Overlapping climate policies

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Motivation: Overlapping climate policies

Carbon pricing now often involves multiple jurisdictions

- EU ETS, Regional Greenhouse Gas Initiative (RGGI), California-Québec cap-and-trade, Canada minimum carbon tax

Unilateral climate policies overlap with a wider carbon price

– Carbon price support in UK
– Coal phase-out in Germany
– Renewable subsidies in Spain
– Aviation tax in Netherlands

$\Rightarrow$ *Additional climate policies by individual jurisdictions for emission-intensive sectors already covered by EU ETS*

$\Longrightarrow$ **What is the climate benefit of such overlapping policies?**

- Answer depends on carbon market design as well as details of how overlapping policy affects product market competition

UK Carbon Price Support for electricity generation

"Britain is covered by the European Union's broader cap-and-trade system . . . in 2013, Parliament enacted . . . a policy that essentially functions as a carbon tax of around $25 per ton. That tax has encouraged electric utilities to rapidly switch from coal to somewhat cleaner natural gas. This is perhaps the clearest example in the world of a carbon tax leading to a significant cut in emissions." — *New York Times*, 2 April 2019

Contribution of this paper

Integrated approach

1. Wide range of popular overlapping climate policies
2. Almost all types of carbon-pricing systems

Carbon market

- Textbook ETS: Fixed emissions cap $\Longrightarrow$ "waterbed effect" is 100%
- Real world: Flexibility mechanisms with punctured waterbed
  - EU ETS Market Stability Reserve (since 2018 reform)
  - Price corridors in RGGI, California-Québec, UK ETS

$\Longrightarrow$ Now overlapping policies *may* have a climate benefit

Product market

- Coal phase-out cuts domestic emissions by 1 tCO_2 but (say) raises imported emissions by 1 tCO_2—"internal carbon leakage" of 100%
  - More important than "external" leakage for e.g. aviation, electricity

$\Longrightarrow$ *Magnitudes of waterbed effect & internal leakage both matter...*

Policy relevance

2018 EU ETS reform was motivated partly by "complementary" policies:

> "the Market Stability Reserve will also enhance synergy with other climate and energy policies" — European Parliament and Council

This paper:

- High stakes for climate policy design:
  - Some unilateral policies are truly complementary in that they induce further emissions reductions elsewhere in the system...
  - But other policies now backfire due to internal carbon leakage...
- Practical guidance for policymakers:
  - Simple formulae for internal leakage and waterbed effects for many popular overlapping policies and carbon market designs
- *Limitations*: No fiscal impacts or welfare analysis

Plan for today's talk

1. Conceptual framework
2. Product market: Internal carbon leakage
3. Carbon market: Waterbed effect
4. Empirical illustrations

Conceptual framework

- **ETS-wide carbon price**: τ across two jurisdictions i and j
- **Overlapping policy**: Reduces i's *domestic* emissions demand, $\Delta e_i < 0$ (fixed τ)

  $\Longrightarrow$ What is the equilibrium impact on aggregate emissions, ΔE^*?
- **Internal carbon leakage**: $L_i \equiv -\Delta e_j / \Delta e_i$ (fixed τ)
  - Change in aggregate emissions demand: $\Delta E = \Delta e_i + \Delta e_j$
- **Waterbed effect**: $W \equiv 1 - \Delta E^* / \Delta E$ (equilibrium τ)
  - $W = 1$ with fixed emissions cap (as $\Delta E^* \equiv 0$)
  - $W = 0$ with simple carbon tax

Lemma 1

Equilibrium change in aggregate emissions due to i's overlapping policy is:

$$\Delta E^* = [1 - L_i][1 - W]\Delta e_i$$

$\Longrightarrow$ *Overlapping policy is "complementary" if* $R_i = [1 - L_i][1 - W] \geq 1$

Product market: Internal carbon leakage

- Perfect competition in product market, with two jurisdictions
  - Heterogeneity: Production cost, emissions intensity, abatement cost
    - Product price = marginal production cost + carbon cost
    - Abatement decision: carbon price = marginal abatement cost
- Supply-side overlapping policies
  - Unilateral carbon price (e.g. UK), aviation tax (e.g. Netherlands)
  - Coal phase-out (e.g. Germany)

Proposition 1

A supply-side overlapping policy *increases* the product price and has *positive* internal carbon leakage:

$$L_i = \frac{\frac{\text{emissions intensity}_j}{\text{emissions intensity}_i}\left[\frac{\text{market share}_j}{\text{market share}_j + \frac{\varepsilon \text{ of demand}}{\varepsilon \text{ of supply}_j}}\right]}{[1 + \text{abatement effect}_i]} > 0$$

Intuition: i responds to policy by cutting production, so product price rises, so j fills gap (e.g. coal phase-out leads to higher electricity imports)

Product market: Internal carbon leakage

- Perfect competition in product market, with two jurisdictions
  - Same model as for supply-side policies
- Demand-side overlapping policies
  - Renewables support (e.g. Spain)
  - Energy efficiency program, carbon consumption tax

Proposition 2

A demand-side overlapping policy *decreases* the product price and has *negative* internal carbon leakage:

$$L_i = -\frac{\text{emissions intensity}_j}{\text{emissions intensity}_i} \frac{\text{market share}_j}{(1 - \text{market share}_j)} \frac{\varepsilon \text{ of supply}_j}{\varepsilon \text{ of supply}_i} < 0$$

Intuition: i and j both respond to policy by cutting carbon-intensive production as product price falls (e.g. renewables displace fossil imports)

Carbon market: Waterbed effect

Flexibility mechanisms based on allowance prices

- Carbon market with (weakly) upward-sloping allowance supply curve
  - Price caps/floors: California-Québec, RGGI, UK ETS
  - Carbon price = marginal cost of abatement
- Overlapping policy reduces aggregate allowance demand if $L_i \leq 1$

Proposition 3

$$W = \frac{\varepsilon \text{ of allowance demand}}{\varepsilon \text{ of allowance demand} + \varepsilon \text{ of allowance supply}} \in [0, 1]$$

$\Longrightarrow$ Classic principle of tax incidence via pass-through coefficient

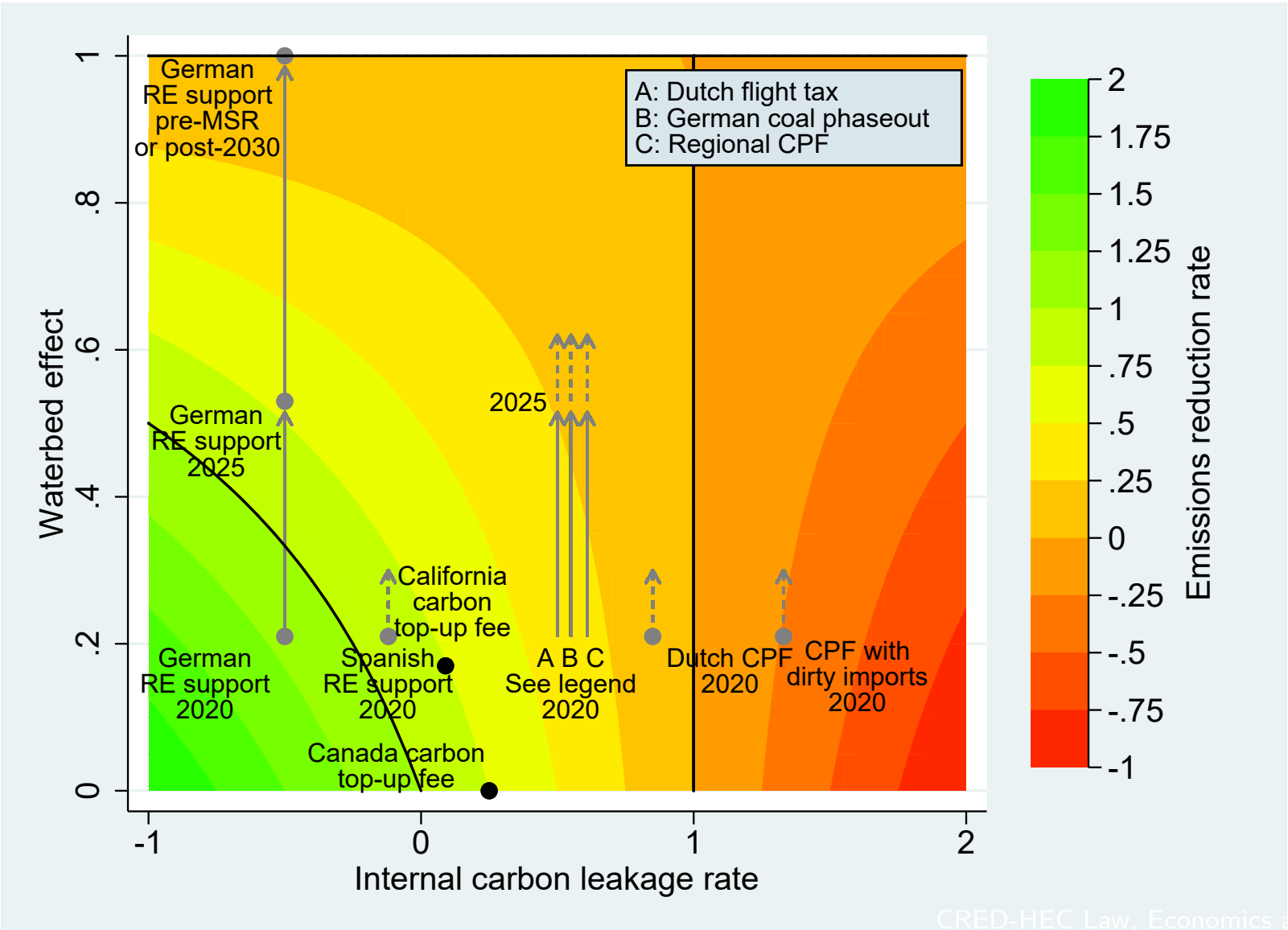
- $W = 1$ if ε of allowance supply $\to 0$ (e.g. pre-2018 EU ETS)
- $W = 1 -$ prob(price cap or floor binds) (e.g. California)

Flexibility mechanisms based on allowance banking

- Post-2018 EU ETS Market Stability Reserve
  - Very complex: Punctured waterbed depends on timing of overlapping policy, whether it is anticipated, etc. (see Proposition 4)

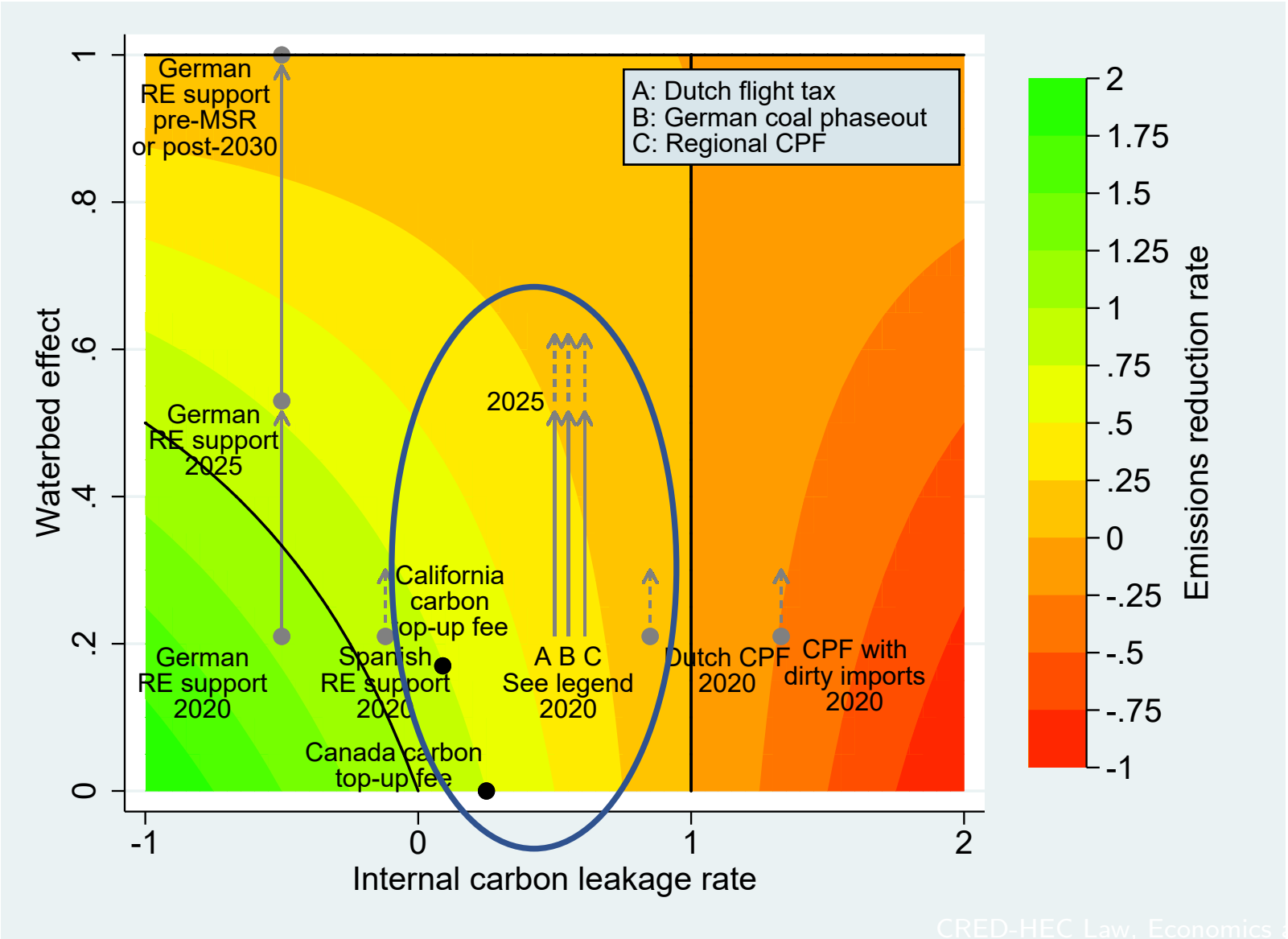
Empirical illustrations

Framework: Emissions reduction rate $R_i \equiv \frac{\Delta E^*}{\Delta e_i} = [1 - L_i][1 - W]$



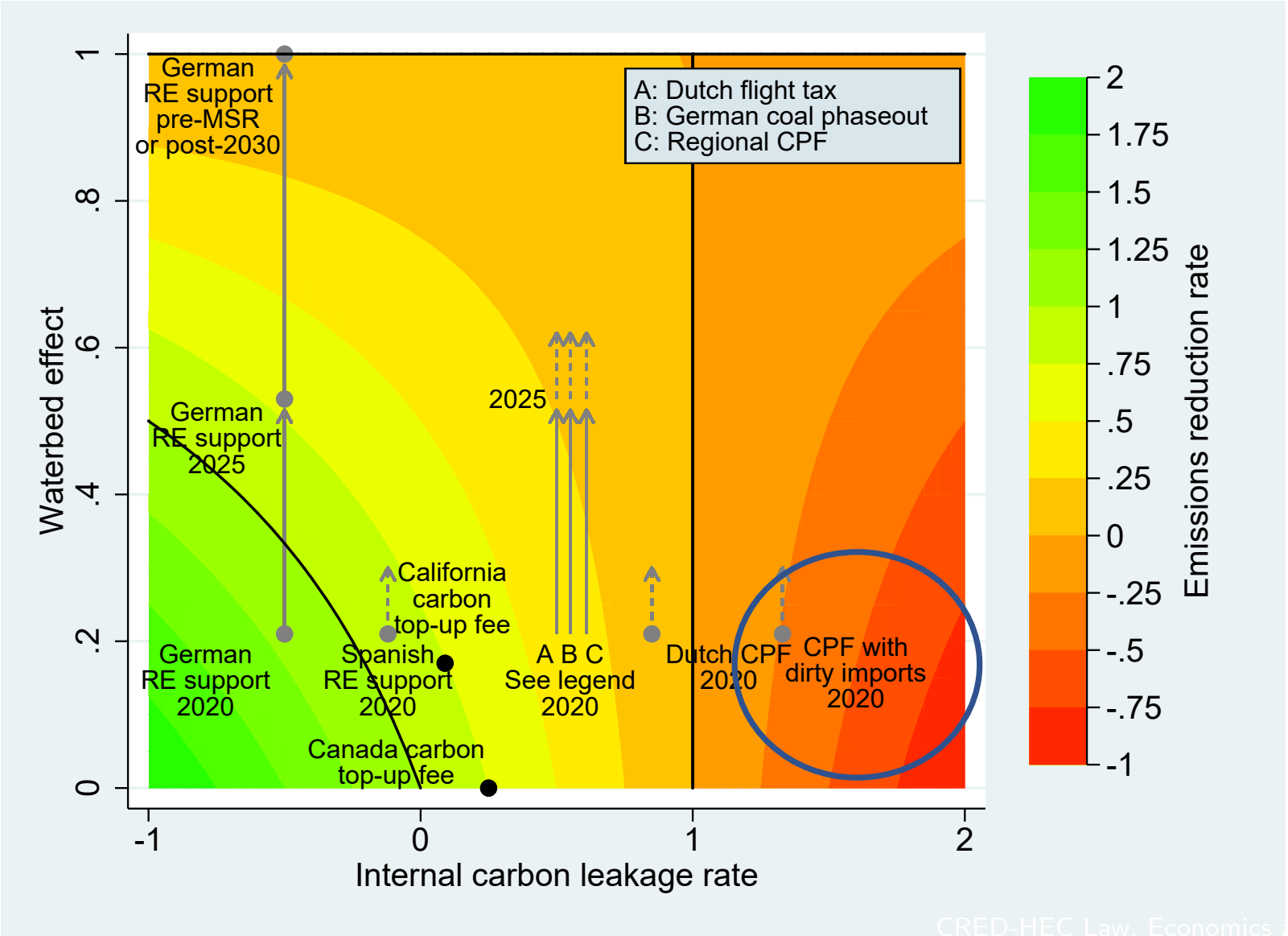
Empirical illustrations

Supply-side overlapping policies can yield a climate benefit ($R_i > 0$)...



Empirical illustrations

.. but they can backfire if imports are sufficiently "dirty" ($R_i < 0$)...



Empirical illustrations

... while demand-side policies *may* be truly complementary ($R_i > 1$)