

Climate Change and International Risk-Sharing

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Introduction

- **Climate risk:** magnitude and timing of damages *uncertain*
- Can climate risks be **insured** by international financial markets?
- Do all regions **benefit** from
 - Joining **financial markets**?
 - Engaging in **capital trade**?
 - **Cooperating** on climate policy?

Model

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

$$Y_t^\ell = Q_t^\ell F_t^\ell(K_t^\ell, X_t^\ell) \rightarrow C_t^\ell$$

- **Risk structure:**

$$Q_t^\ell = \exp(\theta_t^\ell - \gamma_t^\ell \cdot T_t)$$

- γ_t^ℓ : climate risk
- θ_t^ℓ : fundamental risk

- **Temperature anomaly:**

$$T_t = \delta_E T_{t-1} + (1 - \delta_E) T_{t-1} + \zeta \sum_{i=1}^L X_t^i$$

- **Preferences:**

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

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

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

Scenarios

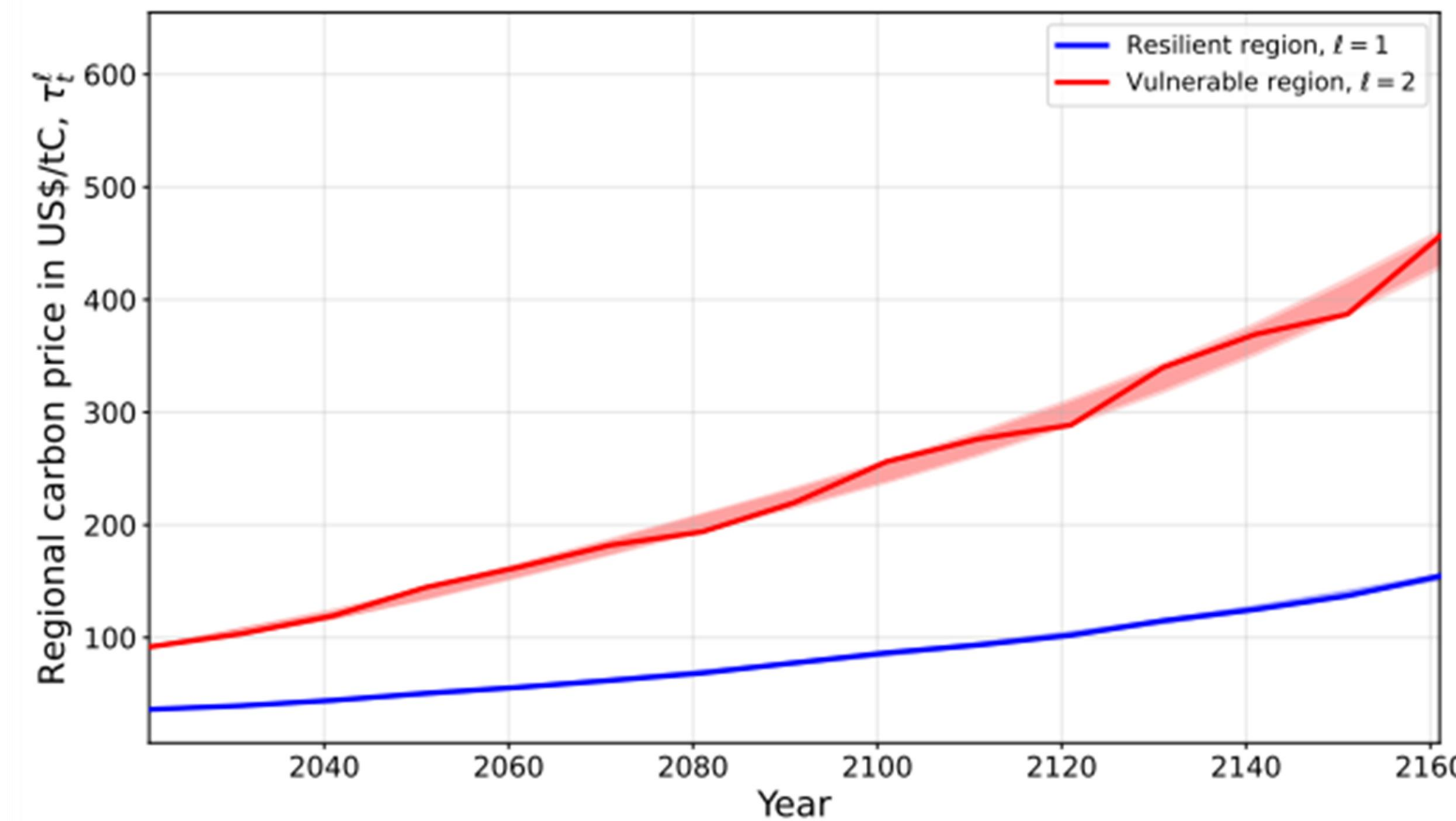
- **Add market structure** rel. to **autarky**:

1. **Trade and financial markets**
2. **Capital trade**

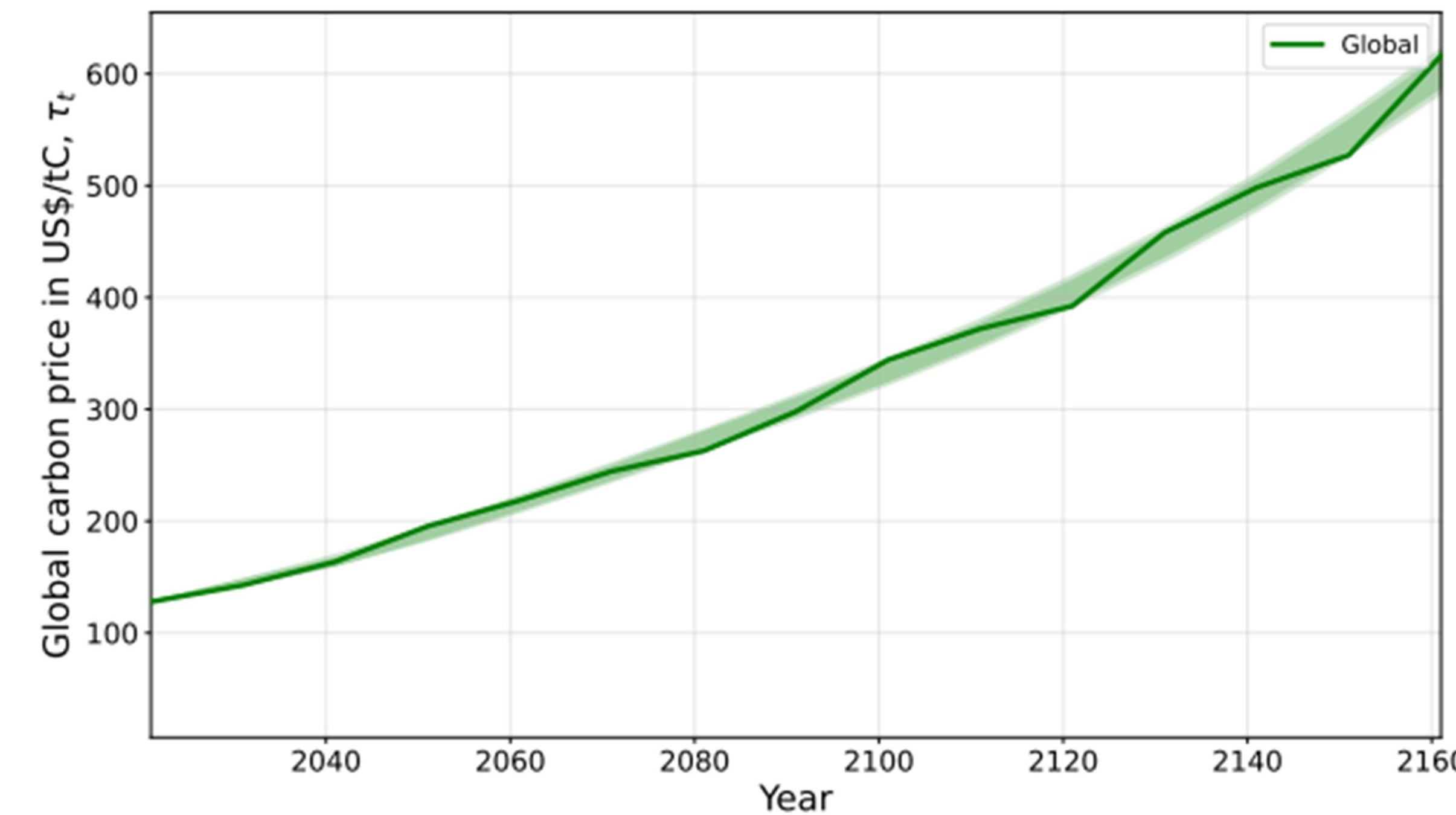
- **Study optimal climate policy:**

- a) **Non-cooperation**
- b) **Cooperation:** $\tau_t^\ell = \tau_t$

Not all regions benefit from cooperation *or* markets

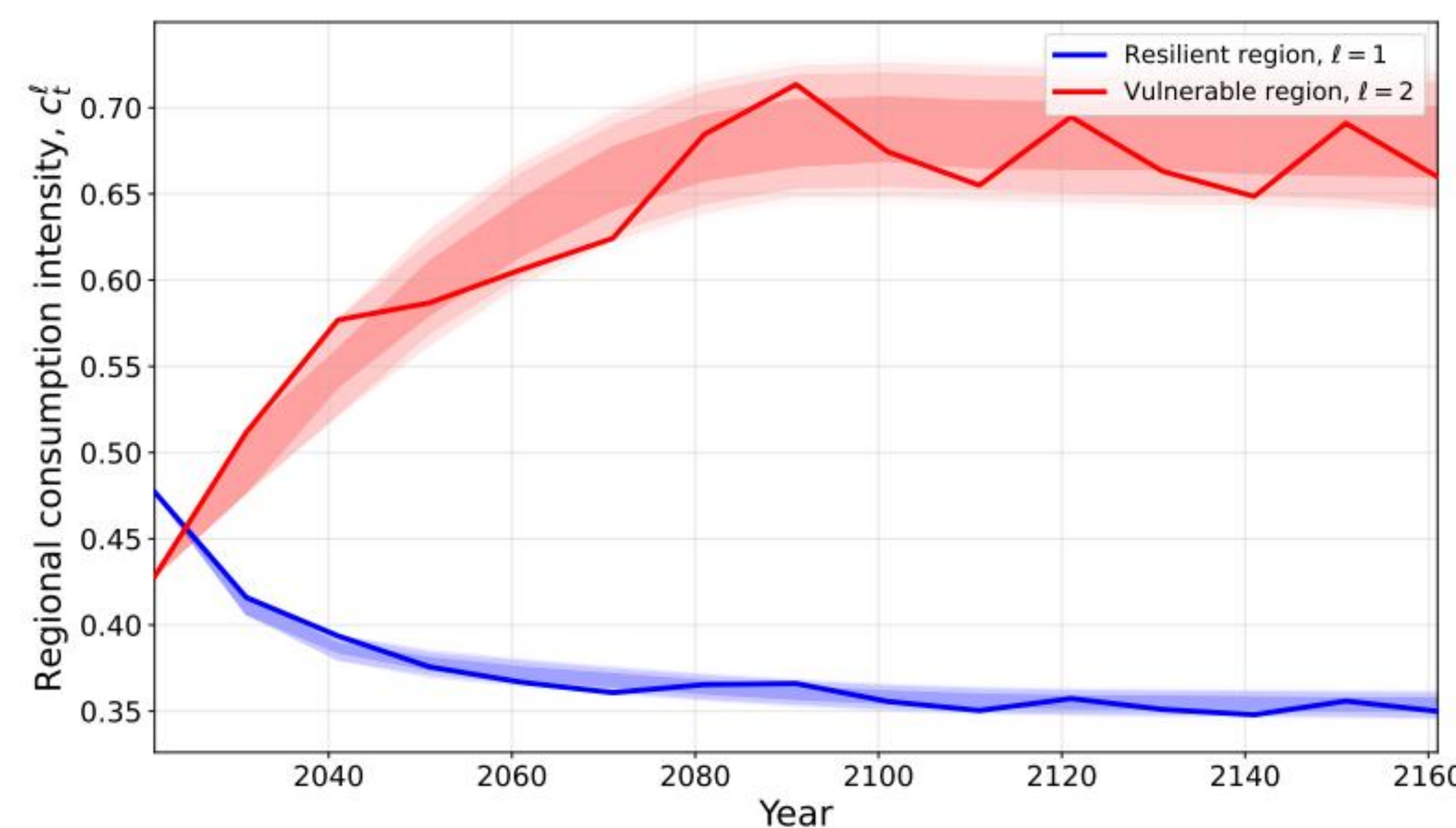


(a) Carbon prices under non-cooperation, τ_t^ℓ

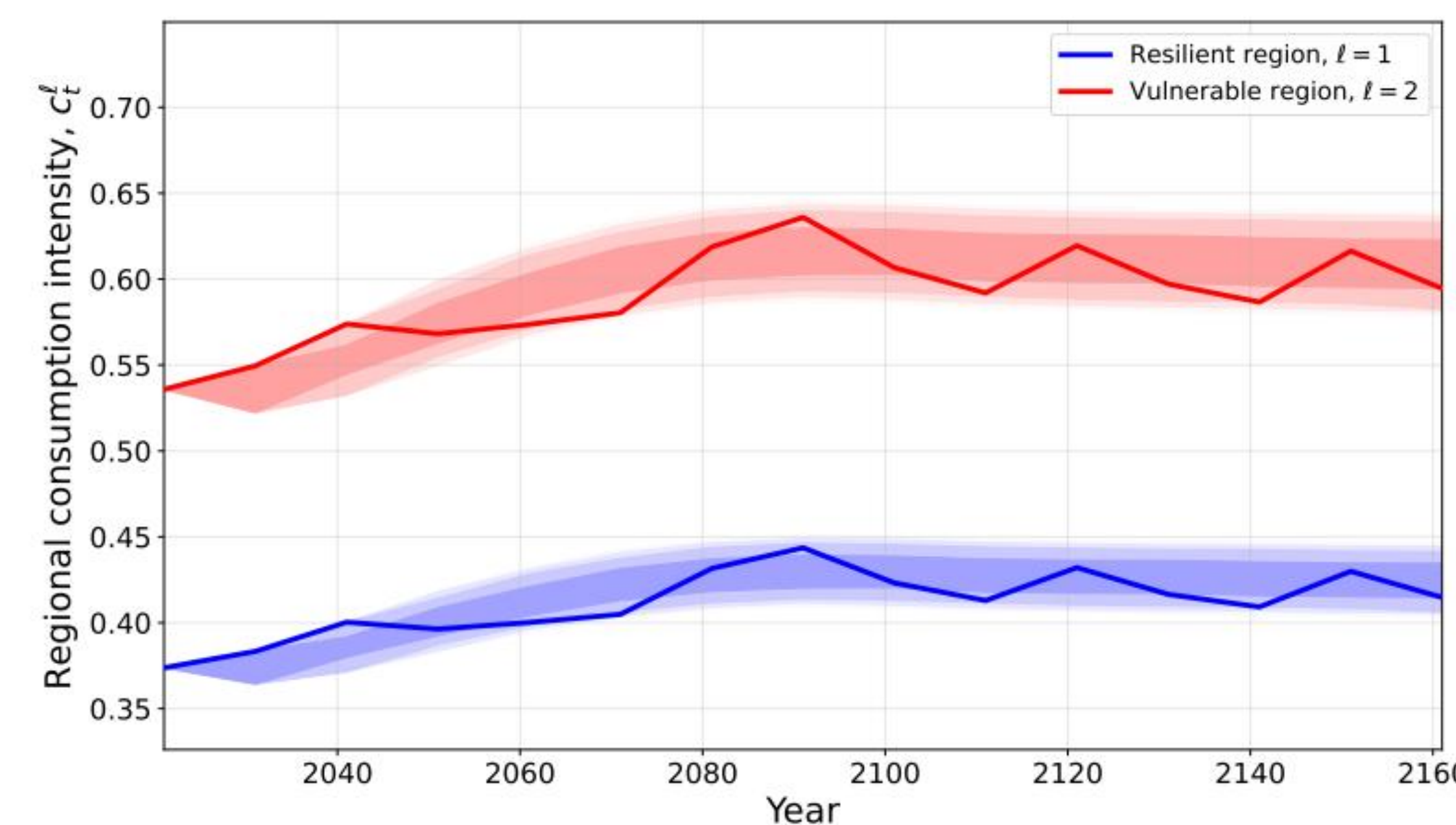


(b) Carbon prices under cooperation, τ_t

All regions benefit from cooperation *and* markets



(a) Cons. intensity c_t^ℓ , autarky.



(b) Cons. intensity c_t^ℓ , financial markets.

Theoretical results

- Effects of added **market structure**:

1. **Trade and financial markets:**

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

⇒ **perfect** risk-sharing

2. **Capital trade:**

$$r_t^\ell = r_t = Q_t^\ell \partial_K F_t^\ell(K_t^\ell, X_t^\ell)$$

⇒ **efficient** capital allocation

- **Optimal regional climate policy:**

- a) **Non-cooperation:**

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

⇒ internalize **local** damages

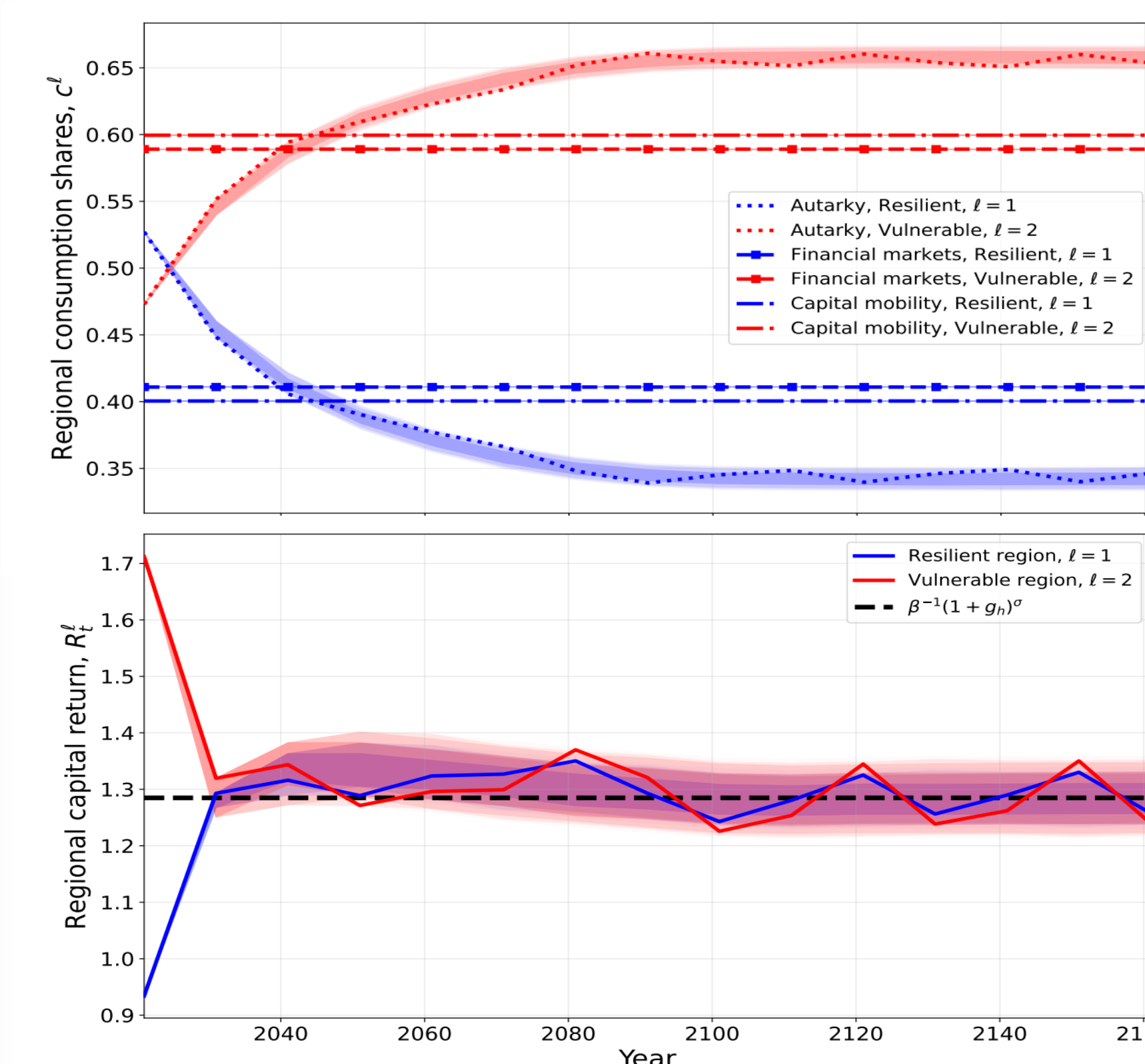
- b) **Cooperation:**

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

⇒ internalize **global** damages

Quantitative results

- **Markets redistribute & synchronize:**



- **Pareto-improvements** are possible:

	Resilient	Vulnerable
<i>Isolated effects</i>		
Financial markets	4.47	-1.25
Capital trade	-1.69	2.56
Cooperation	-0.08	0.28
<i>Combined effects</i>		
Openness	2.70	1.29
Openness & cooperation	2.62	1.57

