period) exerts a greater effect on communal violence outbreaks than overall vulnerability to climate change.

Opportunity-cost mechanism is at play: overall, greater access to productive means and livelihood essentials – which is measured by agricultural land over rural population size – is consistently conducive to a reduction of the likelihood as well as the severity of communal violence.

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#2 - Land, institutional settings and communal conflicts

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We explore the relationship between different aspects of **institutional quality** and **communal violence**

This research aims at exploring the effect of **land-related institutional settings** on the **likelihood and severity of communal violence** in Sub-Saharan Africa (SSA) and test such relations in case of climate shocks.

Research Design

Panel data covering Sub-Saharan African countries, using **country/year observation as unit of analysis** (Obs=1352).

Period of observation:**1990-2021**

Dependent Variable: **events of communal violence**, coded as dichotomous variable and count variable. Estimation technique: **panel probit** for binary outcomes and **panel negative binomial** for count data, both with robust errors clustered at country level

Explanatory variables of interest:

transparent laws with predictable enforcement

prior experience of communal violence (UCDP-GED)

climate shock: drought and flood frequency (EM-DAT)

Table 1: Likelihood of events of communal violence (1990-2021)

	Panel probit		IV probit	
	(1)	(2)	(3)	(4)
Transparent laws	-0.278***	-0.310***	-0.800***	-0.949***
	(0.108)	(0.091)	(0.198)	(0.064)
Pasture land (%)	0.599		-0.547	
	(1.069)		(0.676)	
Forest land (%)		-2.153**		-0.979
		(0.899)		(0.755)
Discriminated pop. (%)	1.338**	1.261**	-0.438	-1.301
	(0.576)	(0.516)	(0.887)	(0.823)
(ln) GDPpc	-0.079	-0.025	0.143	0.166
	(0.192)	(0.174)	(0.167)	(0.143)
(ln) Rural pop.	0.908***	0.856***	0.596***	0.291
	(0.205)	(0.195)	(0.219)	(0.285)
Predominantly rural	-0.220	-0.242	-0.182	-0.066
	(0.271)	(0.260)	(0.370)	(0.375)
Past communal violence	1.204***	1.222***	0.745	-0.329
	(0.220)	(0.213)	(0.618)	(0.681)
Obs	1304	1304	1304	1304
AIC	542.782	535.884	4498.167	4491.760
BIC	589.341	582.443	4591.284	4584.878

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Standard errors clustered at country level in parentheses. All variables are temporally lagged one year. In IV estimations "Transparent laws" is instrumented by the distance from the Equator.

Table 3: Likelihood of events of communal violence (1990-2021)

	(4.1)	(4.2)	(4.3)	(4.4)
Transparent laws	**-0.328*** **	**-0.363*** **	**-0.211***	**-0.239****
	(0.111)	(0.100)	(0.118)	(0.053)
$\text{Drought}_{(t)}$	-0.033	-0.062		
	(0.158)	(0.158)		
$\text{Drought}_{(t)}$×Transparent laws	**0.326*** **	**0.322*** **		
	(0.110)	(0.109)		
$\text{Flood}_{(t)}$			0.036	0.028
			(0.053)	(0.053)
$\text{Flood}_{(t)}$×Transparent laws			**-0.100***	**-0.103***
			(0.057)	(0.055)
Other controls	Yes	Yes	Yes	Yes
Obs	1304	1304	1304	1304
AIC	542.225	535.363	544.418	537.339
BIC	599.130	592.268	601.323	594.244

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Panel probit regression coefficients with standard errors clustered at country level in parentheses. Unless specified, all variables are temporally lagged one year. Mod.(4.1) and (4.3) include pasture land; Mod.(4.2) and (4.4) forest land.
Results are robust to the inclusion of institutional settings variations with respect to the beginning of the period.

Table 4: Number of events of communal violence (1990-2021)

	(5.1)	(5.2)	(5.3)	(5.4)
Transparent laws	0.011	-0.080	0.018	-0.071
	(0.080)	(0.082)	(0.093)	(0.095)
$\text{Drought}_{(t)}$	0.082	0.042		
	(0.142)	(0.148)		
$\text{Drought}_{(t)}$ × Transparent laws	**0.275****	**0.274***		
	(0.134)	(0.163)		
$\text{Flood}_{(t)}$			**0.087****	**0.086****
			(0.042)	(0.042)
$\text{Flood}_{(t)}$ × Transparent laws			0.012	0.006
			(0.055)	(0.057)
Other controls	Yes	Yes	Yes	Yes
Obs	1304	1304	1304	1304
AIC	2226.146	2237.427	2227.566	2237.449
BIC	2288.224	2299.505	2289.644	2299.527

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Panel probit regression coefficients with standard errors clustered at country level in parentheses. Unless specified, all variables are temporally lagged one year. Mod.(5.1) and (5.3) include pasture land; Mod.(5.2) and (5.4) forest land. Results are robust to the inclusion of institutional settings variations with respect to the beginning of the period.

The formal definition of transparent laws reduces the likelihood of communal violence in SSA.

However, climate change has a substantial impact on violent conflict also overcoming the effect of formal institutions. In particular:

In the presence of drought, probability of violent conflict increases

In the presence of flood, higher institutional quality may reduce violent conflict

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#3 - Education and Military Expenditures: Countervailing forces in designing economic policy

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- The aim of this research is to identify **a method for integrating peace as a key objective within economic policy.**

- The policy target is a metric capturing internal positive peace termed the Social Peace Index

- The policy instrument is Edumilex, defined as the ratio between public investment in education and military expenditure.

Edumilex (proposed by Caruso 2017) draws inspiration from Baumol (1990), emphasizing the significance of balancing productive and destructive activities for the enduring establishment of a peaceful society.

Productive activity: Education

- The pacifying effect of education is both direct [see among others Østby et al. (2019); Pinker(2011); Thyne (2006); Collier and Hoeffler (2004)] and indirect as it is positively related to the long-term economic development [see among others Hanushek and Woessmann (2020); Marconi (2018); Krueger and Lindhal (2001)]

Destructive activity: Military Expenditure

- Military spending and militarization negatively affect peace both directly [see among others Carlton-Ford et al. (2018); Dube and Naidu (2015); Collier and Hoeffler (2006)] and indirectly as it is negatively related to economic growth [see among others Dunne and Tian (2020; 2016); D'Agostino et al. (2019); Kollias and Paleologou (2019)]

The Social Peace Index is designed as the **geometric mean of four pillars:**

- Health (Female Life Expectancy Index, source: HDI)
- Standard of living (GDP per capita)
- Quality of Institutions (Rule of Law Index , source V-Dem)
- Spread of Violence, (Physical Violence Index , V-dem)

Social Peace values are constructed by initially transforming indicators into indices, followed by the aggregation of dimension indices using the geometric mean. The index range from 0 (low) to 100 (high).

	Social Peace Index	Human Development Index	V- Dem
Social Peace Index	1.000		
Human Development Index	0.805*	1.000	
V-Dem	0.866*	0.579*	1.000

Table 2: Correlation

We exploit a panel of 88 countries over the period 1990-2021

$$SPI_{it}(log) = \alpha + \beta Edumilex_{it}(log) + \gamma \mathbf{X}_{it} + \delta_t + \mu_i + \epsilon_{it}$$

Dependent variable: Social peace (SPI)

Explanatory variables of interest: (i) Edumilex; among controls: (ii) SPEI ; (iii) CO2

To address potential endogeneity we use an IV. Instruments for Edumilex are:

- Food Price Index (IMF)
- Metals Price Index (IMF)

In the light of established literature which links the commodity price and the GDP cycle [see among others Ginn (2023); Benguria et al. (2023); Ojeda-Joya et al. (2019); Erten & Ocampo (2013)]

	(1)	(2)	(3)	(4)	(5)
	FS	2SLS	2SLS	2SLS	2SLS
Dep. Var.	Edumilex (log)	SPI (log)	SPI (log)	SPI (log)	SPI (log)
Food Price Index (log)	**.476*** **				
	[.064]				
Metal Price Index (log)	**.149*** **				
	[.038]				
Edumilex (log)		**.233*** **	**.170*** **	**.152*** **	**.124*** **
		[.020]	[.039]	[.057]	[.035]
Trade openness (log)			**.115** **	**.154*** **	**.139*** **
			[.046]	[.041]	[.039]
Gini Index (log)			**-.231*** **	**-.228*** **	**-.195*** **
			[.052]	[.051]	[.047]
Employment to population ratio (15-24) (log)			.069		
			[.082]		
Urban population (log)				.066	
				[.105]	
Fertility rate (log)				**.117** **	**.127*** **
				[.052]	[.041]
Young male population (log)				-.014	
				[.044]	
CO2 emissions (metric tons per capita) (log)					**.133*** **
					[.020]
SPEI (log)					**-.007** **
					[.003]
Country FE		Y	Y	Y	Y
Year FE		Y	Y	Y	Y
Cragg-Donald Wald F stat		178.019	47.686	23.005	54.054
Sargan stat p-value		[.589]	[.194]	[.123]	[.434]
Obs	2,214	2,214	985	995	995
Countries	88	88	81	81	81

Robust standard error in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 9: Edumilex and the dimensions of the Social Peace Index

	Social Peace Index Low (below the median)		Social Peace Index High (above the median)	
	(1) 2SLS SPI (log)	2 2SLS SPI (log)	(3) 2SLS SPI (log)	(4) 2SLS SPI (log)
Edumilex (log)	**.254*** **	**.116***	**.089*** **	**.050*** **
	[.042]	[.065]	[.005]	[.010]
Controls	N	Y	N	Y
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Cragg-Donald Wald F stat	47.365	13.558	183.705	33.430
Sargan stat p-value	.722	.187	.090	.333
Obs	1,018	323	1,196	655
Countries	48	42	57	47

Robust standard error in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 10: Low vs. High SPI

In this work we try to identify a method for **integrating peace as a key objective within economic policy.**

We build a new metric of internal peace, the Social Peace Index.

Edumilex consistently exhibits a positive and statistically significant association with our metric of internal peace. (in particular, **the impact of Edumilex on the Social Peace Index is higher in less peaceful countries** compared to more peaceful countries).

When the government chooses to allocate a multiple amount of dollars to education for each dollar spent on the military, there is a discernible enhancement in social peace. This empirical evidence support the proposition that Edumilex could serve as an apt instrument for economic policy to establish and fortify social peace.

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In summary, the findings of the CC2C research project so far suggest the following:

1. The likelihood and severity of communal violence tend to increase with greater vulnerability to climate change.
2. The presence of formal and transparent legal frameworks is associated with a lower likelihood and severity of communal violence; however, this protective effect may be undermined by climate change.
3. Social peace is negatively impacted by climate change, but a public policy strategy that balance education and military expenditures—favoring education—can enhance societal peace.