

Temporal and spatial distribution of global mitigation cost: INDCs and equity

Jing-Yu Liu, Shinichiro FUJIMORI, Toshihiko MASUI

National Institute for Environmental Studies, Japan

Introduction

- Immediate GHG emissions reductions scenarios (AR5)
- INDC (Intended Nationally Determined Contribution)
- Post-INDC trajectory VS immediate emission reduction scenarios
 - 2 ° C target
 - Emission gap
 - Different spatial and temporal distribution of mitigation costs : INDCs influence equity both inter-generationally and inter-regionally
- How do the INDCs affect inter-generational equity?
 - Does the use of INDCs lead to more mitigation costs for future generations as compared with the immediate emission reduction 2 °C scenarios presented in AR5?
- How do the INDCs affect inter-regional equity?
- Does greater reduction of emissions in INDCs help to improve equity?

Scenario settings

Table 1 Scenario descriptions			
	Emissions constraints		Radiative forcing in 2100 (W/m ²)
	Before 2030	After 2030	
Baseline	No emission constraints		7.28
450CO ₂ e	Global emission constraint		2.86
INDC_450CO ₂ e	Each country's emission constraint	Global emission constraint	2.83
SINDC_450CO ₂ e	Each country's emission constraint + additional emission reduction	Global emission constraint	2.79

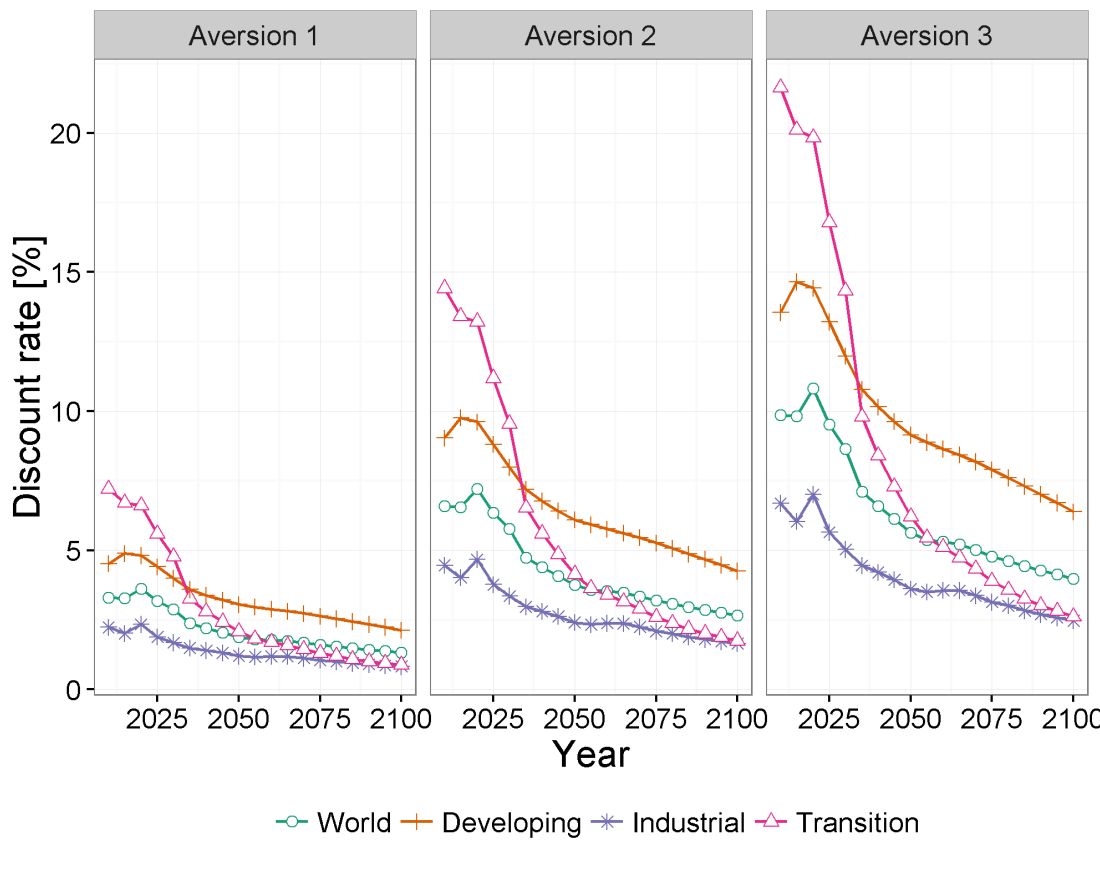


Figure1 Discount rate

- The discount rates were determined based on the Ramsey rule:

$$\rho_{t,r} = \delta + \eta g_{t,r}$$

$\rho_{t,r}$: discount rate at time t for region r .

δ : pure rate of time preference for the present.

η : a measure of intertemporal inequality aversion.

$g_{t,r}$: consumption growth rate in region r at time t .

Results

1 Mitigation pathway and costs

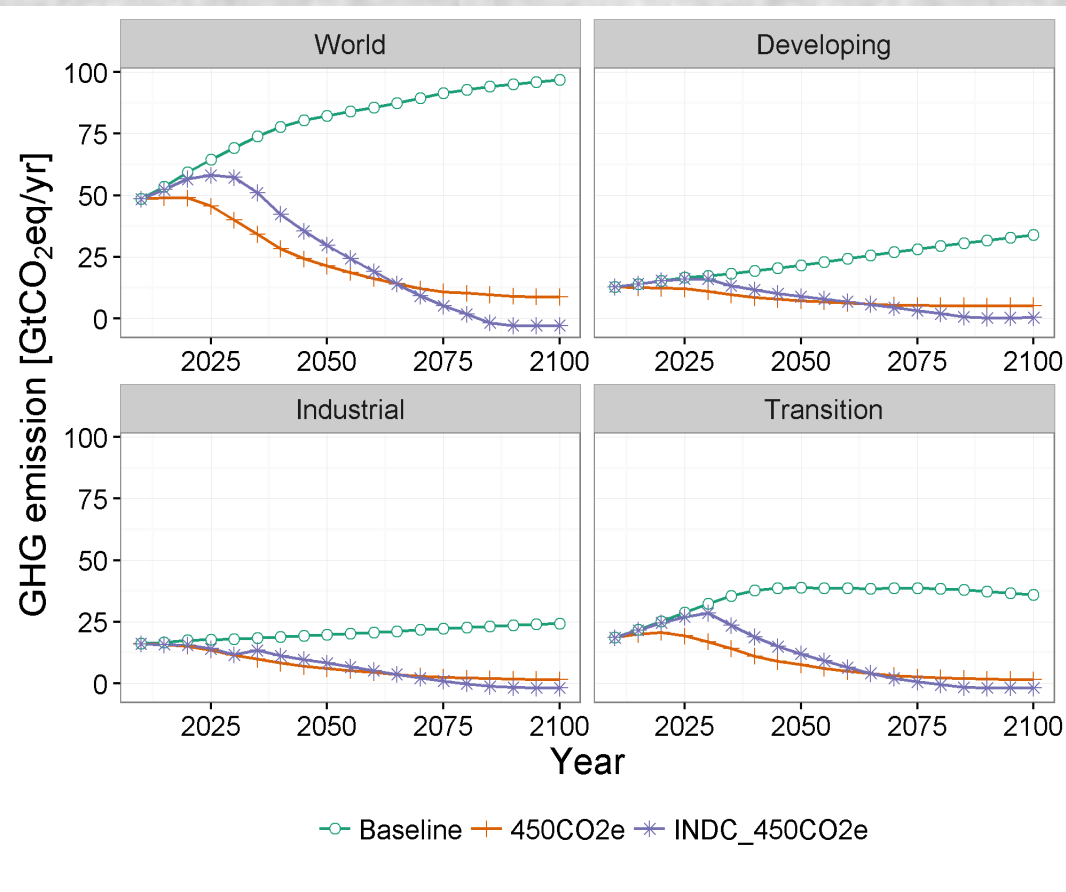


Figure2 emission pathway

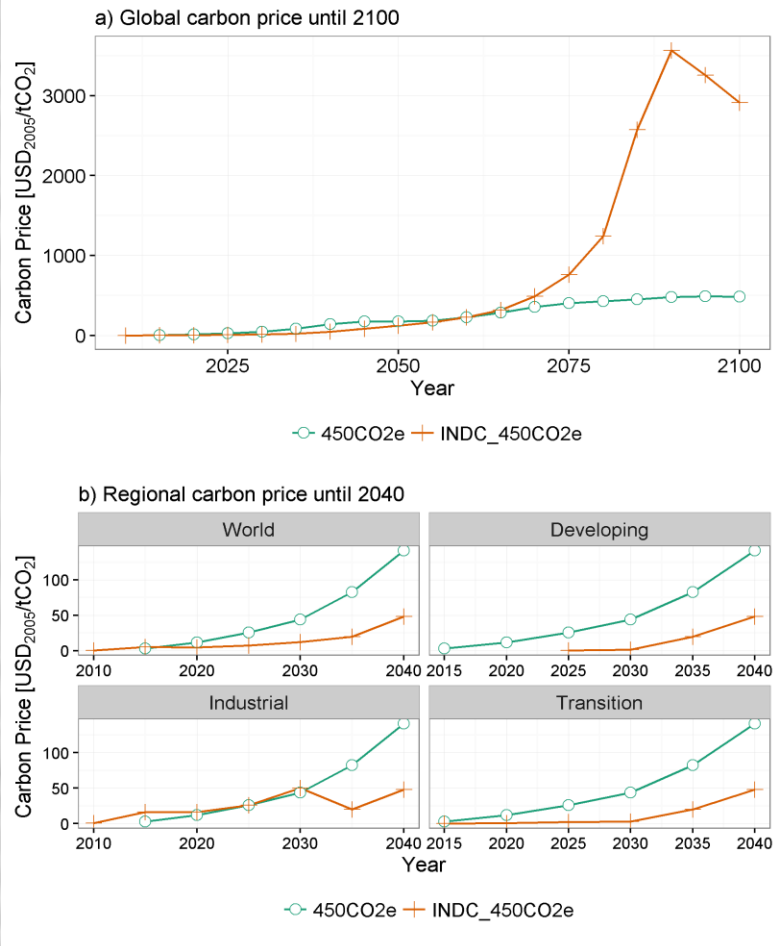


Figure3 carbon price

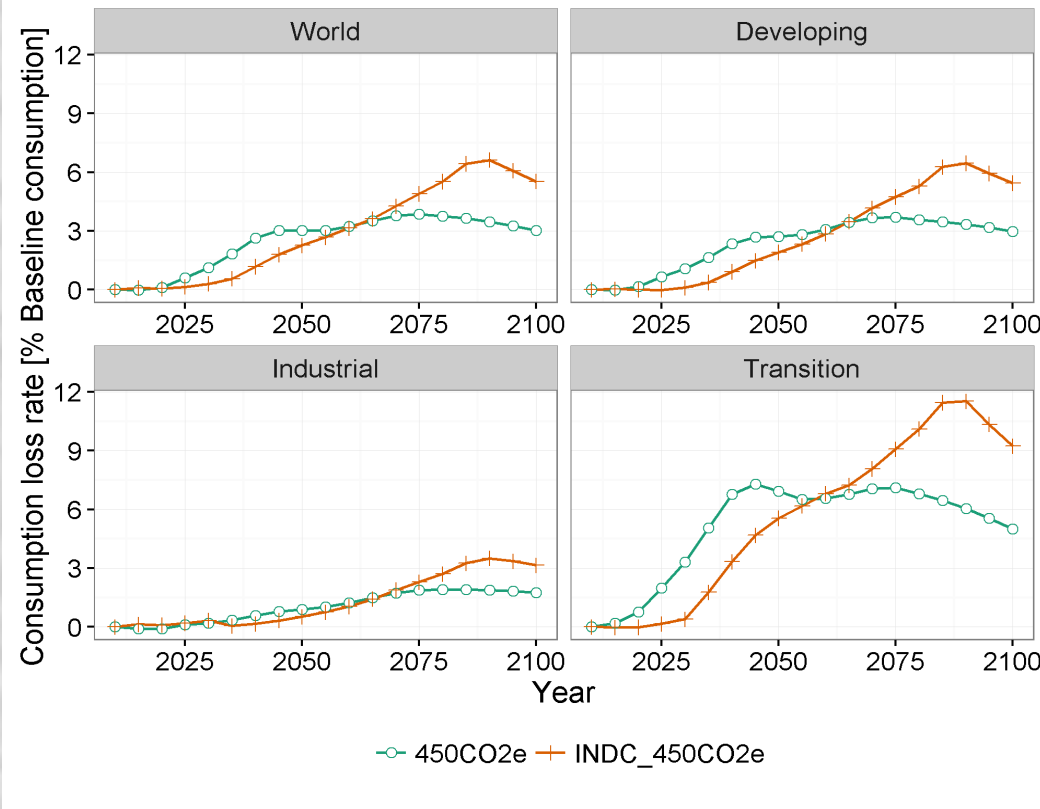


Figure4 GDP loss rate

- 450CO₂e scenario: gradually declining global emission path
- INDC_450CO₂e scenario: 2020-2030 consistent with its INDC pledge.
- After 2030, the gap in cumulative CO₂ emissions is gradually filled in INDC_450CO₂e.
- Both meet 2 °C target.

Results

2 inter-generational and inter-regional equity

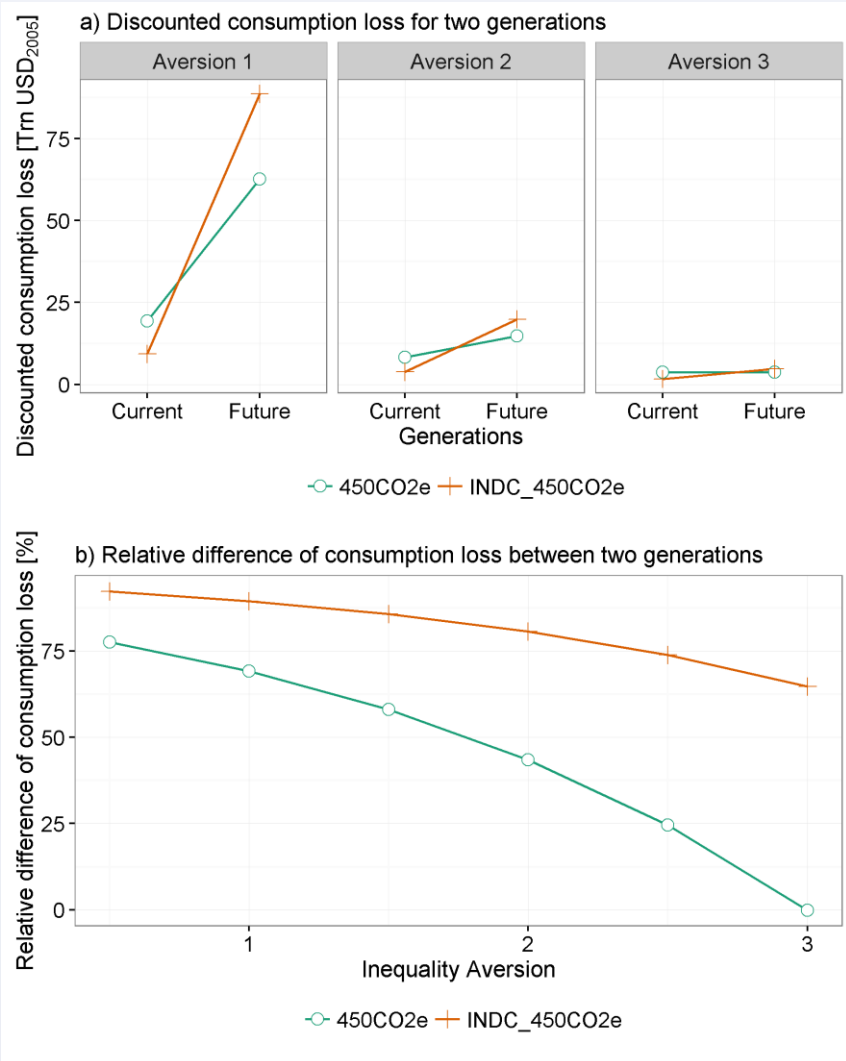


Figure5 inter-generational equity

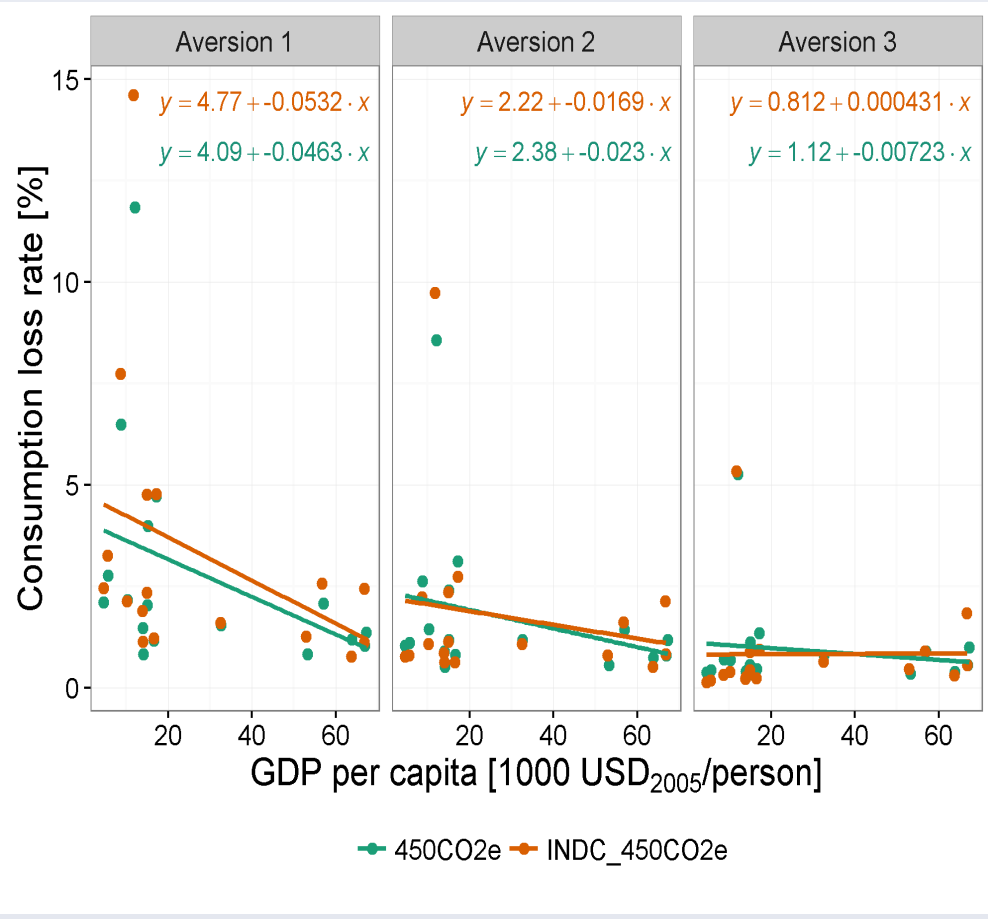


Figure6 inter-regional equity on average

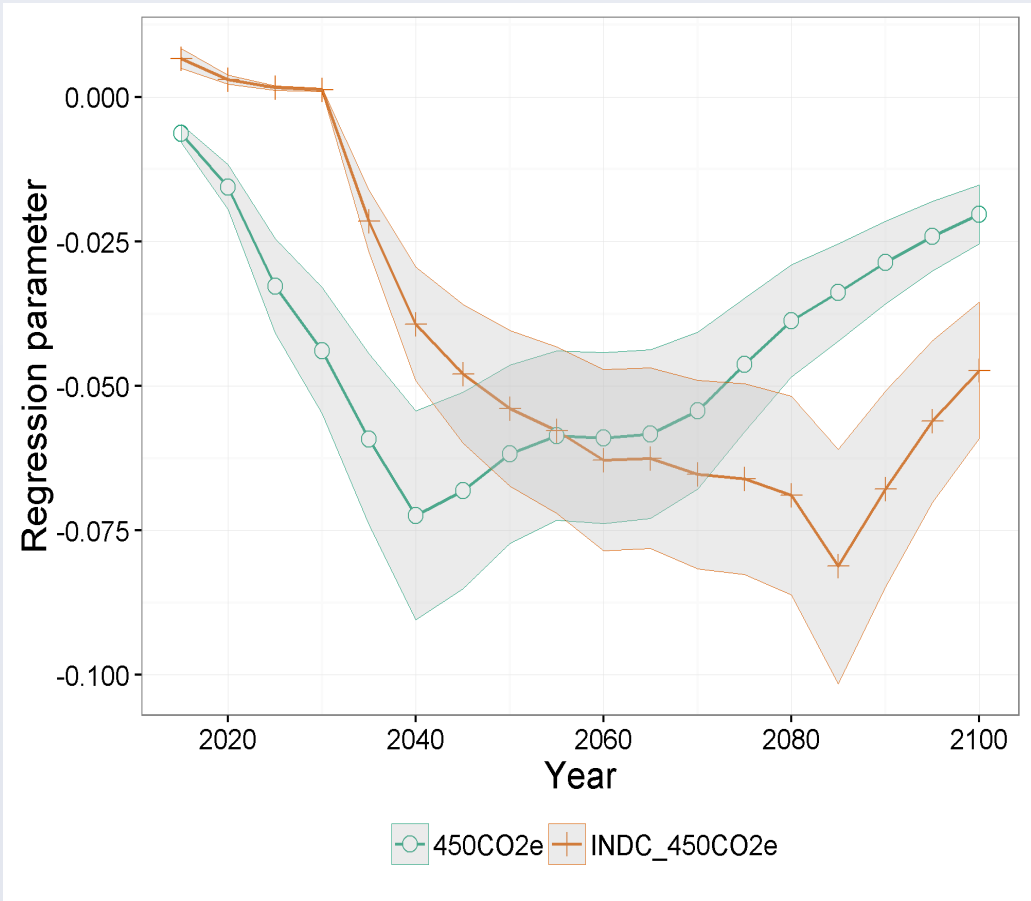


Figure7 inter-generational equity through 2100

- Trend lines: flatter means more inter-regional equity
- INDC_450CO₂e has better equity if inequality aversion is high
- INDC_450CO₂e is better before 2060, worse after 2060
- Uniform carbon price: harmful to inter-regional equity

3 Stringent emission reduction scenario

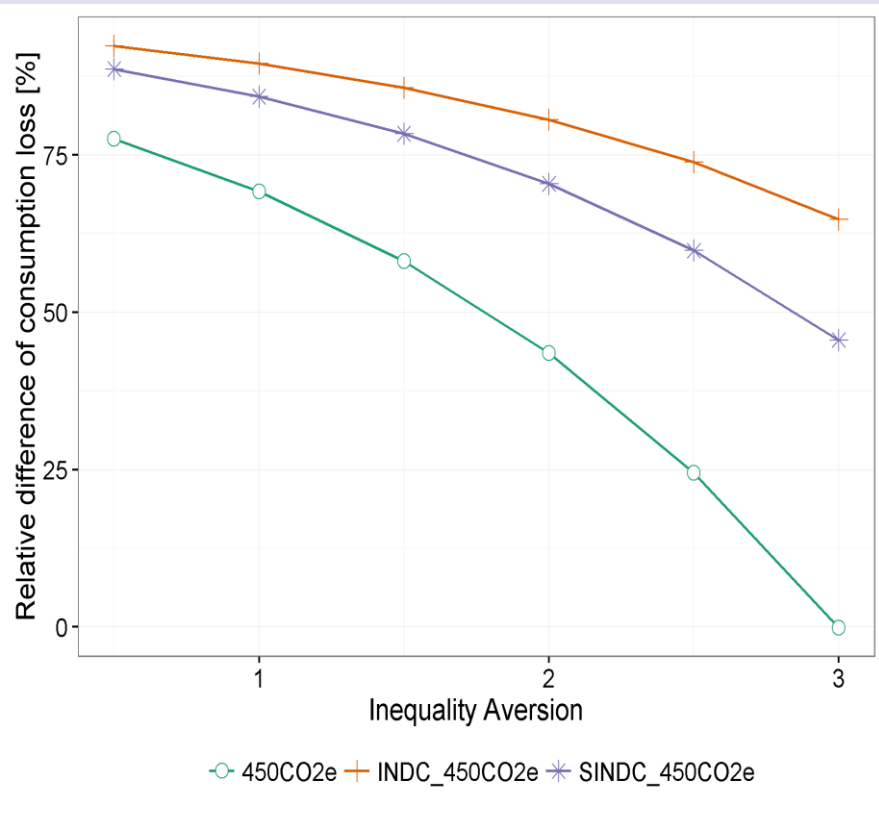


Figure8 inter-generational equity for SINDC_450CO2e scenario

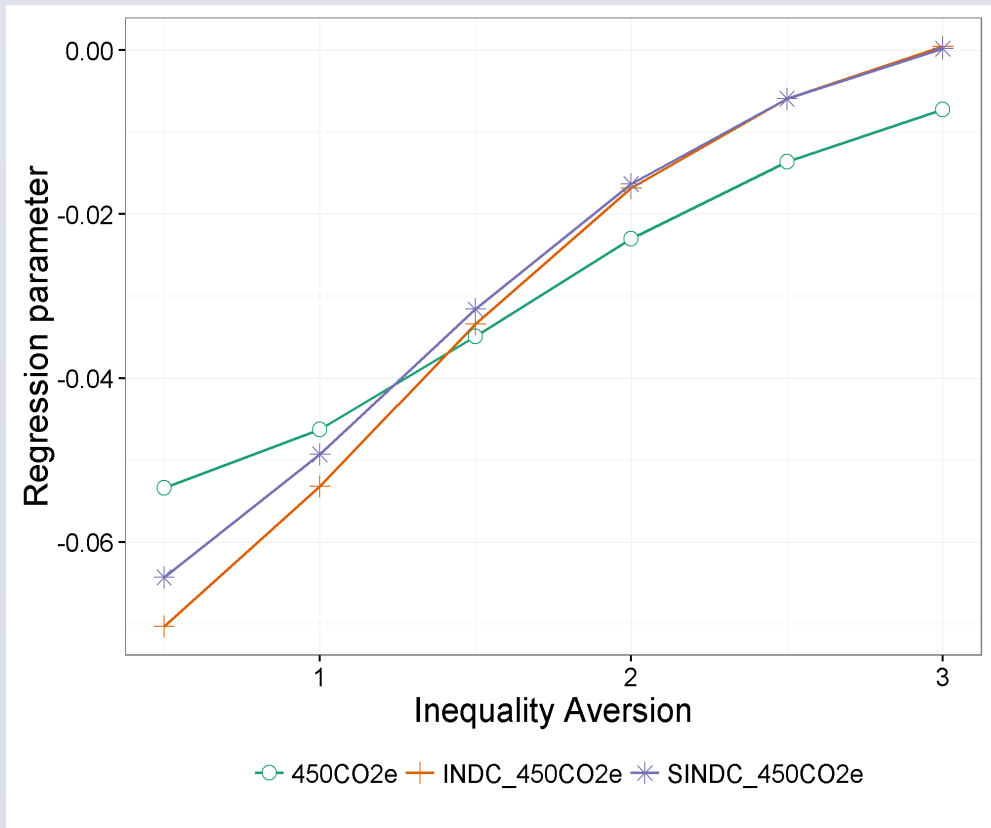


Figure9 inter-regional equity for SINDC_450CO2e scenario

- SINDC_450CO₂e increase emission reduction target of INDC
- SINDC_450CO₂e also has better inter-generational and inter-regional equity

Discussions

Inter-generational equity

- Worse in scenario INDC_450CO₂e than 450CO₂e.
- This conclusion was robust for inequality aversion parameters (i.e., implied discount rates).
- additional emission reduction efforts in the near term are desirable to achieve the 2 ° C target.

Inter-regional equity

- Better in INDC_450CO₂e during the entire period on average if the inequality aversion is large.
- Better in INDC_450CO₂e in the early part of the century, worse in the latter part of the century (drastic increase of mitigation costs).
- Ongoing consideration for low-income countries will be needed as part of global climate change cooperation after 2030.

SINDC_450CO₂e improves inter-generational equity compared with INDC_450CO₂e, but still worse than 450CO₂e. Its average inter-regional equity was also better than INDC_450CO₂e.

- Emissions targets will be reviewed and revised in 2020. Still room to enforce stronger emissions reduction for 2030.
- Each country should adjust its target and commit to greater emissions reductions in the follow-up INDC communications.