# Modeling within-country inequality and impacts in RICE50+

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#### Introduction - Motivation

#### Distribution of

- Income/Consumption
- Impacts
- Mitigation effort / energy share /...
- Literature
  - ▶ Dennig et al. (2015): quintiles, equal dist. within, constant over time
  - ▶ Hallegatte and Rozenberg (2017): micro simulation, monte carlo analysis
  - ▶ van Ruijven et al. (2015): heterogeneous households in CGE
  - Rao et al. (2019): empirical determinants of inequality (TFP, education,weak), SSP projection



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- (up to) 57 countries/regions
- First results and model presentation: Gazzotti et al. (2021)



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- Features
  - flexible regional and temporal/tree setup & modular structure
  - calibrated to ENERDATA MACC curves
  - Integration of RCPs, country-level climates, climate extreme indices
  - Modules for government sector, DACCS, SRM, SLR, Inequality, Natural Capital
  - Full intertemporal optimization across coalitions













# Implementation and comparison of impacts



Country level temperature (change) based (except for DICE2016,HS2017)
This work: Kalkuhl and Wenz (2020)'s preferred and robust specification

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# Modelling of inequality

• Welfare:  $W(n) = \sum_t l(t, n) \frac{\left(\frac{C(t,n)}{l(t,n)}\right)^{1-\eta} - 1}{1-\eta} \beta^t$  now based on deciles in the optimization (as option

- mod\_inequality.gms contains remaining part:
  - $\blacktriangleright$  Carbon tax and MAC are distributed across deciles based on ()<sup> $\omega$ </sup> elasticity,  $\omega = 0.5$
  - Damages at the country level accrue based on ()<sup> $\xi$ </sup> elasticity ( $\ddot{\xi} = 0.5$ )
  - Normalization to match macro aggregates; Minimum threshold
  - Government Budget: TRANSFER(t, n) are computed based on CTAX revenue before net-negative(!)
    - distributional-neutral
    - on an equal per capita basis
    - optimally (additional control variable)

#### Preliminary Results - Scenario Matrix

Transfer scheme / Policy	Reference		30\$/ <i>tCO</i> 2	100\$/ <i>tCO</i> 2	COOP CBA
Impacts	w/ Impacts	w/o Impacts	w/ Impacts	w/ Impacts	w/ Impacts
Neutral					
Equal per capita	-	-			
Optimal	-	-			



# Preliminary Results

TATM over time



## **Preliminary Results**

TATM in 2100 0\$ 30\$ 100\$ cba 3 TATM in 2100 [°C]  $^{\circ}$ TR neutral epc opt 1 0. neutral neutral epc opt neutral opt neutral epc epc opt

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# Preliminary Results

NPV global





#### Preliminary Results - Carbon tax scenarios





#### Preliminary Results - Economic Impact





#### Preliminary Results - CBA





#### Preliminary Results - Economic Impact





#### Climate impacts directly on inequality?

Similar to Kalkuhl and Wenz (2020), Burke et al. (2015), but looking at (In)equality or deciles:

based on panel data, temperature and lcimate (30 year average)



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Source: Dasgupta, Emmerling, and Shayegh (2021, under review

## Conclusion

Conclusions

- Baseline inequality projections bear large uncertainty
- Issues of inequality NOT secondary to the CC issue
- Redistribution crucial for support of climate policies



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Open issues

- Different damage function specifications
- Empirical foundation of  $\xi$  ?
- > Alternatively, implement climate-econometric impact function directly on deciles or Gini
- Different transfer schemes?
- Negative Emissions!



17 / 17

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