Climate Change and International Risk Sharing

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Introduction

- **Climate risk:** magnitude and timing of damages *uncertain*
- Can climate risk be **shared** by different countries?
- How do **market structure** and **international (non-)cooperation**
  - ➢ affect international risk-sharing?
  - ➢ shape optimal carbon taxation?

Framework

- Regions: $\mathbb{L} = \{1, \dots, L\}$
- **Production** of region $\ell \in \mathbb{L}$*:*

$$Y_t^\ell = Z_t^\ell \, F_t^\ell\left(K_t^\ell, X_t^\ell\right) \to C_t^\ell$$

- **Risk structure***:*

$$Z_t^\ell = \exp(\zeta_t^\ell - \gamma_t^\ell \cdot T_t)$$

with

- ➢ γ_t^ℓ: climate risk
- ➢ ζ_t^ℓ: fundamental risk

- **Temperature** anomaly:

$$T_t = (1-\varphi)T_{t-1} + \sum_{\ell \in \mathbb{L}} X_t^\ell$$

- Regional carbon taxes $\left(\tau_t^\ell\right)_{t\geq 0}$
- **Preferences:**

$$U\left(\left(C_t^\ell\right)_{t\geq 0}\right) = \mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t u(C_t^\ell)\right]$$

- **Scenarios**:
  - ➢ **Market** structure*:*
    1. Autarky (no trade)
    2. Incomplete markets (bonds)
    3. Complete markets (insurance)
  - ➢ **Policy** scenarios:
    a) Non-cooperation
    b) Cooperation: $\tau_t^\ell = \tau_t^{\text{opt}}$

Adaptation: markets shape risk sharing

Stochastic discount factor

$$M_{t,t+1}^\ell = \beta \cdot \frac{u'(C_{t+1}^\ell)}{u'(C_t^\ell)}$$

Autarky

$$M_{t,t+1}^\ell \overset{?}{\leftrightarrow} M_{t,t+1}^h$$

Incomplete markets

$$\mathbb{E}_t M_{t,t+1}^\ell = \mathbb{E}_t M_{t,t+1}^h$$

Complete markets

$$M_{t,t+1}^\ell = M_{t,t+1}^h =: M_{t,t+1}$$

Increasing scope for trade and risk sharing

Mitigation: cooperation shapes policy

Non − cooperation

$$\tau_t^\ell = \gamma_t^\ell \cdot Y_t^\ell + \mathbb{E}_t\left[M_{t,t+1}^\ell \tau_{t+1}^\ell\right]$$

Cooperation

$$\tau_t^{\text{opt}} = \sum_{\ell \in \mathbb{L}} \gamma_t^\ell \cdot Y_t^\ell + \mathbb{E}_t\left[M_{t,t+1} \tau_{t+1}^{\text{opt}}\right]$$

zee Zentrum für Erneuerbare Energien Centre for Renewable Energy

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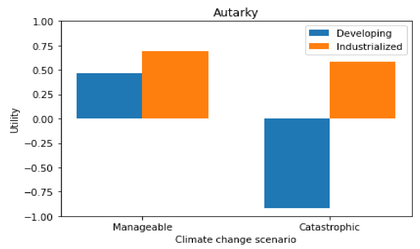
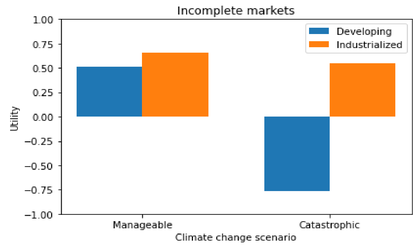
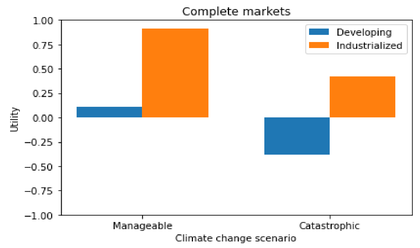
Illustration of risk-sharing

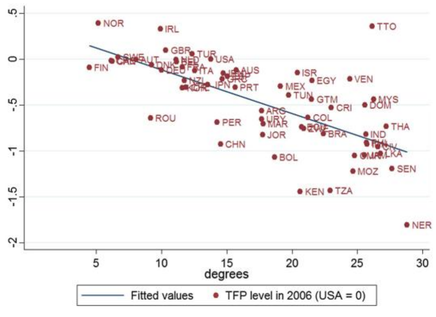




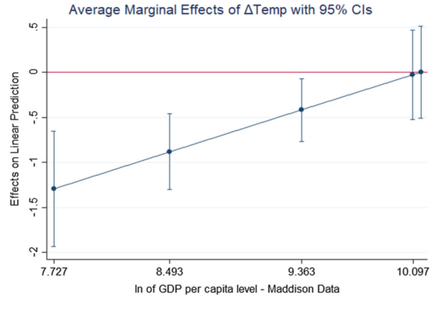


Empirical background

- Temperatures affect productivity:



- Effect depends on development:



Source: Letta and Tol (2018)