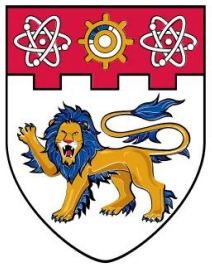
Environmental-Unfriendly Tax Avoidance

Zhimin Chen
Nanyang Technological University

Martin Jacob
IESE Business School

Xiang Zheng
Nanyang Technological University



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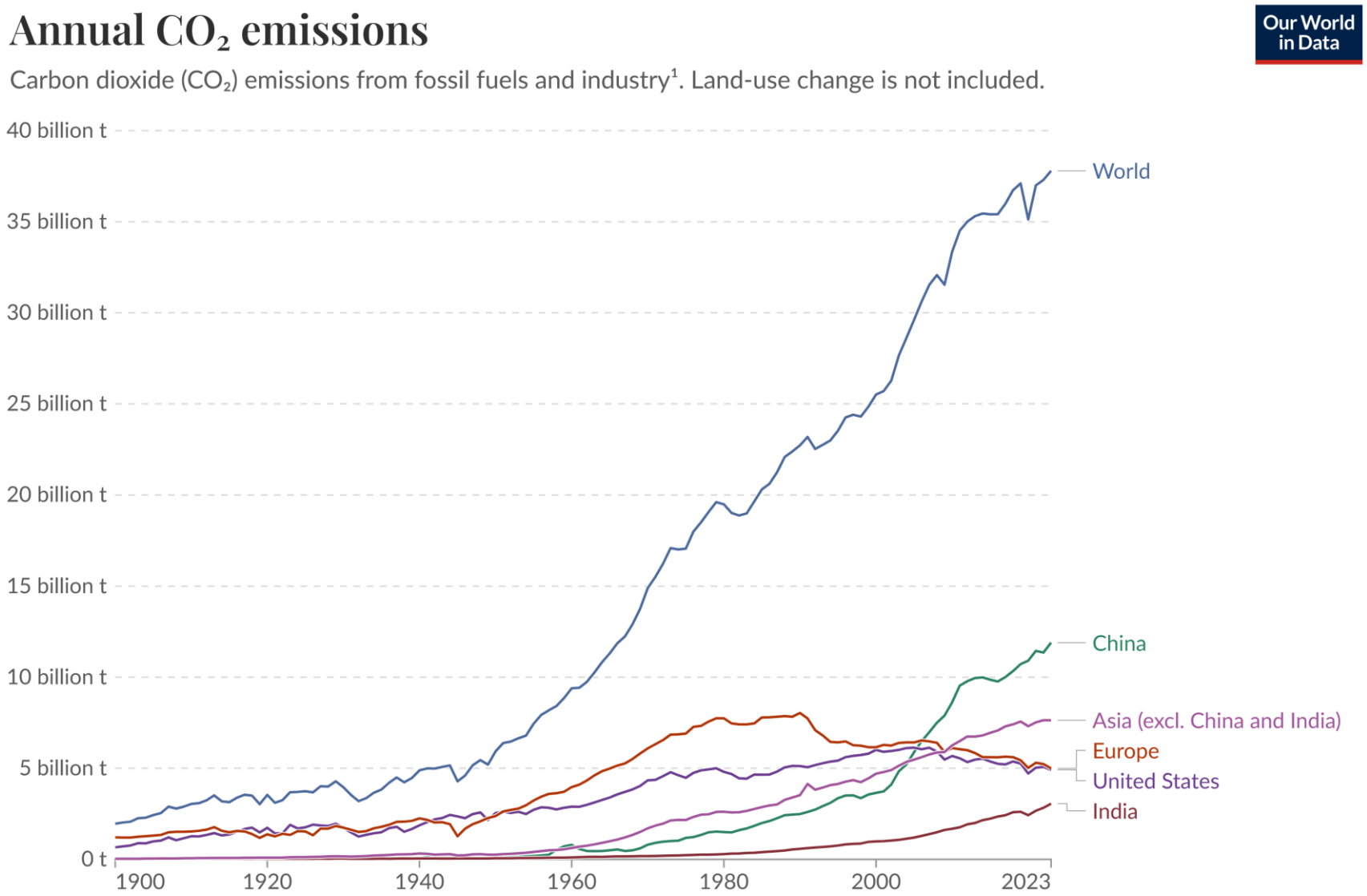
Motivation – Increasing CO_2 emissions



This paper - overview

What

We investigate profit shifting within multinational enterprises via intra-group carbon allowance trading and assesses its association with firms' green investment.

Why

- The market for allowances creates new financial instruments and cross-border transactions, which can inadvertently open channels for profit shifting.
- Unintended consequences of the cap-and-trade system
  - The EU ETS was designed to reduce carbon emissions efficiently by putting a price on carbon and creating market incentives for cleaner production.

How

- Detailed transaction-level data from EUTL
- We link transaction data to groups via LLM-assisted group affiliation check

Summary of main findings

- We find evidence of tax avoidance with carbon allowances
  - More than 1/3 of firms implements internal, cross-border trading hubs
  - Hubs are located in low-tax countries, e.g., Switzerland, Jersey or Singapore
  - Hubs have substantially lower effective tax rate
  - Many hubs in "opaque" locations → we can see their profits / activity

- Some evidence on the consequences of this tax avoidance:
  - Lower abatement investments
  - Early indication of more emissions

➢ One implication is that tax avoidance may undermine policy efforts to reduce carbon emissions via cap-and-trade systems

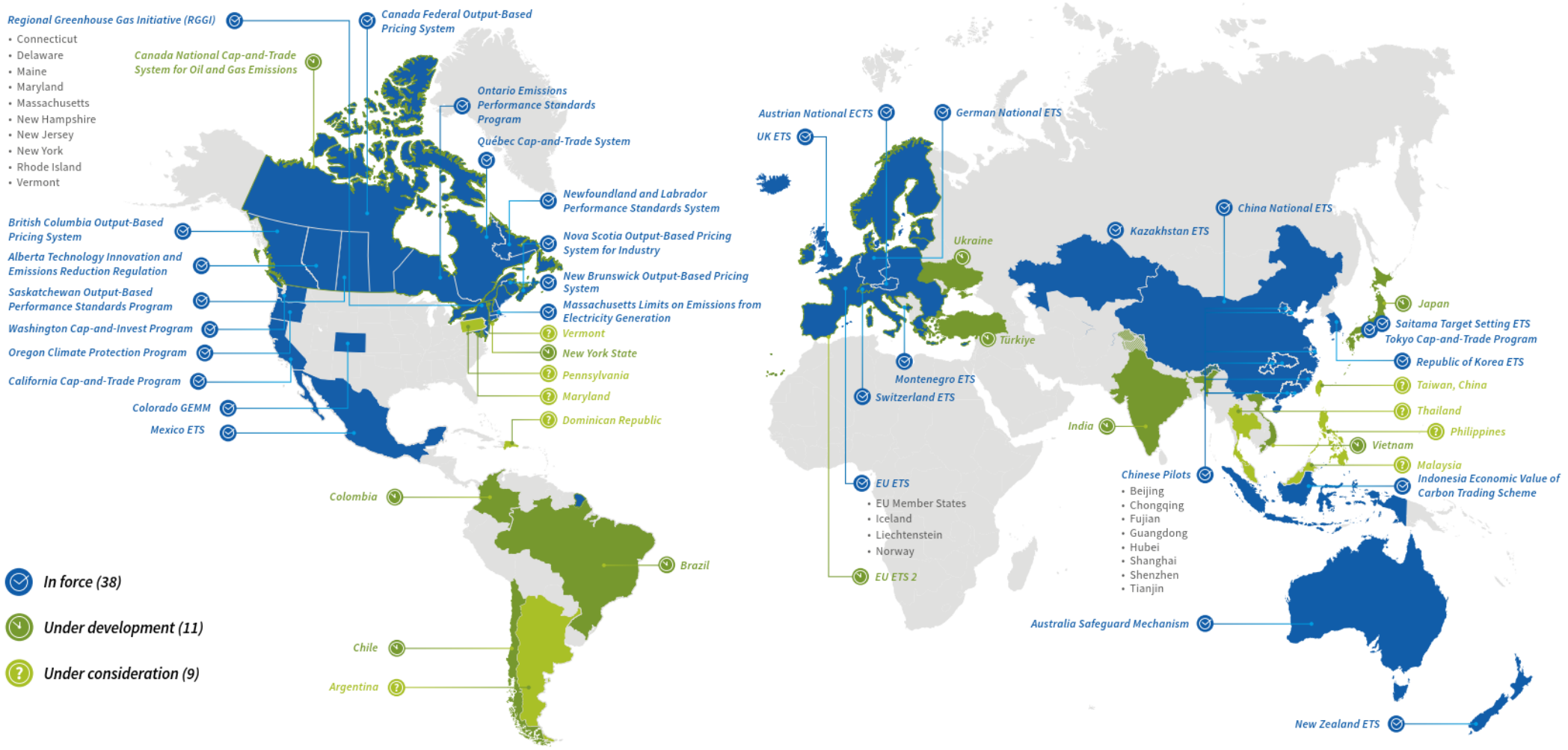
Contribution

- To the Cap-and-Trade Literature:
  - Issues of the ETS: earnings management-induced trading of carbon allowances (N'Gatta et al., 2025) as well as "carbon leakage" (see, e.g., Naegele and Zaklan, 2019; Borghesi et al., 2020; Dechezlepretre et al., 2022; Colmer et al., 2025).
  - We uncover a new unintended consequence: tax-motivated intra-group trading of carbon allowances, thereby firms can generate substantial tax savings.
  - Demonstrate that such tax-driven transactions weaken environmental incentives, reducing firms' investments in abatement technologies.
- To the Tax Avoidance Literature (e.g., Hanlon and Heitzman, 2010; Wilde and Wilson, 2018):
  - 1) Provide the first comprehensive evidence on how firms use internal cross-border carbon allowance trading as a tax avoidance mechanism.
    - Highlight a novel channel of profit shifting linked to environmental markets, extending prior work on multinational tax strategies. (e.g., Clausing, 2003; Grubert, 2003; Dischinger and Riedel, 2011; De Simone et al., 2014; De Simone and Sansing, 2019
  - 2) Move beyond determinants to document real consequences of tax avoidance (e.g., the calls in Wilde and Wilson (2018) and Jacob (2022)).
    - We show that greater tax avoidance is associated with lower green investments.

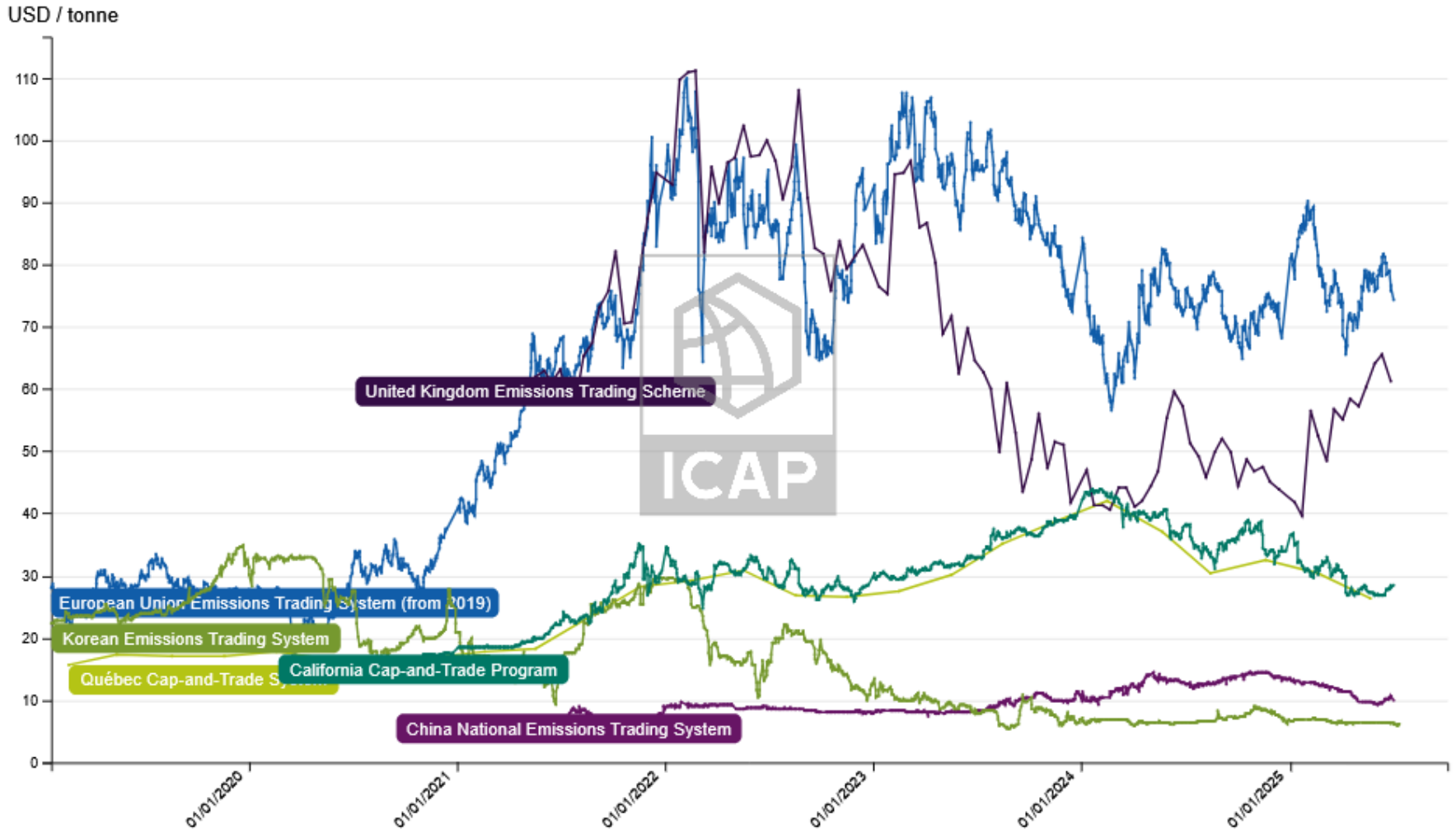
Cap-and-Trade System

- **Cap**: The EU sets a total cap on the amount of certain GHGs that can be emitted by all covered installations.
- **Allowance**: Within this cap, companies receive or buy **emission allowances** (EUAs). Each allowance permits the holder to emit **one tonne of CO_2-equivalent**.
- **Trading**: Companies can **trade allowances** — buying more if they expect higher emissions, or selling surplus ones if they reduce emissions more than required.
- **Compliance**: At the end of each year, companies must surrender enough allowances to cover their verified emissions. Those that fail to comply face heavy fines.
- Several **issues** with EU ETS: carbon leakage (e.g., Kanzig et al. 2025) and real earnings management (N'Gatta, Ormazabal, Raney 2025)

Cap-and-Trade System – Overview



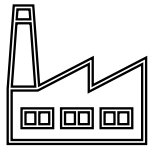
Cap-and-Trade System – Carbon Prices



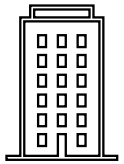
Tax Avoidance with Carbon Allowances

(Reasonable) Assumption: internal transfer is set via CUP method

Step 1: Purchase of allowance



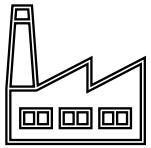
Plant



Trading Hub

Buys allowance for EUR 50

Step 2: Transfer of allowance



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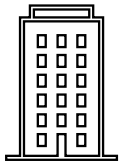


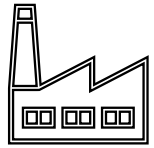
Trading Hub

Transfer of allowance (market price is EUR 70)

Profit of EUR 20

Taxed in the hub

Step 3: Surrender of allowance

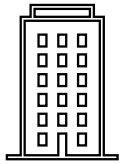


Plant

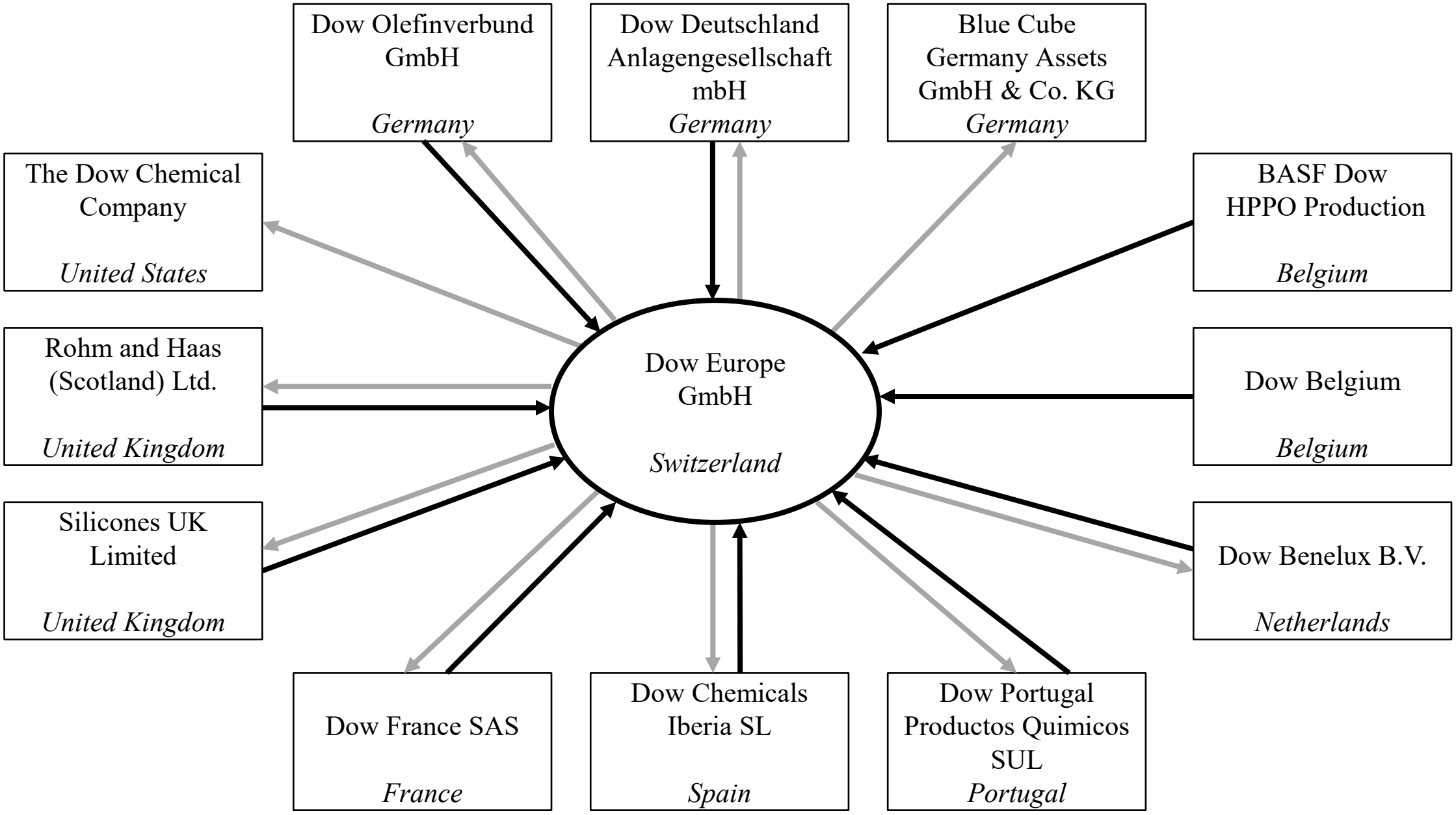
Surrender of allowance

Expense of EUR 70

Deductible in the plant



Trading Hub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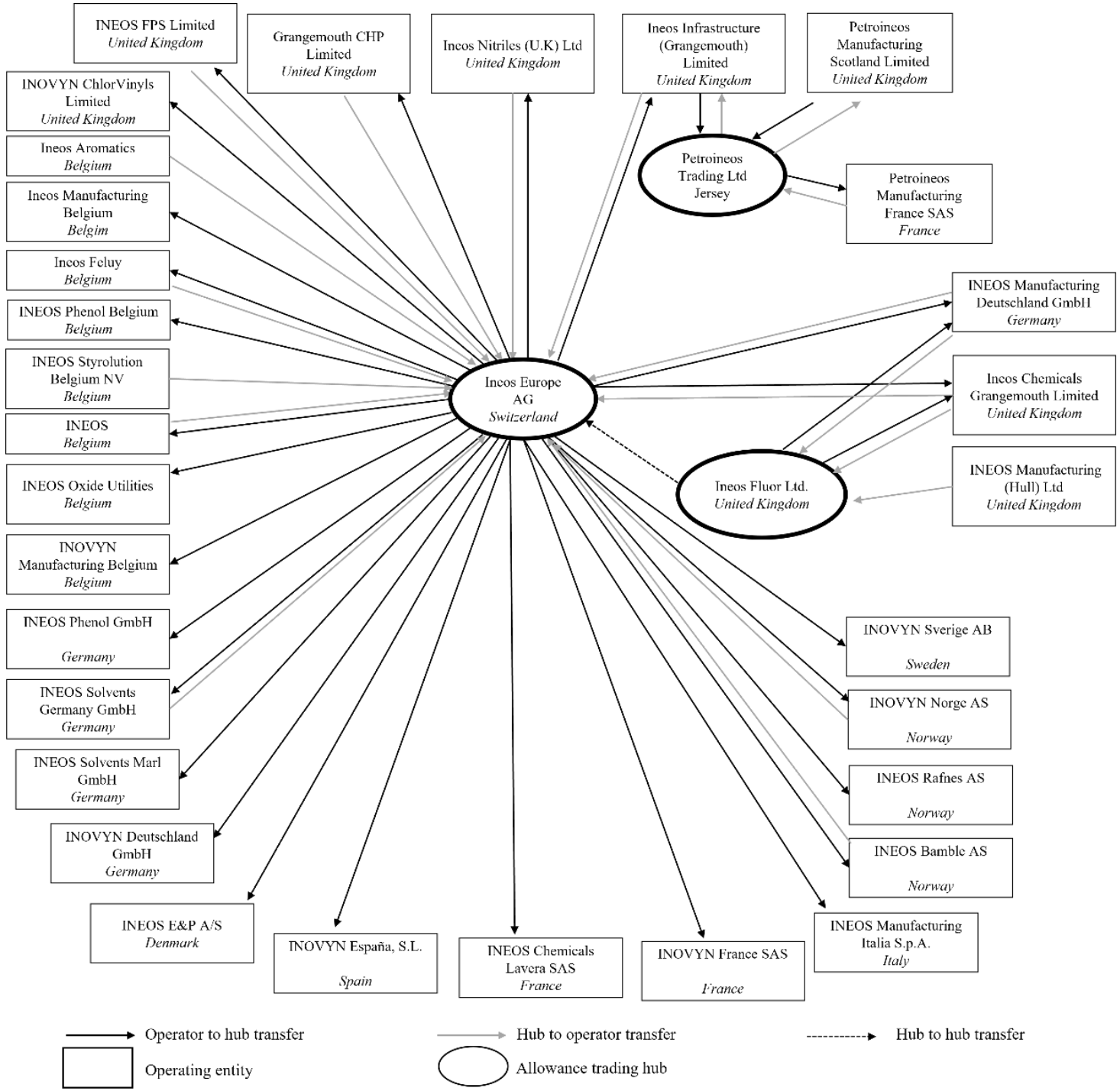
Dow Deutschland Anlagengesellschaft mbH
Germany
Blue Cube Germany Assets GmbH & Co. KG
Germany
The Dow Chemical Company
United States
BASF Dow HPPO Production
Belgium
Rohm and Haas (Scotland) Ltd.
United Kingdom
Dow Europe GmbH
Switzerland
Dow Belgium
Belgium
Silicones UK Limited
United Kingdom
Dow Benelux B.V.
Netherlands
Dow France SAS
France
Dow Chemicals Iberia SL
Spain
Dow Portugal Productos Quimicos SUL
Portugal
Operator to hub transfer
Hub to operator transfer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Grangemouth CHP Limited
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Ineos Nitriles (U.K) Ltd
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Ineos Infrastructure (Grangemouth) Limited
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Petroineos Manufacturing Scotland Limited
United Kingdom
INOVYN ChlorVinyls Limited
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Ineos Aromatics
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Ineos Manufacturing Belgium
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Ineos Feluy
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INEOS Phenol Belgium
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INOVYN Manufacturing Belgium
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INEOS Phenol GmbH
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INEOS Solvents Germany GmbH
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INEOS Solvents Marl GmbH
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INOVYN Deutschland GmbH
Germany
INEOS E&P A/S
Denmark
INOVYN España, S.L.
Spain
INEOS Chemicals Lavera SAS
France
INOVYN France SAS
France
INEOS Manufacturing Italia S.p.A.
Italy
Petroineos Trading Ltd
Jersey
Petroineos Manufacturing France SAS
France
Ineos Europe AG
Switzerland
Ineos Fluor Ltd.
United Kingdom
INEOS Manufacturing Deutschland GmbH
Germany
Ineos Chemicals Grangemouth Limited
United Kingdom
INEOS Manufacturing (Hull) Ltd
United Kingdom
INOVYN Sverige AB
Sweden
INOVYN Norge AS
Norway
INEOS Rafnes AS
Norway
INEOS Bamble AS
Norway
Operator to hub transfer
Hub to operator transfer
Hub to hub transfer
Operating entity
Allowance trading hub

Our Agenda

- Uncover the mechanism how firms avoid taxes via carbon allowance transactions

- Evaluate the aggregate size and consequences of profit shifting via internal carbon trading

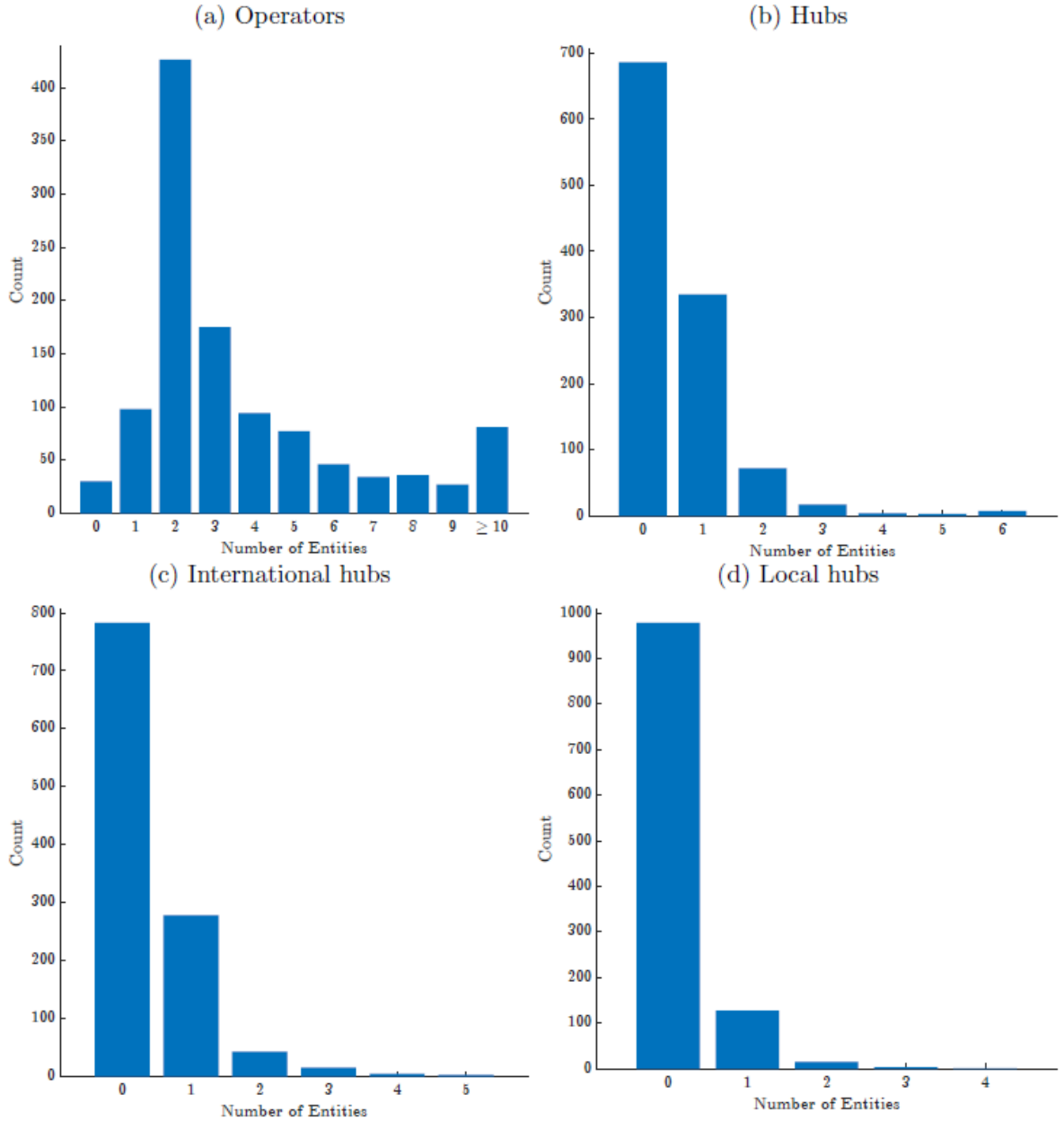
Empirical Strategy

- Our paper is of a **descriptive** nature
- **Data source:** EUTL (all carbon allowance transactions)
- **Hub definition:** No free allocation or verified surrender
- **Hub type:** International (>50% cross-border volume); Local otherwise
- **Key challenge: Identification of ownership links via** Orbis + LLM (to detect missing group relationships)

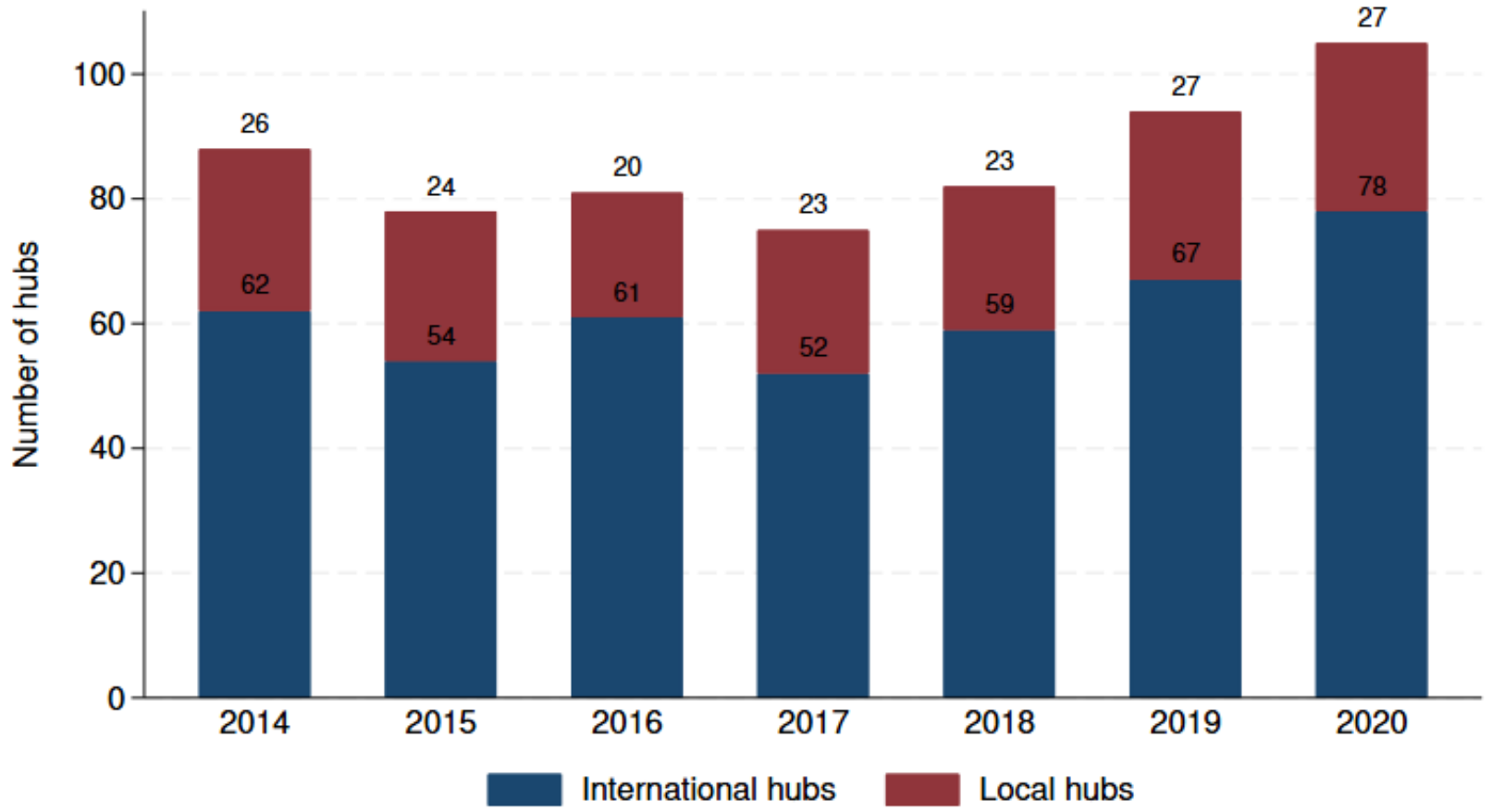
Key item of our approach: Matching EUTL with ownership information

- **The key problem:** linking the names of sellers and buyers in the EUTL to the respective group (or MNE)
- Usual solution: Orbis ownership (and match via names)
- However, more than a third of the buyer-seller pairs cannot be identified in Orbis (and there might be errors on top of that)
- Hence, we adopt a three-step approach:
  1. Heuristic Screening via Large Language Models (ChatGPT & Deepseek)
  2. Evidence-Based Verification (to reduce "hallucinations")
  3. Manual Verification of
     I. cases where a single entity appears with multiple global ultimate owners
     II. cases where GPT and DeepSeek produce conflicting classifications
     III. 10% random sample of the remaining observations.

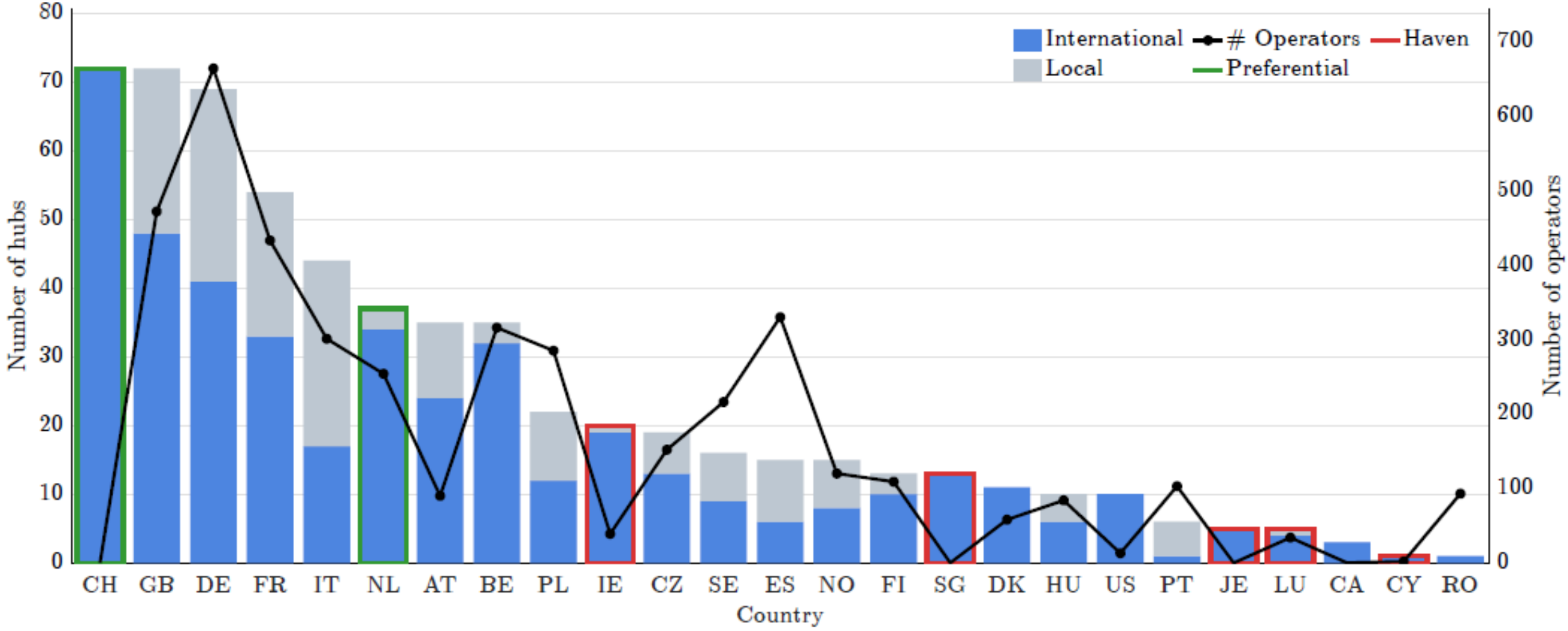
Number of Hubs / Operators



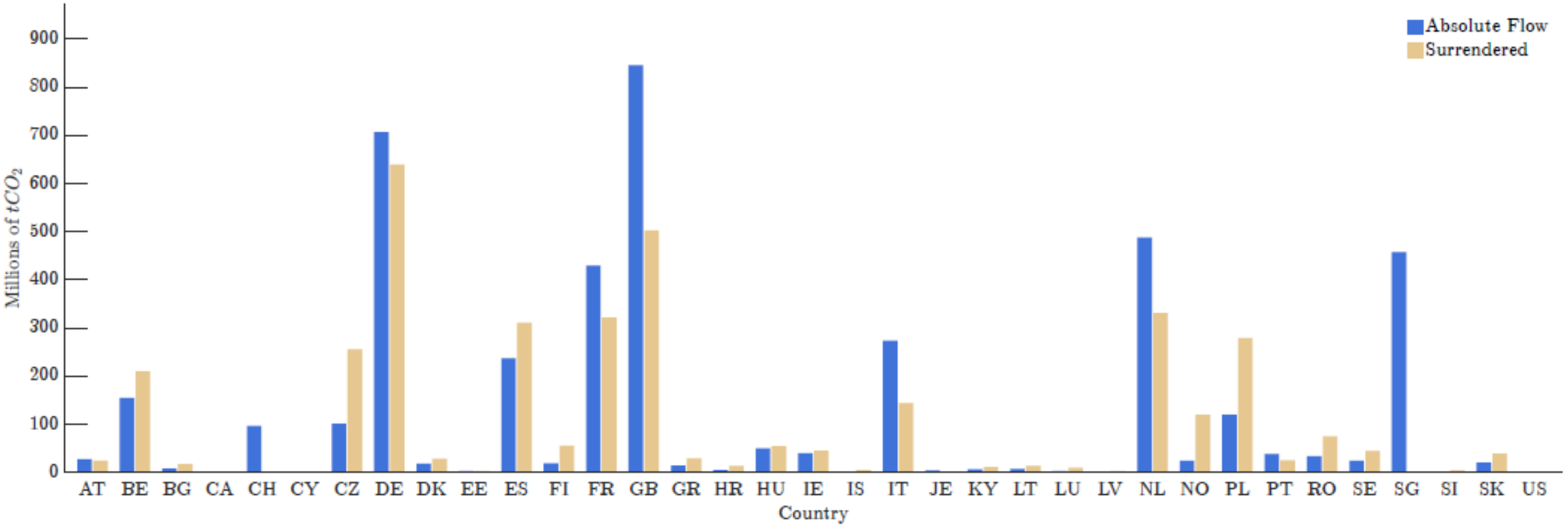
Number of Hubs over Time



Location of Hubs & Operators



Traded and Surrendered Allowances by Location

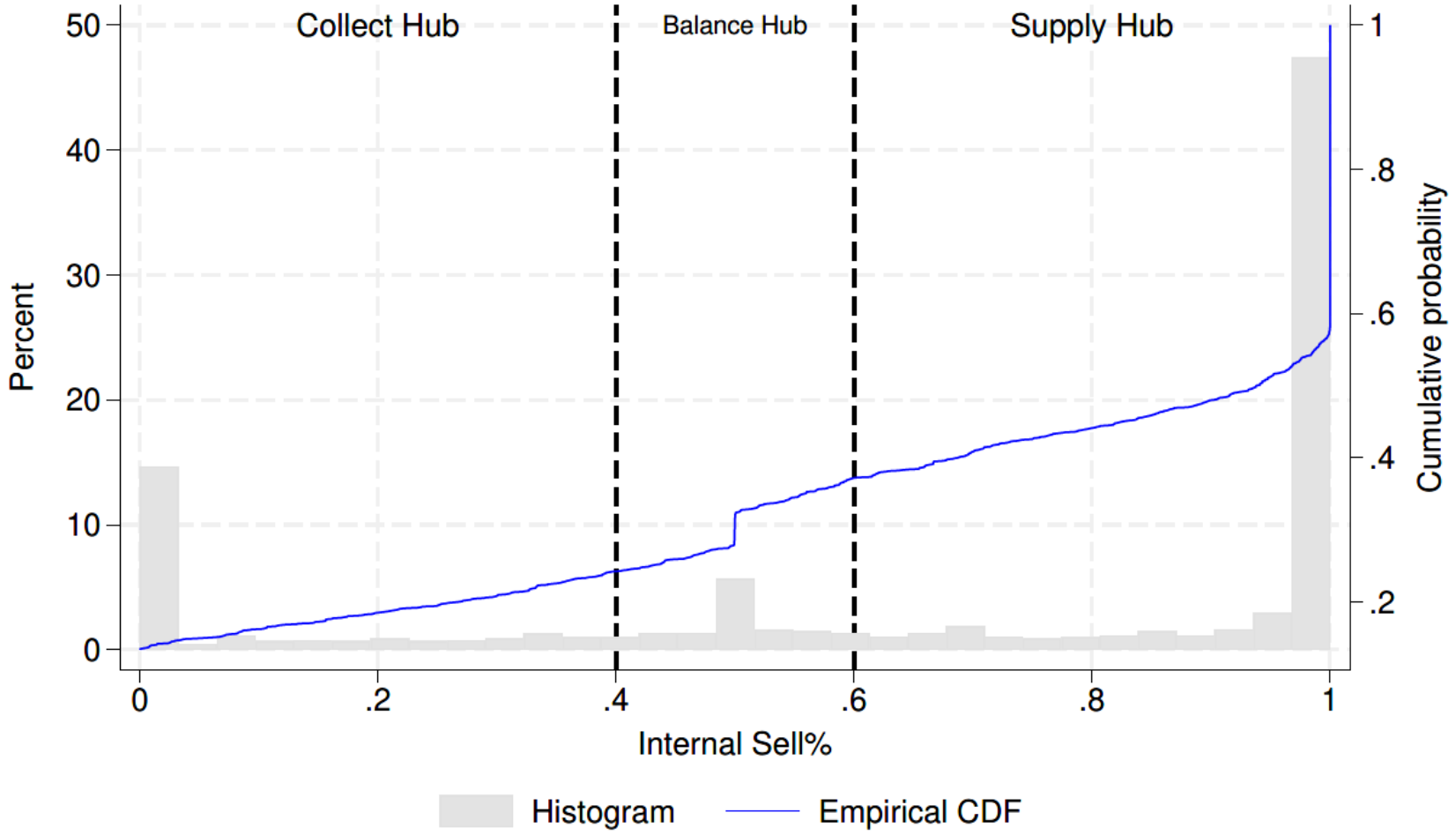


Empirical Evidence - Effective tax rate in Hubs

	Effective Tax Rate			
	(1)	(2)	(3)	(4)
Hub	-0.0696**	-0.0685**		
	(0.0277)	(0.0320)		
International Hub			-0.0746**	-0.0732**
			(0.0305)	(0.0360)
Local Hub			-0.0594	-0.0584
			(0.0364)	(0.0437)
Controls	Yes	Yes	Yes	Yes
Group FE	Yes		Yes	
Year FE	Yes		Yes	
Group × Year FE		Yes		Yes
S.E. clustered by	Subsidiary	Subsidiary	Subsidiary	Subsidiary
N	1593	1507	1593	1507
Adj. R^2	0.08	0.02	0.08	0.02

Key point: International hubs have roughly 7 percentage points lower ETRs than affiliated operating entities.

A second classification of hubs



Empirical Evidence - Effective tax rate in Hubs

	Effective Tax Rate		
	(1)	(2)	(3)
Collect Hub	-0.0245	-0.0497	-0.0410
	(0.0388)	(0.0414)	(0.0507)
Balance Hub	-0.1055***	-0.1117***	-0.1406***
	(0.0280)	(0.0319)	(0.0327)
Supply Hub	-0.0518*	-0.0564*	-0.0425
	(0.0295)	(0.0311)	(0.0365)

Key point: Balance hubs show the strongest ETR discount, consistent with tax-motivated round-trip trading.

Empirical Evidence - Effective tax rate in Hubs

	Effective Tax Rate		
	(1)	(2)	(3)
Collect × International Hub	-0.0321	-0.0603	-0.0502
	(0.0401)	(0.0457)	(0.0555)
Collect × Local Hub	0.0077	-0.0071	0.0020
	(0.1043)	(0.0775)	(0.1058)
Balance × International Hub	-0.1161***	-0.1201***	-0.1447***
	(0.0256)	(0.0328)	(0.0391)
Balance × Local Hub	-0.0894*	-0.0984**	-0.1338***
	(0.0538)	(0.0488)	(0.0426)
Supply × International Hub	-0.0584*	-0.0589*	-0.0475
	(0.0311)	(0.0334)	(0.0393)
Supply × Local Hub	-0.0440	-0.0539	-0.0352
	(0.0464)	(0.0464)	(0.0576)

Key point: International balance hubs have the largest ETR gap, reaching about 12-15 percentage points.

The hidden hubs: We can observe their trading

	Tax Rate		*Carbon Profit*	
	(1)	(2)	(3)	(4)
Opaque Hub	-0.0352***	-0.0358***	2.8065***	2.9599***
	(0.0111)	(0.0118)	(0.4988)	(0.5482)
Transparent Hub	0.0003	0.0004	1.4685***	1.4740***
	(0.0075)	(0.0081)	(0.3169)	(0.3513)
Group FE	Yes		Yes	
Year FE	Yes		Yes	
Group × Year FE		Yes		Yes
S.E. clustered by	Subsidiary	Subsidiary	Subsidiary	Subsidiary
N	2675	2672	2675	2672
Adj. R^2	0.24	0.18	0.12	0.02
p (Opaque Hub = Transparent Hub)	0.004	0.007	0.017	0.018
F (Opaque Hub = Transparent Hub)	8.261	7.366	5.695	5.614

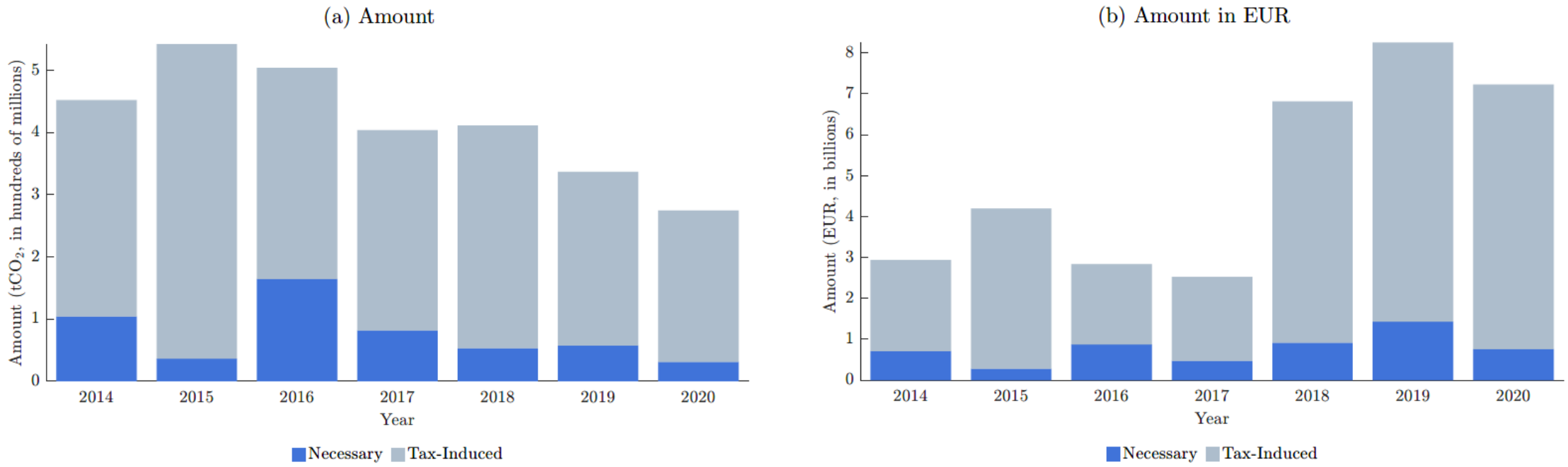
Key point: Opaque hubs sit in lower-tax countries and route about twice the carbon profit of transparent hubs.

Flow of Carbon Allowances Among Operators

	Inbound Profit Share				
	(1)	(2)	(3)	(4)	(5)
Asset	0.0037***	0.0036***	0.0040***	0.0037**	0.0050
	(0.0013)	(0.0013)	(0.0015)	(0.0015)	(0.0049)
ROA (Exclude Carbon)	-0.0689***	-0.0659***	-0.0694***	-0.0649***	-0.0504***
	(0.0198)	(0.0205)	(0.0203)	(0.0205)	(0.0142)
Leverage	-0.0173***	-0.0154**	-0.0151**	-0.0129*	-0.0331***
	(0.0062)	(0.0062)	(0.0067)	(0.0067)	(0.0109)
Tangible Ratio	-0.0193**	-0.0185**	-0.0218**	-0.0200**	-0.0047
	(0.0077)	(0.0077)	(0.0087)	(0.0088)	(0.0187)
Tax Rate	-0.0104	0.0295	-0.0152	-0.0613	-0.0741
	(0.0190)	(0.1555)	(0.0208)	(0.2184)	(0.0739)
Surrender–Allocation Gap	-0.0057***	-0.0048***	-0.0059***	-0.0049***	0.0017
	(0.0010)	(0.0010)	(0.0012)	(0.0012)	(0.0046)
Constant	-0.0483**	-0.0578	-0.0530*	-0.0389	-0.0639
	(0.0245)	(0.0480)	(0.0275)	(0.0660)	(0.1000)

Key point: Operator-to-operator flows help separate compliance-driven allowance needs from tax-induced flows.

Aggregate Size of tax induced trading



Group-level tests - Effective tax rates

	3-year Cash ETR		
	(1)	(2)	(3)
Shifted Profit Share	-0.1149***	-0.1128***	-0.1481***
	(0.0414)	(0.0415)	(0.0466)
Sample	All	Ever	CDP
Controls	Yes	Yes	Yes
Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
S.E. clustered by	Group	Group	Group
N	1411	928	556
Adj. R^2	0.50	0.53	0.52

Key point: More shifted profit today predicts lower cash ETRs over the next three years.

Group level findings - Abatement investment (or green investment)

	3-year Scope 1 Abatement			*3-year Scope 1-3 Abatement*		
	(1)	(2)	(3)	(4)	(5)	(6)
Shifted Profit Share	-0.0269*	-0.0257**	-0.0242*	-0.0284*	-0.0278*	-0.0274*
	(0.0140)	(0.0129)	(0.0127)	(0.0155)	(0.0144)	(0.0144)
Sample	All	Ever	Current	All	Ever	Current
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Group FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
S.E. clustered by	Group	Group	Group	Group	Group	Group
N	933	650	424	933	650	424
Adj. R^2	0.49	0.47	0.44	0.53	0.53	0.51

Key point: Higher profit shifting is followed by lower decarbonization investment.

Group level findings - Carbon allowance surrenders in the EU

	3-year Verified Emissions		
	(1)	(2)	(3)
Shifted Profit Share	0.1205	0.1431*	0.1810*
	(0.0854)	(0.0804)	(0.0993)
Sample	All	Ever	Current
Controls	Yes	Yes	Yes
Group FE	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes
S.E. clustered by	Group	Group	Group
N	720	518	353
Adj. R^2	0.90	0.97	0.96

Key point: Profit shifting is positively associated with future verified emissions, though this evidence is less precise.

Summary

- We examine how MNEs use internal carbon allowance trading to shift profits from high-tax to low-tax jurisdictions.
- Findings:
  - 35% of the MNEs operate internal trading hubs.
    - Many of these hubs are located in low-tax countries such as Switzerland.
  - These trading hubs play a significant role in facilitating tax avoidance.
    - Some hubs more than the others: international hubs, balance hubs, & opaque hubs.
  - The tax-induced intra-group cross-border transactions undermine the environmental incentives built into the cap-and-trade system.

Takeaways

- Takeaways for researchers
  - Multinational firms exploit the EU ETS for tax avoidance through intra-group cross-border trading, reducing incentives to invest in abatement technologies.

- Policy implication
  - Aligning the tax treatment of carbon allowances with the objectives of cap-and-trade systems is essential to prevent fiscal arbitrage from undermining both tax revenues and the effectiveness of climate policy.

Thank you!

Backup - Determinants of Hub Usage

	Hub existence			*Hub counts*		
	Hub	International	Balance	Hub	International	Balance
	(1)	(2)	(3)	(4)	(5)	(6)
Asset	0.4428***	0.4216***	0.5527***	0.4388***	0.4396***	0.6706***
	(0.0478)	(0.0537)	(0.1021)	(0.0455)	(0.0484)	(0.0919)
ROA	-9.0956***	-8.7960***	-10.0942***	-7.4672***	-6.3454***	-9.7430***
	(1.3172)	(1.4819)	(2.5949)	(0.9282)	(1.1751)	(1.7331)
Leverage	-0.5424	0.5011	1.8332	-1.1046***	-0.7140*	-0.3983
	(0.6187)	(0.6869)	(1.2142)	(0.3631)	(0.4219)	(0.6665)
Cash	-1.2535	-1.3298	3.9427*	1.5261	0.9949	4.2079***
	(1.1898)	(1.3460)	(2.3565)	(0.9729)	(1.2710)	(1.6135)
Constant				11.3217***	11.7682***	10.0580***

Key point: Hub use is more common among larger groups and less profitable groups.