Exporting Pollution: Where Do Multinational Firms Emit CO_2?

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*All views expressed in this paper are those of the authors and not necessarily those of Federated Hermes or EOS at Federated Hermes.

Carbon Leakage by Multinational Firms

- Variation in environmental policies across countries

- Diversity can lead to **"carbon leakage"**
  - Strategic decision whether/where to pollute

- **Multinational firms:**
  - Large economic players: Cross-border investment by multinational firms in 2017: 50% of GDP of OECD countries
  - Existing infrastructure: Low cost of shifting polluting activities
  - Activities are easy to observe

This Paper

- Study multinational firms' CO_2 emissions at home and foreign countries wrt environmental policies
  - Novel panel dataset: CO_2 emissions at firm-country-year level
  - Importance of home versus foreign environmental policies
  - Broad-brush mapping of pollution activities vs tight identification

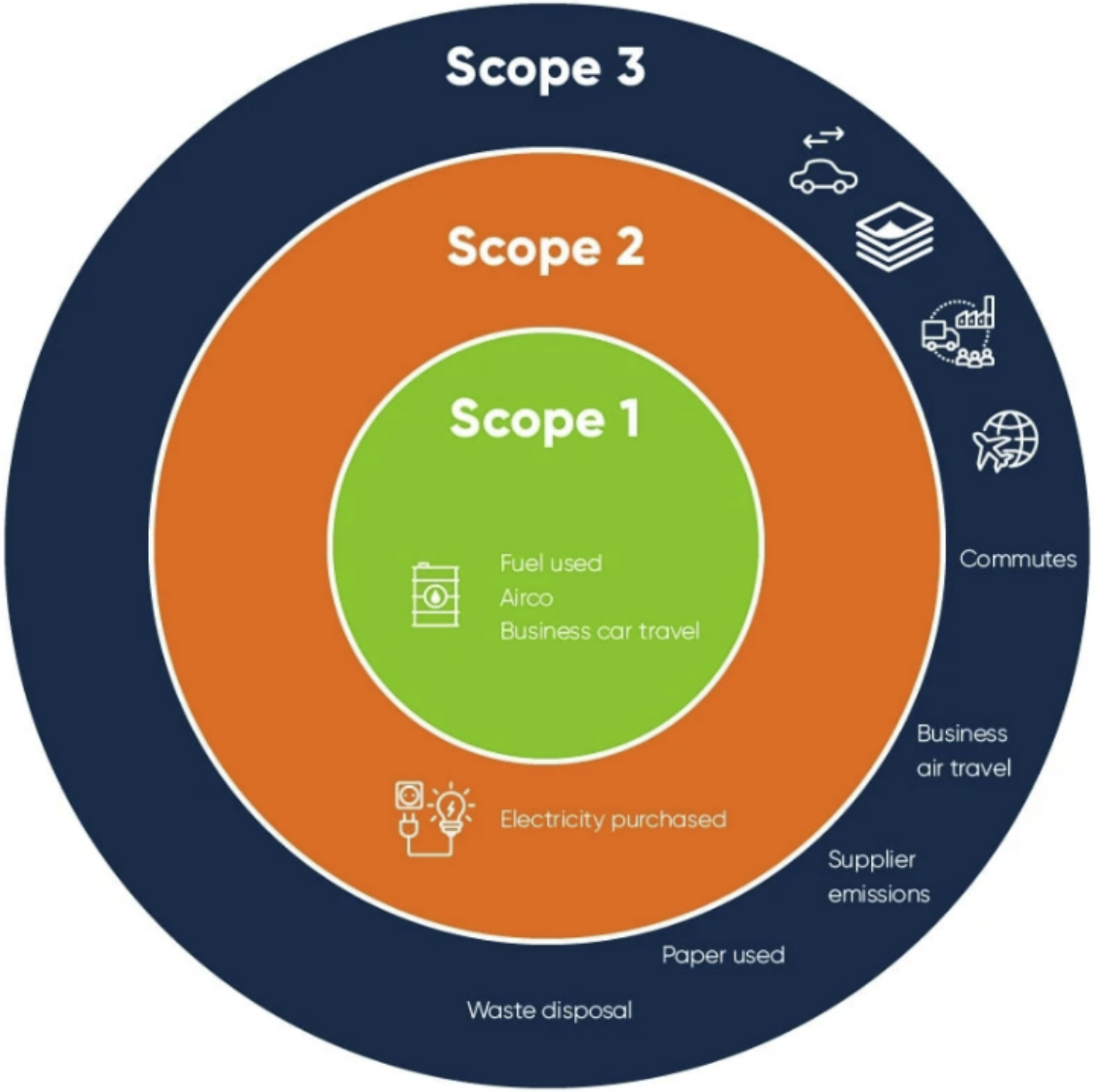
- What are the drivers of carbon leakage?
  - Push versus Pull forces
  - Spillover effect through supply chains
  - Maybe: corporate governance and industry characteristics

Summary of Findings

- Evidence of carbon leakage
  - Firms headquartered in countries with strict policies:
    - Pollute *less at home*
    - Pollute *more abroad*
    - *Outsource* polluting activities
  - Pollution abroad increases with policy gap
- Strict domestic policy is associated with *minor* impact on overall *global* pollution
- Push versus pull
  - *Strict domestic policies push* firms abroad
  - No evidence of pull effects
- More carbon leakage
  - Firms with *weak governance*
  - Not for *Pollution-intensive industries*

Firm-Country-Year Level CO_2 Emission Data

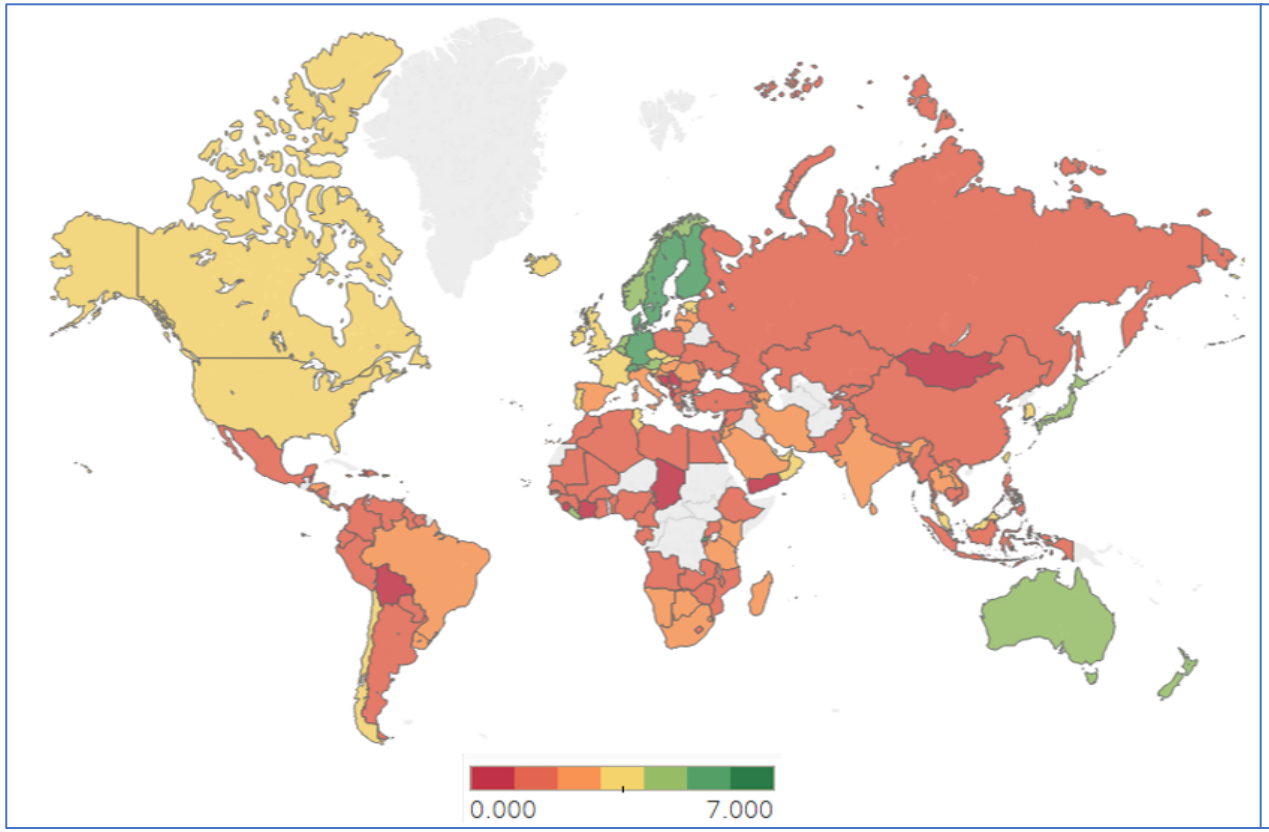
Emission Classification



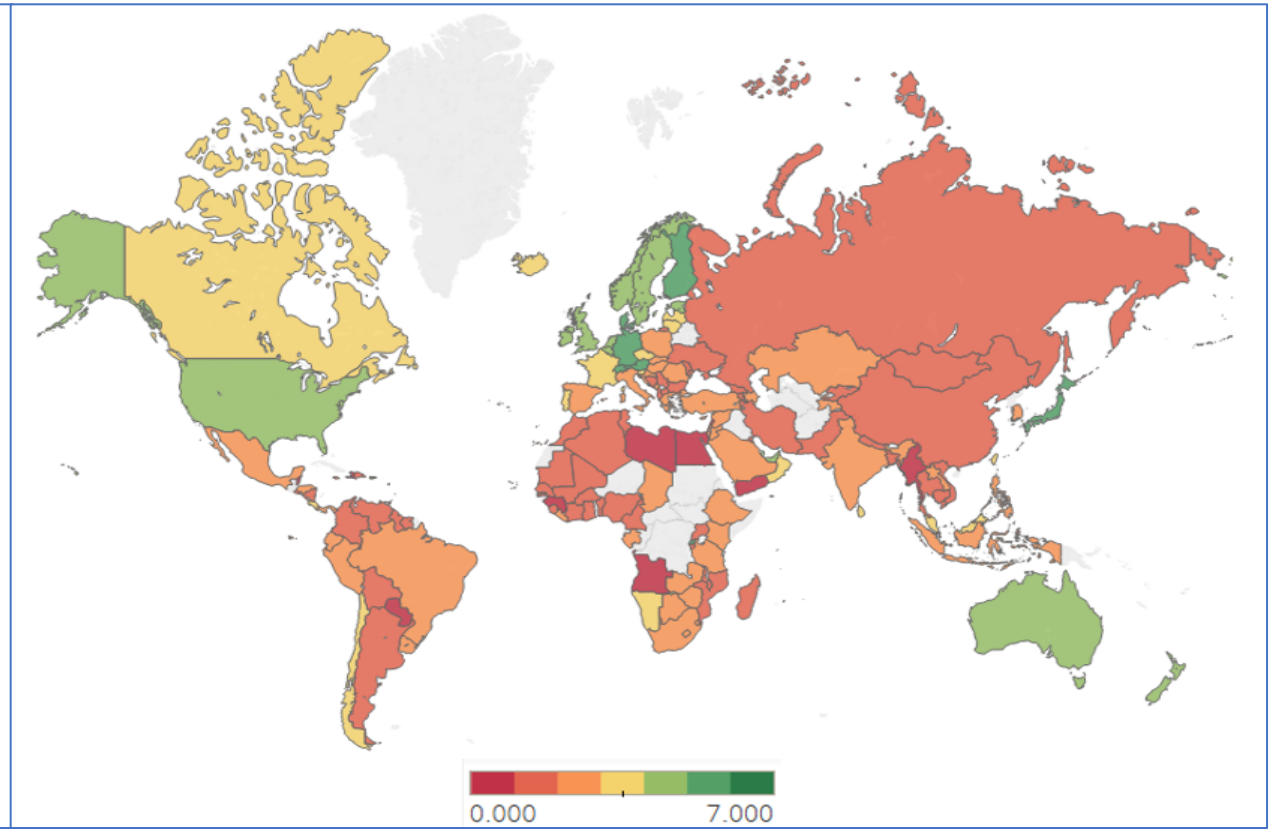
Data

- Pollution from the Carbon Disclosure Project (CDP)
  - CO_2 emissions: 1,970 public firms
  - 48 home countries; 218 foreign countries
  - Annual survey 2008-2015
  - Scope 1, Scope 2
  - Scope 3 for 40% firms, 5 years
  - Limitation: self-reported
- Environmental Regulation from the World Economic Forum (WEF)
  - Stringency, Enforcement
  - SEER = 1 to 7 (higher = stricter)

Environmental Regulation: 2008 → 2015



2008



2015

CO_2 Emissions and Environmental Policies

Scope 1 + Scope 2: Global, Home, Foreign Emissions

$$y_{it} = \beta_1 SEER_{home} + \beta_2 Controls + \sigma_{st} + \varepsilon_{it}$$

Dependent variable:	ln(1+Global emissions)		ln(1+Home emissions)		ln(1+Foreign emissions)		Foreign/global emissions	
	Scope 1	Scope 2	Scope 1	Scope 2	Scope 1	Scope 2	Scope 1	Scope 2
Specification:	OLS	OLS	Tobit	Tobit	Tobit	Tobit	Tobit	Tobit
SEER	**-0.17*** **	**-0.20*** **	**-0.38*** **	**-0.48*** **	**0.40*** **	**0.41*** **	**4.46*** **	**7.35*** **
	(-3.40)	**(-5.00)**	**(-4.24)**	**(-5.78)**	**(3.90)**	**(4.34)**	**(4.00)**	**(6.87)**
Firm & Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj/Psd R2	0.697	0.579	0.114	0.0789	0.106	0.0955	0.034	0.037
Observations	6,325	6,530	6,325	6,530	6,325	6,530	6,325	6,530

- Strict countries: Lower global emissions
- Strict countries: Lower home emissions; higher foreign emissions
- Controls: ln(Assets), Foreign asset share, ln(GDP), GDP per capita growth

Scope 1 + Scope 3: Global Emissions

$$y_{it} = \beta_1 SEER_{home} + \beta_2 Controls + \sigma_{st} + \varepsilon_{it}$$

Dependent variable:	ln(1+Scope 1)	ln(1+Scope 3)	ln(1+Scope 1 + Scope 3)
SEER	**-0.24*** **	**0.07**	**-0.12***
	(-3.75)	**(0.75)**	**(-1.94)**
Firm & Country controls	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes
Adj/Psd R2	2,426	2,426	2,426
Observations	0.737	0.417	0.638

- Consistent with firms in strict policy countries *outsource* polluting activities
- Global emissions by firms in strict policy countries do not decline as much
- Caveat: Scope 3: 40% of firms; 2009-2012; non-standardized definition

Where Do Firms Emit CO_2?

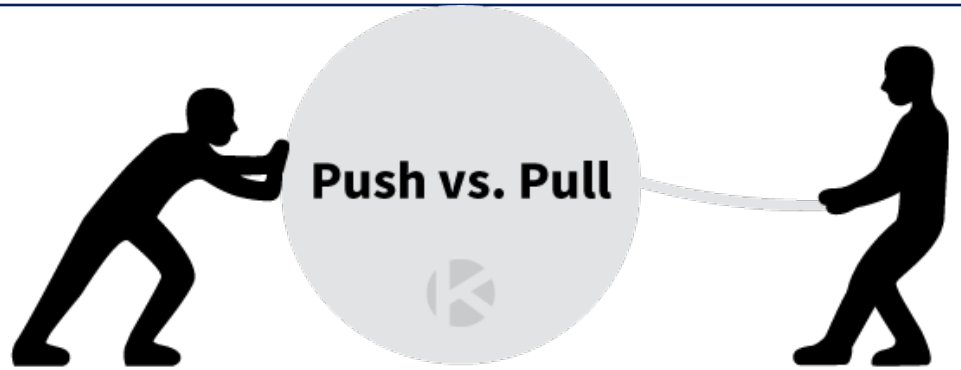
$$y_{ict} = \beta_1(SEER_{home} - SEER_{foreign}) + \beta_2 Controls + \sigma_{st} + \pi_c + \theta_h + \varepsilon_{ict}$$

Dependent variable:	ln(1+Foreign emissions)		Foreign/global emissions (%)	
	Scope 1	Scope 2	Scope 1	Scope 2
Specification:	OLS	OLS	Tobit	Tobit
$SEER_{home}$ - $SEER_{foreign}$	**0.40*** **	**0.55*** **	**0.47*** **	**0.52*** **
	(2.93)	**(3.02)**	**(3.78)**	**(3.22)**
Firm & Country controls	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes
Foreign country	Yes	Yes	Yes	Yes
Home country	Yes	Yes	Yes	Yes
Adj/Psd R2	0.203	0.182	0.208	0.186
Observations	671,717	671,717	689,448	689,448

- Firm-HomeCountry-TargetCountry-Year data
- Emissions increase in country policy gap

Economic Mechanisms

Economic Mechanism 1: Push versus Pull



Strict domestic policies "push away" firms to pollute abroad as reducing emissions might be costly and require investment in resources

Foreign countries with lenient environmental policies "attract" pollution from firms in countries with stricter regulations

- Specification style Khwaja and Mian (2008):
  - Push: $y_{ict} = \gamma_1 SEER_{home} + \gamma_2 Controls + \sigma_{st} + \pi_{ct} + \theta_h + \varepsilon_{ict}$
  - Pull: $y_{ict} = \delta_1 SEER_{foreign} + \delta_2 Controls + \sigma_{st} + \pi_c + \theta_{ht} + \varepsilon_{ict}$

Evidence for "Push Effect"

$$y_{ict} = \gamma_1 SEER_{home} + \gamma_2 Controls + \sigma_{st} + \pi_{ct} + \theta_h + \varepsilon_{ict}$$

Dependent variable:	ln(1+Foreign		Foreign/global emissions (%)	
	Scope 1	Scope 2	Scope 1	Scope 2
Specification:	OLS	OLS	Tobit	Tobit
$SEER_{home}$	**1.03*** **	**1.26*** **	**1.48*** **	**1.61*** **
	(4.61)	**(4.22)**	**(7.42)**	**(5.54)**
Firm & Country controls	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes
Foreign country × Year	Yes	Yes	Yes	Yes
Home country	Yes	Yes	Yes	Yes
Pseudo R2	0.203	0.182	0.208	0.186
Observations	671,717	671,717	689,448	689,448

No Evidence for "Pull Effect"

$$y_{ict} = \gamma_1 SEER_{home} + \gamma_2 Controls + \sigma_{st} + \pi_c + \theta_{ht} + \varepsilon_{ict}$$

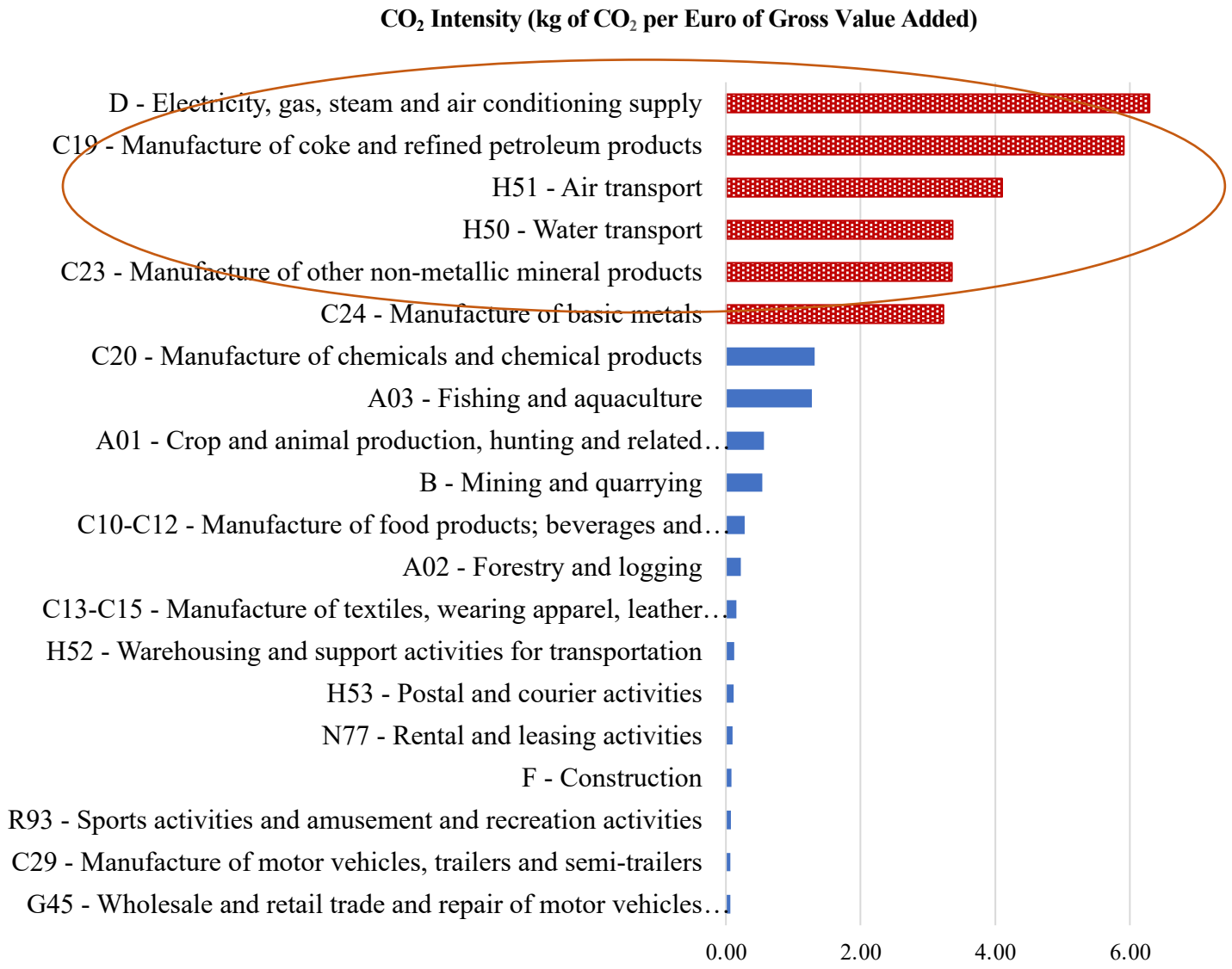
Dependent variable:	ln(1+Foreign emissions)		Foreign/global emissions	
	Scope 1	Scope 2	Scope 1	Scope 2
Specification:	OLS	OLS	Tobit	Tobit
$SEER_{foreign}$	**0.04**	**0.13**	**-0.16**	**-0.18**
	(0.30)	**(0.65)**	**(-1.22)**	**(-1.02)**
Firm & Country controls	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes
Foreign country	Yes	Yes	Yes	Yes
Home country × Year	Yes	Yes	Yes	Yes
Pseudo R2	0.203	0.182	0.209	0.187
Observations	671,717	671,717	689,448	689,448

Economic Mechanism 2: Governance, Scope 1

Dependent variable:	ln(1+Global emissions)	ln(1+Home emissions)	ln(1+Foreign emissions)	Foreign/global emissions (%)
	Scope 1	Scope 1	Scope 1	Scope 1
Specification:	OLS	OLS	Tobit	Tobit
SEER	-0.13*	-0.22*	0.41***	3.44**
	(-1.90)	(-1.95)	(2.88)	(2.51)
SEER×I(Gov score>p50)	**-0.02**	**-0.77*** **	**-0.29**	**5.42****
	(-0.12)	**(-2.66)**	**(-1.43)**	**(2.19)**
I(Strong governance)	0.15	2.87**	1.94**	-13.11
	(0.26)	(2.41)	(2.17)	(-1.27)
Firm & Country controls	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes
Adj/Psd R2	0.683	0.123	0.125	0.0616
Observations	4,376	4,376	4,376	4,376

- Thomson Reuters Asset4 database (often used by institutional investors)
- *CGVSCORE* variable: Extent to which management acts on behalf of long-term investor value
- Reverse causality?
- Scoring high on governance is associated with lower emissions, especially **at home**

Economic Mechanism 3: Pollution-Intensive Industries



Economic Mechanism 3: Pollution-Intensive Industries, Scope 1

Dependent variable:	ln(1+Global emissions)	ln(1+Home emissions)	ln(1+Foreign emissions)	Foreign/global emissions (%)
	Scope 1	Scope 1	Scope 1	Scope 1
Specification:	OLS	OLS	Tobit	Tobit
SEER	-0.20***	-0.39***	0.25**	3.76***
	(-3.23)	(-3.35)	(2.25)	(2.95)
SEER×I(Pollution Intensive)	**0.30*** **	**0.29*** **	**0.27** **	**-0.19**
	(4.94)	**(2.64)**	**(2.25)**	**(-0.15)**
Firm & Country controls	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes
Adj/Psd R2	4,559	4,559	4,559	4,559
Observations	0.668	0.111	0.125	0.0561

- Firms in pollution-intensive industries emit more, both at home and foreign countries

Conclusion

- Bad news: We find the evidence of *carbon leakage*
  - Stricter home country policies are associated with:
    - More foreign pollution
    - More upstream pollution
  - Stricter home country policies **push** firms to pollute elsewhere
  - No evidence for target countries enticing foreign firms to pollute ("pulling")
- (Little) Good news: strict domestic policies weakly reduce global emission

Our findings highlight **the importance of collective action**
to combat climate change given the global scale of firms' operations

Thank you