Climate change and inequality in a global context. Exploring climate induced disparities and the reaction of economic systems

Elena Paglialunga[§], Andrea Coveri[§], Antonello Zanfei[§]

[§] Department of Economics, Society, and Politics, University of Urbino 'Carlo Bo'

Outline

- Background
- Climate change-inequality nexus
- Structural factors, GVCs and inequality
- Method and data
- Preliminary results
- Conclusions

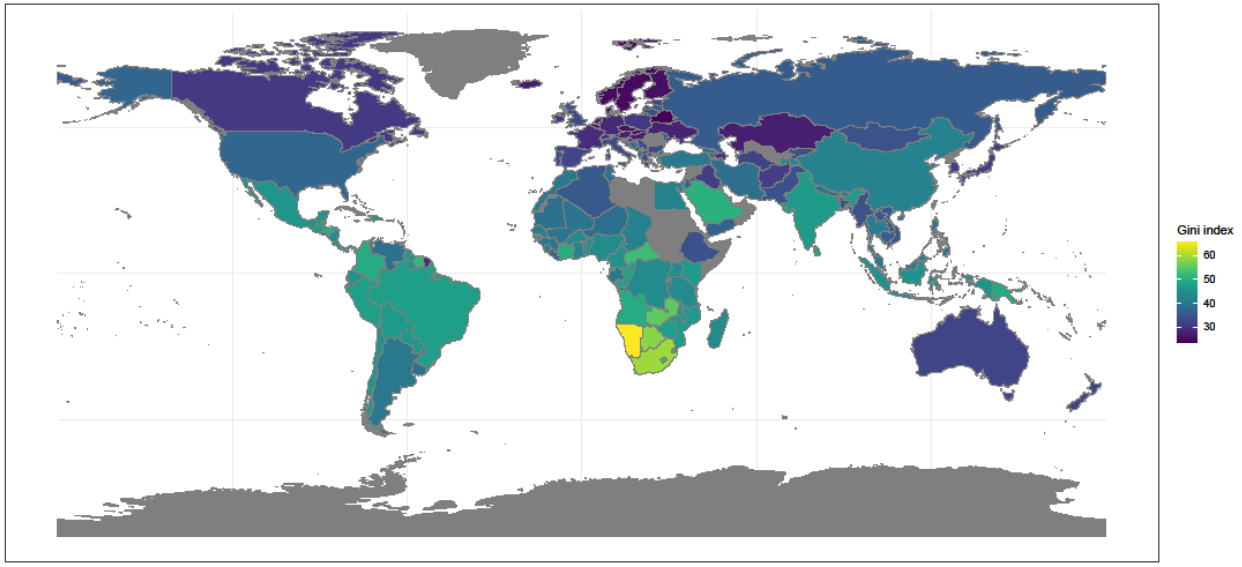
- According to IPCC's most recent Fifth Assessment Report (AR5) distributional impacts of climate impacts remain under-explored.
- Research has been carried out on the role played by **climate change** in explaining between-country inequality (Hallegatte & Rozenberg, 2017; Rao et al., 2017; King & Harrington, 2018).
- However, the impact on **within-country inequality** is far less investigated and aim of this paper is to contribute to this strand of research.
- In addition, we will stress the relevance of some key structural factors conditioning the ability of countries to deal with the inequality effects of climate change.

Inequal impacts of climate change

- **Intra-generational inequity**: low-income countries have contributed very little to greenhouse gas emissions but would bear higher costs of climate change (Moore & Diaz, 2015).
- *"Although between-country inequality has decreased over the past half century, there is ~90% likelihood that global warming has slowed that decrease" (Diffenbaugh & Burke 2019).*
- Also adopting a **within-country** perspective, the cost of climate change unevenly affects different **regions, sectors and population groups** (Hsiang et al., 2017) with vulnerable and poor people being more at risk (Rao et al. 2017).
- **Agriculture** is among the main channels: agricultural yields, income of farmers, food prices, labour productivity, damage to agricultural grassland (Hallegatte & Rozenberg 2017; Diffenbaugh & Burke 2019).

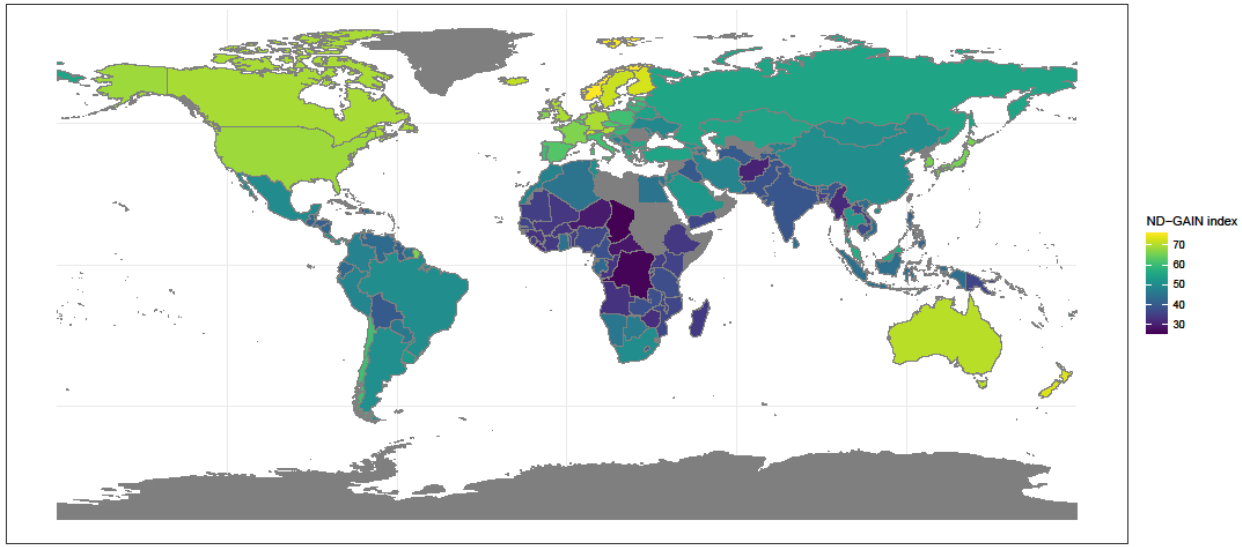
Inequal impacts of climate change

Gini index



Gini index, post-tax, post-transfer (2003-2017 average).

Notre Dame - Global Adaptation Initiative index



The ND-GAIN is an indicator of country level climate vulnerability: higher value indicates that a country is less vulnerable to climate change (i.e., the higher the value, the more resilient the country is). (2003-2017 average).

We observe that less vulnerable countries to climate change (higher ND-GAIN index), are mostly characterized by lower value of the Gini index (e.g., lower level of income inequality).

Drivers of income inequalities

- Economic and technological development

  Kuznets curve (1955), industrialization and population shifts from rural to urban areas, availability of basic services, (skill-biased) technological change (Van Reenen, 2011).

- Institutional drivers of inequality

  "Governance readiness" shaping their capability to timely and virtuously respond to adverse phenomena, including climate-related extreme events (Sarkodie & Strezov, 2019).

  "Social readiness" related to the social safety nets made available to different population groups, e.g. affordability of healthcare services, education (Berg et al. 2018).

- Trade, financial globalization, FDIs and GVC

  International technological spillovers; functional specialization induced by the international fragmentation of production; economic diversification (Hartmann et al. 2017).

Description of variables

Aim: investigate climate change as a channel that may exacerbate inequality, and the role of international investments and structural factors as resilience-enhancing factors.

Variable name	Description	Source
Gini index	Gini index (post-tax, post-transfer)	SWIID
ln(temperature)	Average temperature (log)	CRU
Temperature increase	Ratio between $temperature_{i,t}$ and $temperature_{i,t-1}$	CRU
Temp extreme (increase >1.5C°)	Heat wave (difference between average temperature and historical mean 1900-1950 > 1.5°)	CRU
abs_SPI 3 (av. 5)	3-month Standardized Precipitation Index (SPI-3) (absolute value, 5-years average)	CRU
Increasingly extreme SPI 3 (av. 10)	Extremization of drying/flooding anomalies (ratio between $SPI\text{-}3_t$ and average SPI-3 in the 10 previous years >1)	CRU

Economy & technology: GDP per capita (PPP, constant 2011 international $); Share of industry value added (% of GDP); Mobile-cellular subscriptions; GFCF (% of GDP); Rural electricity access; Rural population with access to electricity (%) - World Development Indicators (WDI) World Bank.
Institution: Worldwide Governance Indicators (WGI) World Bank; Schooling; Domestic general government health expenditure (% of GDP) from WDI.
Financial globalization: de facto Financial globalization index (KOF Swiss Economic Institute ETH).
FDI and GVC: number of Incoming FDIs; share of FDI by GVC stage; GVC diversification index (fDi Markets).

Unbalanced panel of more than 150 countries over the period 2003-2017 (country and time FE).

Climate indicators

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln(GDP pc)	7.102**	6.917*	7.677**	7.057**	6.882*	7.246**	7.644**
	(3.530)	(3.526)	(3.535)	(3.496)	(3.488)	(3.502)	(3.497)
ln(GDP pc)^2	-0.489**	-0.479**	-0.519**	-0.488**	-0.474**	-0.499**	-0.517**
	(0.209)	(0.208)	(0.209)	(0.206)	(0.206)	(0.206)	(0.206)
ln(temperature)	0.519**					0.501**	
	(0.238)					(0.249)	
Temperature increase		0.070***					0.063*
		(0.023)					(0.032)
Temp extreme (increase >1.5C°)			0.243***				0.236***
			(0.088)				(0.087)
abs_SPI 3 (av. 5)				0.512		0.507	
				(0.310)		(0.309)	
Increasingly extreme SPI 3 (av. 10)					0.123**		0.123**
					(0.050)		(0.050)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1918	1918	1918	1918	1918	1918	1918
r2_a	0.129	0.127	0.132	0.132	0.131	0.134	0.136

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Results are robust to: Industry share (%); Mobile subscription; GFCF over GDP (%); Rural electricity access; Rural pop (%); Schooling; Gov health expenditure (%); Financial globalization; Incoming FDIs

Agricultural channel

	(1)	(2)	(3)	(4)
ln(temperature)	0.654**	0.337	0.674**	0.360*
	(0.311)	(0.260)	(0.319)	(0.206)
abs_SPI 3 (av. 5)	0.492*	-0.163	-0.089	0.419
	(0.272)	(0.327)	(0.322)	(0.272)
Low pop_rur	0.408	-1.093*	0.125	
	(0.348)	(0.592)	(0.381)	
Low pop_rur*ln(t)	-0.471**		-0.456**	
	(0.205)		(0.199)	
High pop_rur	-5.000***	-0.618*	-4.685***	
	(1.755)	(0.370)	(1.672)	
High pop_rur*ln(t)	1.443**		1.342**	
	(0.560)		(0.536)	
Low pop_rur*abs_SPI3		1.330**	1.248**	
		(0.579)	(0.564)	
High pop_rur*abs_SPI3		-0.018	-0.044	
		(0.502)	(0.499)	
Agr. Empl				-0.003
				(0.022)
Agr. Empl*ln(t)				0.001***
				(0.000)
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	1888	1888	1888	1866
r2_a	0.218	0.217	0.226	0.191

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Controls: GDP per capita (linear and squared); rural electricity access. Results are robust to: Industry share; Mobile subscription; GFCF over GDP; Rural electricity access; Rural pop; Schooling; Gov health expenditure; Financial globalization; Incoming FDIs.

GVC mitigating factors

	(1)	(2)	(3)	(4)	(5)
Temperature increase	0.065*	0.065*	0.062	0.060	0.063*
	(0.039)	(0.038)	(0.039)	(0.038)	(0.037)
Temp extreme (increase >1.5C°)	0.145*	0.148*	0.150*	0.142*	0.140*
	(0.081)	(0.080)	(0.080)	(0.080)	(0.080)
Increasingly extreme SPI 3 (av. 10)	0.099**	0.104**	0.103**	0.111**	0.325**
	(0.049)	(0.050)	(0.050)	(0.051)	(0.131)
Incoming FDIs	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FDI sh. in Upstream activities	-0.647**				
	(0.314)				
FDI sh. in Production activities		0.290**			
		(0.136)			
FDI sh. in Downstream activities			0.071		
			(0.118)		
GVC diversification				-0.004***	-0.002*
				(0.001)	(0.001)
GVC diversification * increasingly extreme SPI 3					-0.004**
					(0.002)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	1721	1721	1721	1721	1721
r2_a	0.288	0.287	0.284	0.290	0.292

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Controls: GDP per capita (linear and squared); rural electricity access; Industry share; Mobile subscription; GFCF over GDP; Rural electricity access; Rural pop; Schooling; Gov health expenditure; Financial globalization.

- Temperature increase and precipitation anomalies have a significant role in worsening **within-country income inequality**.
- **Temperature increases** are associated with inequality in the presence of high shares of population in rural areas and workers in the agricultural sector.
- Foreign capital inflows (FDIs) might exacerbate inequality, especially in case of hyper-specialization in selected GVC functions.
- **GVC diversification** across value chain activities of incoming cross-border investment flows – allowing an increasing sophistication and economic complexity of local economies' production structure – emerges as a resilience-enhancing factor which results negatively associated with within-country inequality.

Thank you!

elena.paglialunga@uniurb.it

Descriptive statistics by rural population groups

Rural population share	Latitude	Temp.	Precip.	abs_SPI 3 (av. 5)	SPI 3 (av. 5)	Gini index	GDP pc (log)	Agr. empl.
Low	41.600	13.828	2.668	0.264	0.117	34.531	10.081	8.763
Mid	24.882	19.443	3.427	0.193	0.045	41.054	8.813	32.778
High	15.272	23.164	3.713	0.194	0.025	42.334	7.819	57.348
Total	27.661	17.973	3.186	0.221	0.069	38.754	9.115	28.190

Temperature increase and 3-month Standardized Precipitation Index (SPI-3) average 2003-2017