### The Role of the Industrial Sector in Meeting California's Carbon Neutrality Goals: Incomplete Regulation and Leakage

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### Carbon neutrality in California?

- The carbon neutrality concept is gaining momentum.
- California's economy is inextricably linked to the global economy.
- A narrow focus on achieving carbon neutrality *in California* could have unintended consequences.



### **Carbon Pricing in 2018**



Source: https://carbonpricingdashboard.worldbank.org/



ETS implemented or scheduled for implementation

ETS or carbon tax under consideration

ETS implemented or scheduled, tax under consideration

- Carbon tax implemented or scheduled for implementati...
- ETS and carbon tax implemented or scheduled
  - Carbon tax implemented or scheduled, ETS under consid...

#### The global nature of climate change creates challenges for regional GHG policies that regulate only a subset of sources...

- Emissions leakage?
- Rent leakage?



Concerns about leakage loom large in debates about whether/how/when to implement regional GHG regulations.

Source: http://www.worldcementassociation.org/wca

### Leakage channels?

- Trade channel: Industrial production (and associated emissions) shifts to jurisdictions outside the reach of the regulation via trade flows
- Factor price channel: If a large open economy reduces demand for carbon-intensive inputs (e.g. fossil fuels), global input prices will fall and stimulate demand for these inputs in unregulated regions
- **Negative leakage**?: Induced innovation in low-carbon technologies can accelerate adoption in countries with low or no carbon prices.

Leakage mitigation tends to focus on the trade channel. But economic research has tried to assess all three.

## Hundreds of studies investigate impacts of asymmetric environmental regulations on industrial activity:

- Impacts on trade flows (e.g. Levinson and Taylor, 2008; Aldy and Pizer, 2015; Sato and Dechezlepretre, 2015)
- Impacts on investment/entry/exit (e.g. Hanna, 2010 ; Millimet and Roy, 2016)
- Impacts on employment (e.g. Hafstead and Williams, 2016; Kahn and Mansur, 2013)
- Impacts on innovation (e.g. Calel and Dechezlepretre, 2016)

#### Research findings (impacts of environmental regulation on industry)

- Asymmetries in environmental regulation can lead to small, statistically significant adverse effects on trade, employment, plant location, and productivity in the short run.
- The scale of these impacts has been small relative to other determinants of trade and investment choices (e.g. proximity to demand, agglomeration).
- These effects tend to be concentrated in a subset of sectors for which energy costs are significant.
- For these impacted subsectors, leakage and competitiveness impacts represent a genuine risk.

# How can we design carbon pricing programs to efficiently mitigate leakage risk?

- Leakage mitigation measures can deliver benefits... at a cost!
- Policymakers must strike a balance between achieving domestic emissions reductions and mitigating leakage.



# Output-based (free) permit allocation (a.k.a. ``benchmarking")



- Stick: Industrial producers must purchase allowances to cover GHG emissions.
- Carrot: Allowances allocated for free to industrial producers on the basis of output.

Production subsidies mitigate leakage by offsetting some share of compliance costs.

### Simulated GHG emissions leakage (Fowlie et al. 2016)

U.S. cement sector. Assumes economy-wide carbon pricing



### This leakage mitigation comes at a cost relative to **100% auctioning** (Fowlie et al. 2016)



Dilutes the carbon price signal that consumers receive Reduce the incentives for abatement in subsidized when they make their consumption decisions.

industries, shifts abatement costs to other industries.

## What output subsidy efficiently balances leakage mitigation benefits and associated costs?

emissions intensity<sub>outside</sub>  $\times$ 

 $\frac{\Delta regulated production}{\Delta``outside" production}$ 

Intuitively, we want to compensate regulated production according to the GHG emissions it displaces/reduces in jurisdictions outside the reach of our climate policy.



Output subsidy = emissions intensity<sub>outside</sub>  $\times$ 

 $\frac{\Delta \ regulated \ production}{\Delta``outside'' \ production}$ 

Source: Standard for Establishing and Assigning Benchmarks-Carbon Competitiveness Incentive Regulation Version 1.0 December 2017

### In conclusion...

- Potential for leakage is significant in some emissions intensive sectors.
- Leakage mitigation benefits come at a cost (efficient level of leakage is not zero!)
- Analysis can be extended to account for rent leakage mitigation.



Credit : Carolyn Fischer

Theoretical prescriptions are relatively clean. But real-world application is more complicated by data limitations, methodological challenges, distributional considerations.