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The effects of carbon pricing along the production network

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Deglobalisation, Decarbonisation, and Digitalisation

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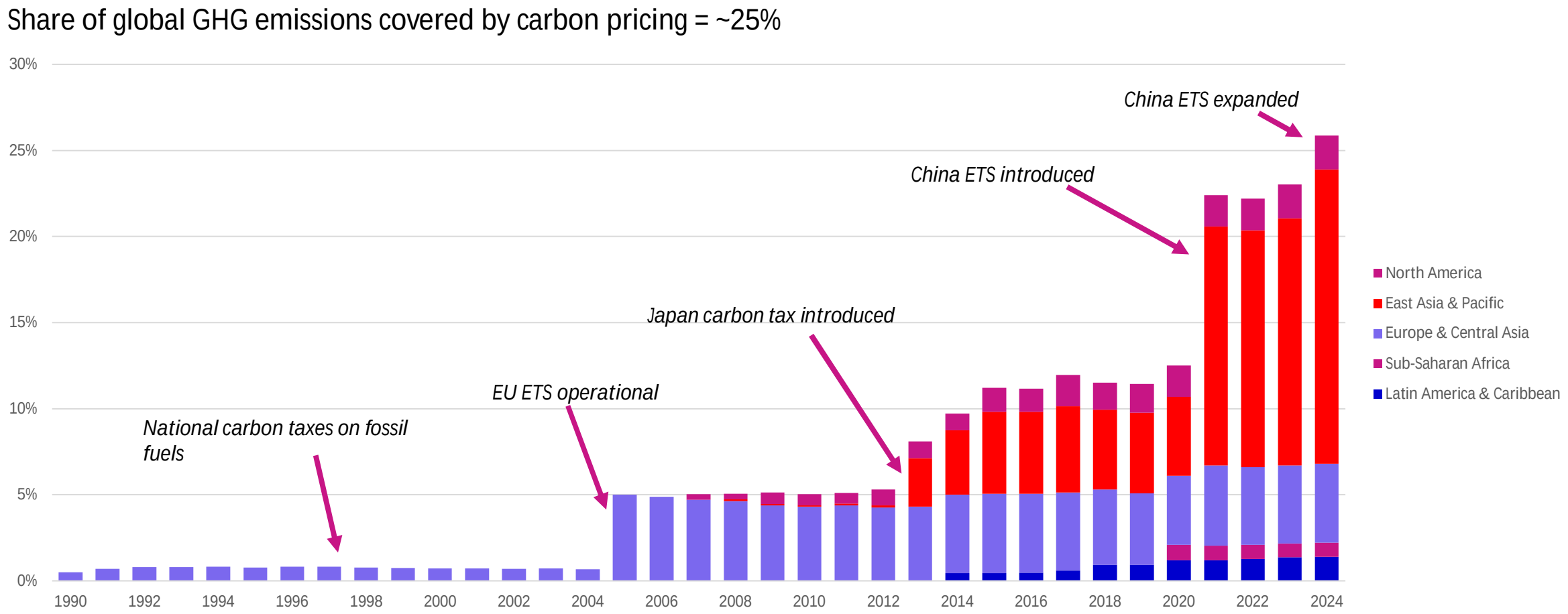
Motivation
+ research question

Motivation

Carbon Pricing - The Past



Source: World Bank, 2024.

Motivation
Carbon Pricing - The Present

75 Schemes in force: 36 ETS. 39 carbon taxes

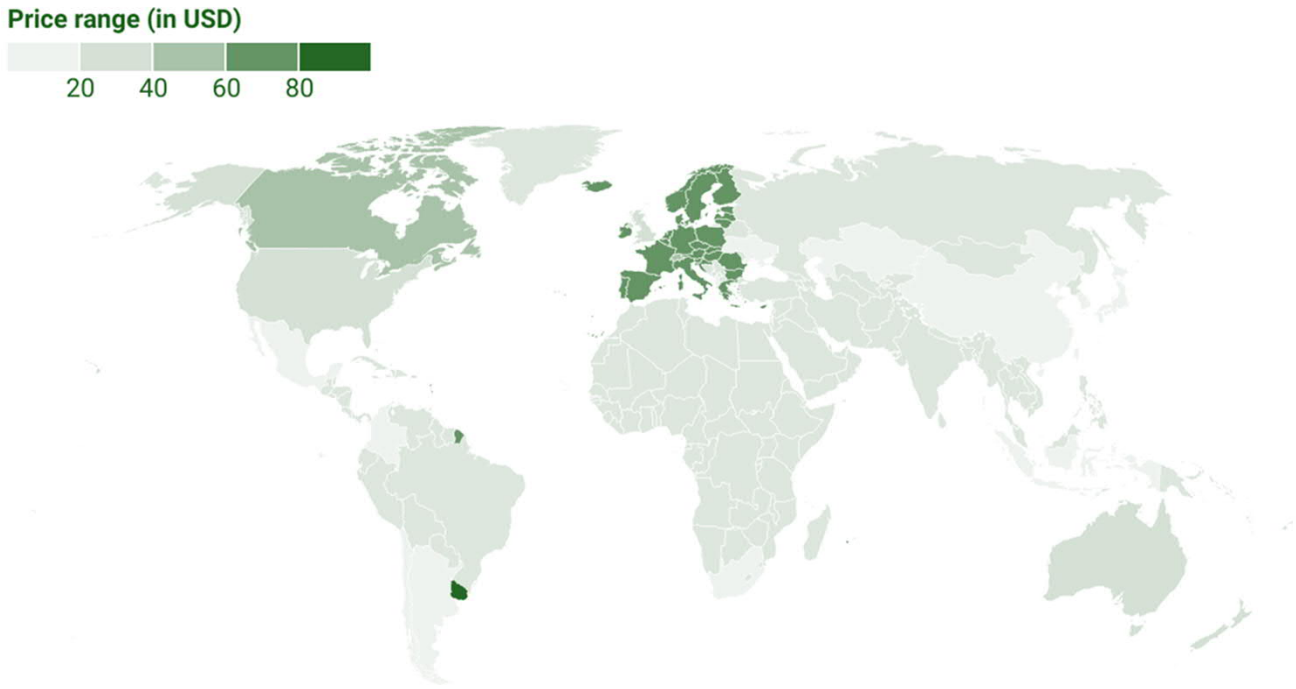
33 Schemes under development

25 % of global emissions covered: 12.8 $GtCO_2e$

1 Active border carbon scheme (EU CBAM)

8 Border carbon schemes under development
US, UK, Canada, Taiwan, Australia, South Korea, Japan, India

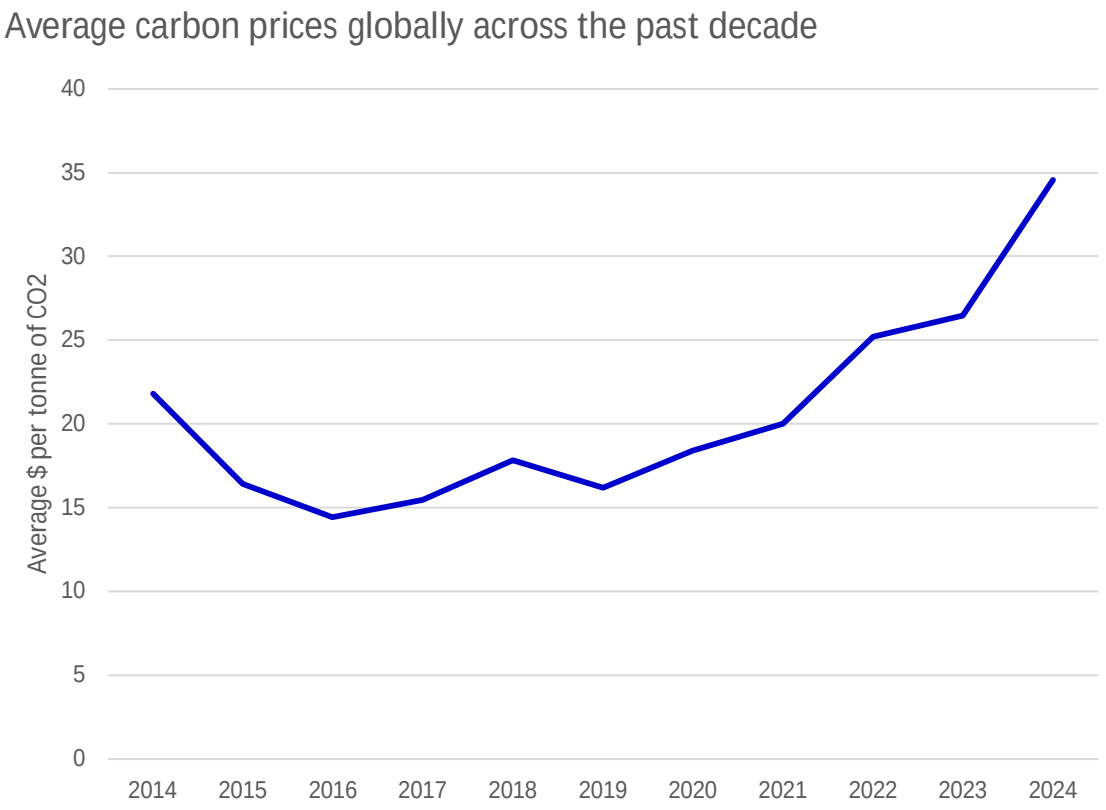
Global carbon prices, 2024-averages*



**Several jurisdictions, such as Canada, China, Mexico, and EU member states, have implemented sub-regional carbon pricing mechanisms, either alongside or instead of regional measures. US displays average price of regional schemes*

Source: ICAP (2024) & World Bank (2024)

Motivation
Carbon Pricing - The Present



Global price range of carbon

€0.41 ⟷ €151

€/tCO2e

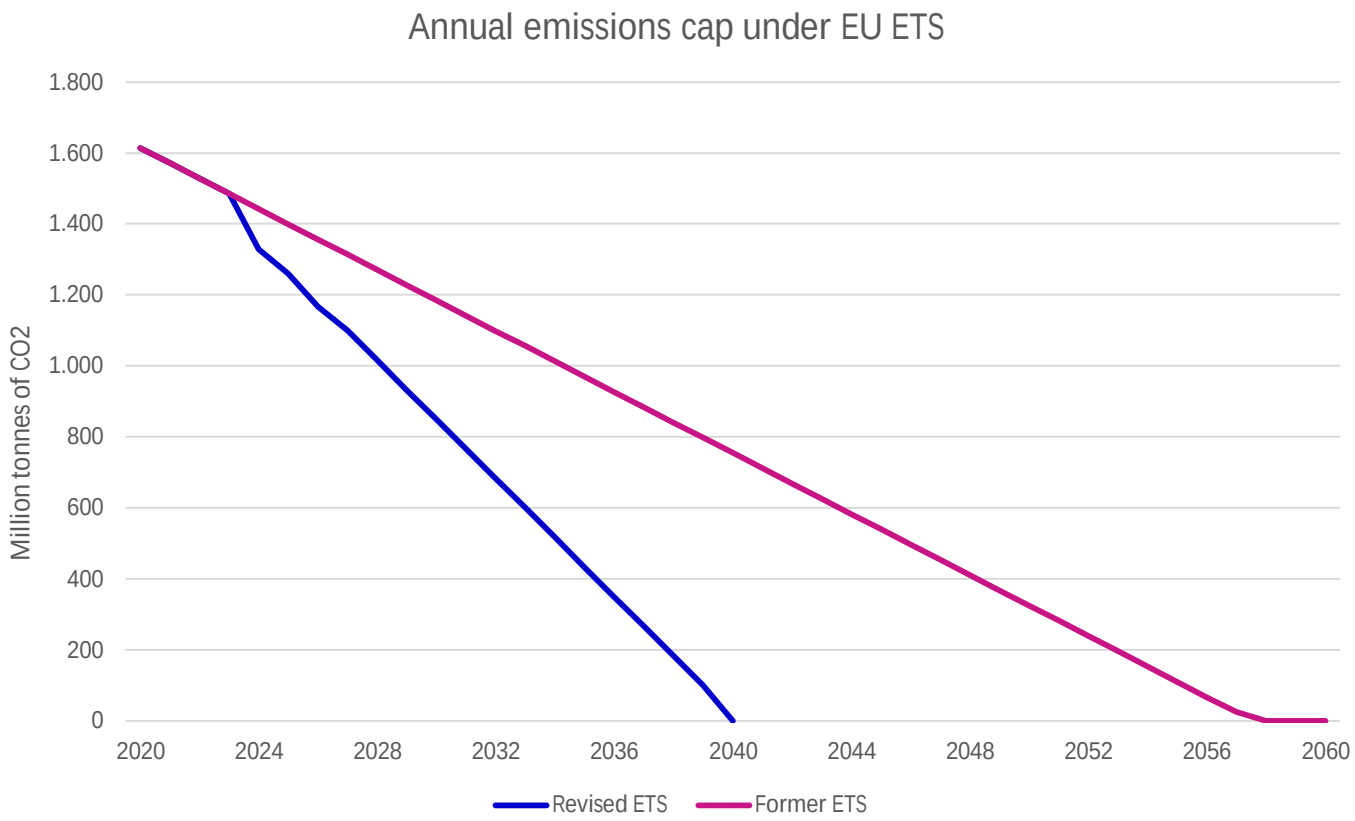
1% of global emissions priced above the recommended level – World Bank

Motivation

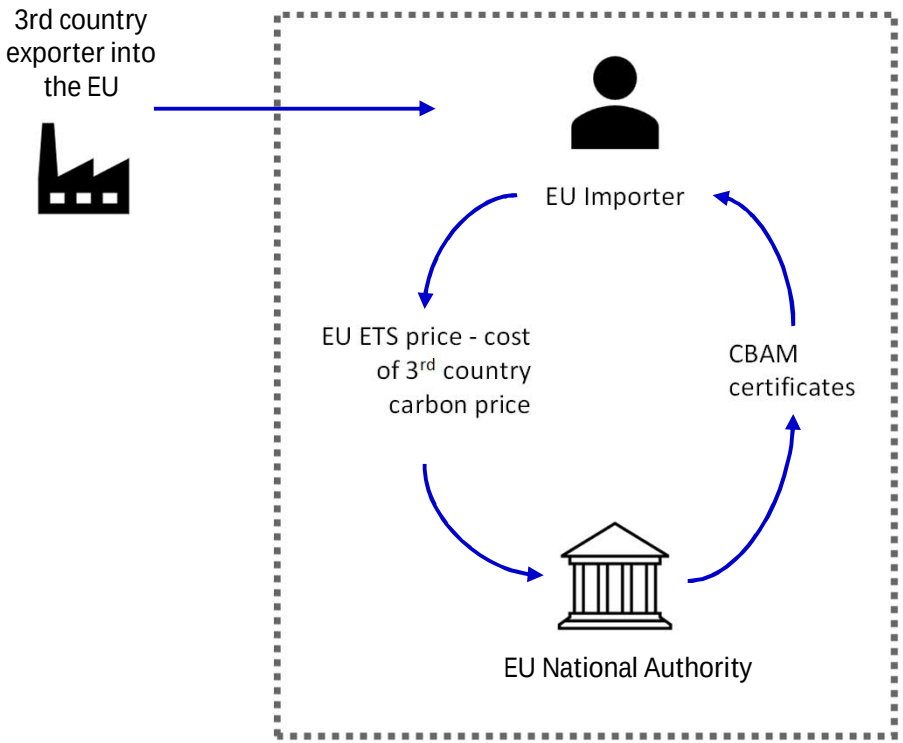
The European Union Emissions Trading System – EU ETS

Motivation
The future EU ETS

A shrinking cap…



A Carbon Border Adjustment Mechanism



Importers pay the difference in carbon price

Motivation
Many aspects still to be analysed

Many GHG emissions are not covered by carbon pricing

- What are the economic implications of incomplete carbon pricing?
- What is the reach of existing ETSs ?
- Do emissions leak to non-regulated sectors/firms?
- Who bears the cost of the policy?
- Are regulated firms just passing through its carbon cost?
- Is carbon pricing driving clean innovation and clean investment?
- Could there be better or worse ways of having ETS with limited scope? (only regulate “central” firms?)
- What will be the impact of CBAM and how should it be designed?

Research question(s)

How does the carbon price shock propagate through the production network?

How does the ETS impact the structure of the network?

Is innovation (or investment) impacted in linked firms?

Literature

Large empirical literature on the firm-level effects of carbon pricing, mostly based on the EU ETS (Colmer et al., 2024, Dechezleprêtre et al. 2018, many more)

- Emissions reductions + no competitiveness effects for firm-level outcomes
- Channels to explain the effects
- Early years of ETS, focus on treated firms

Network amplification of carbon pricing effectiveness

- Supply side production effects affect effectiveness of carbon pricing (King, Tarbush and Teytelboym, 2019)
- Positive social network effects lower the carbon tax required to achieve a given emissions target to 38% below the Pigouvian carbon tax (Konc, Savin and van den Bergh, 2021)

Production network-based research in productivity, macroeconomics and trade. (Large literature)

Data

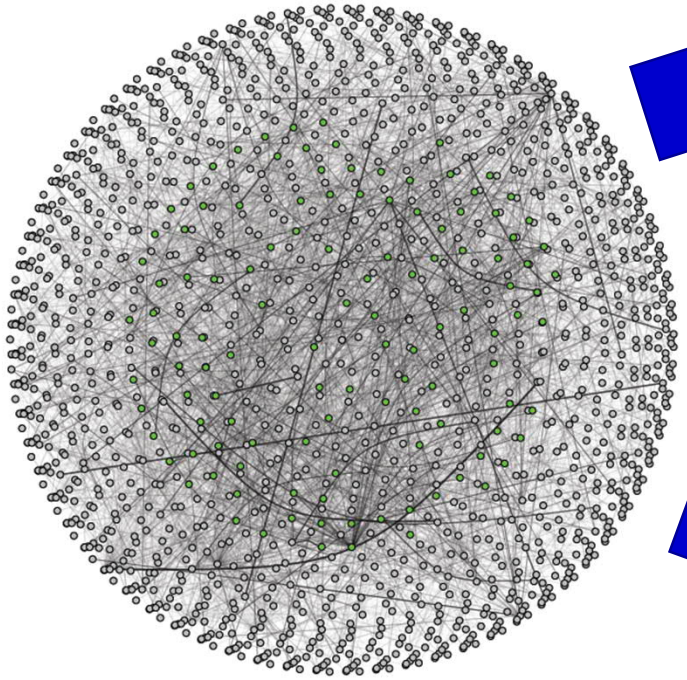
Frontier data
Datasets

Annual accounts: revenue, capital stock, employees, etc.

PATSTAT: patenting, including green vs. brown

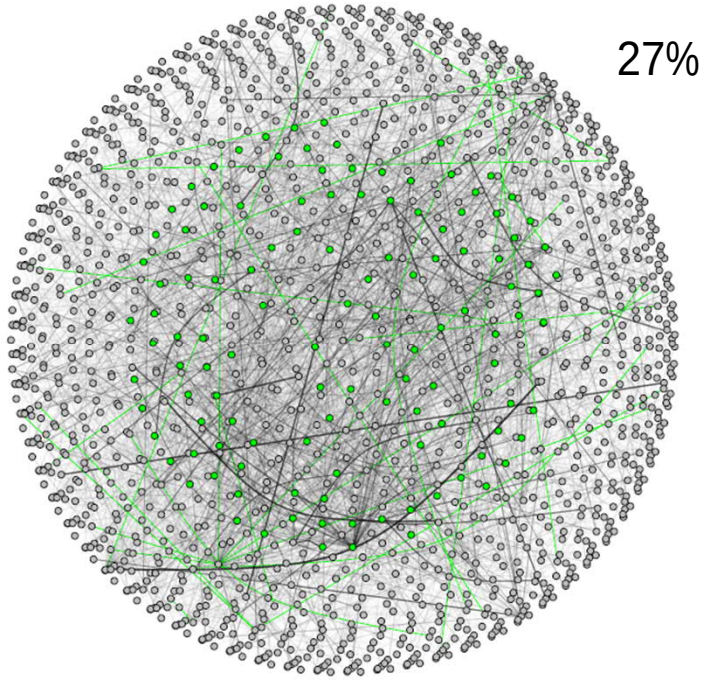
Carbon market data (European Union Transaction Log)
Treatment status and treatment intensity
Greenhouse gas emissions for regulated installations (not unregulated ones)

Production network:
B2B data (Dhyne, Duprez and Komatsu, 2023) identify upstream suppliers and downstream buyers, and quantitative importance of relationship



Upstream

Downstream



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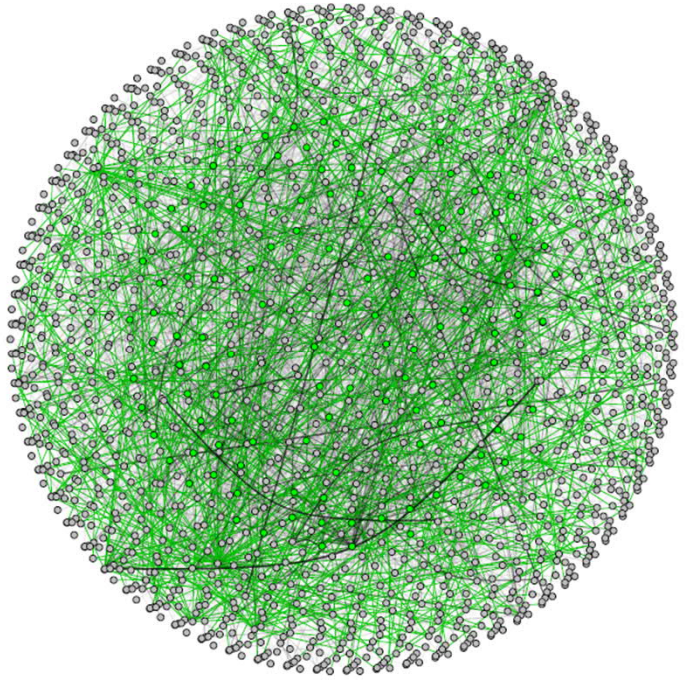

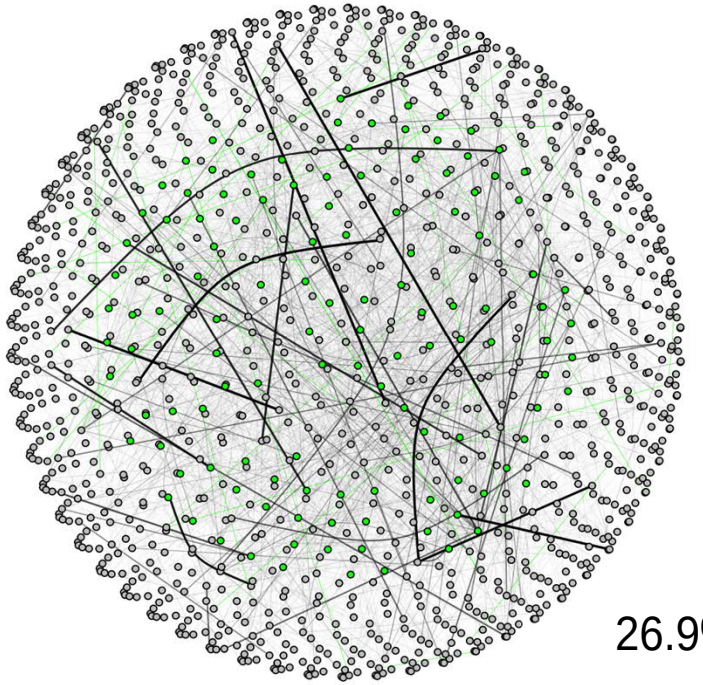

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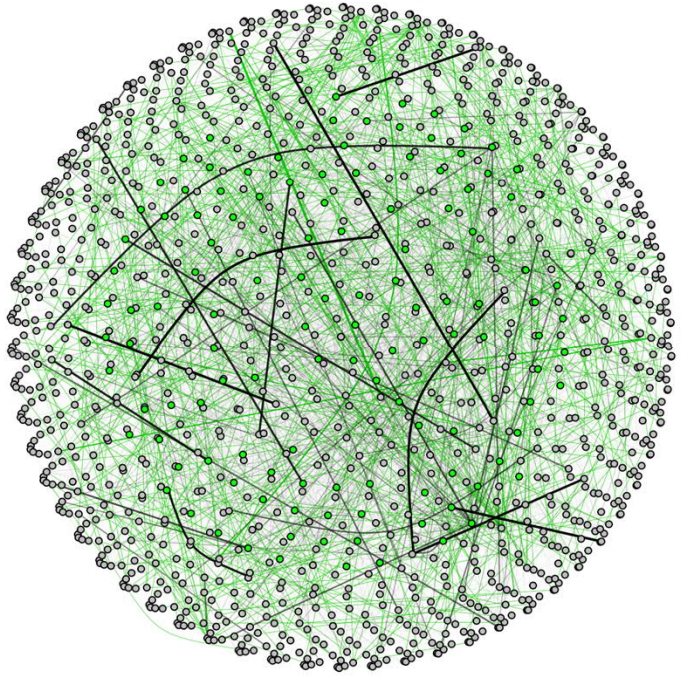
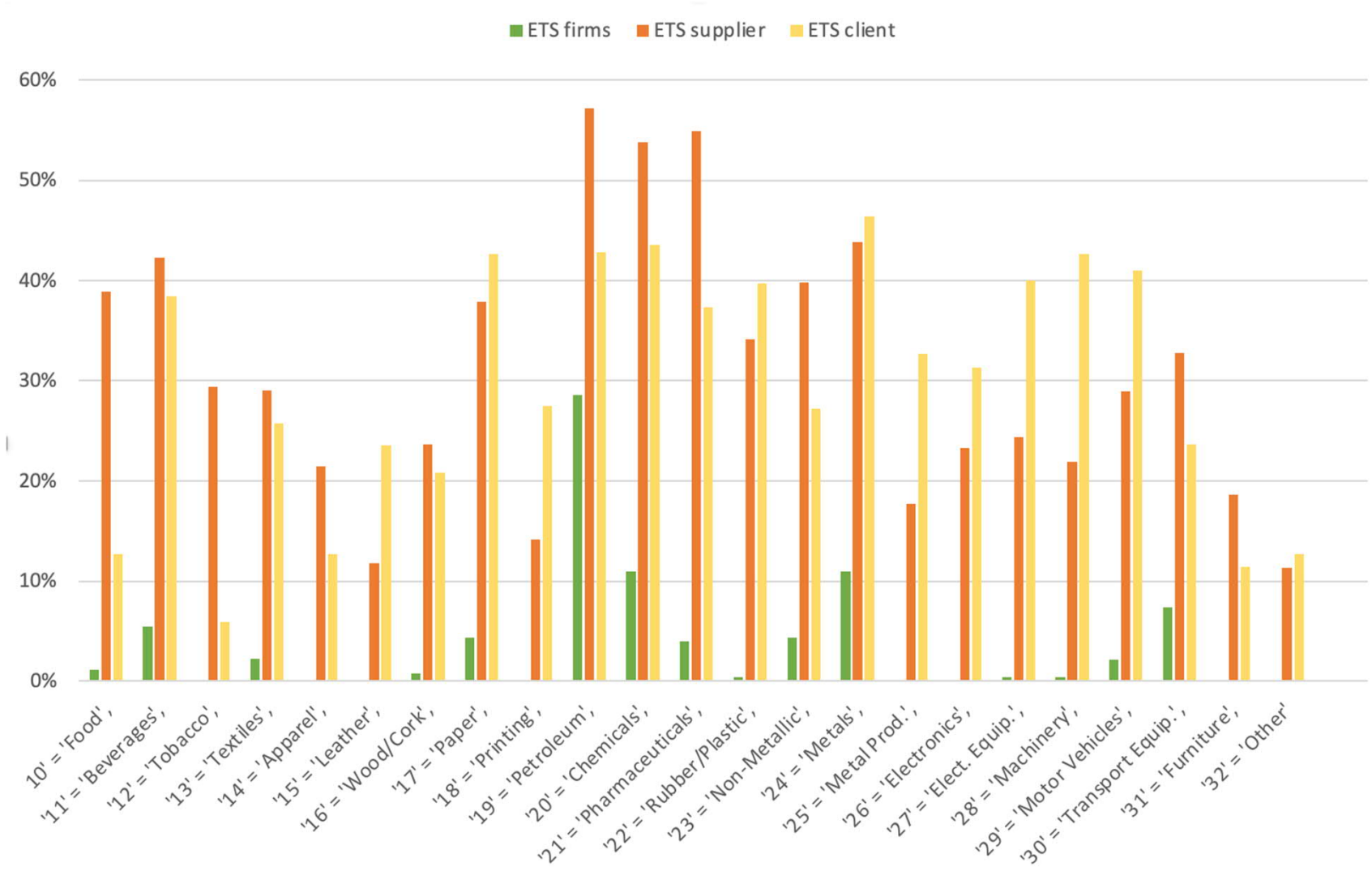
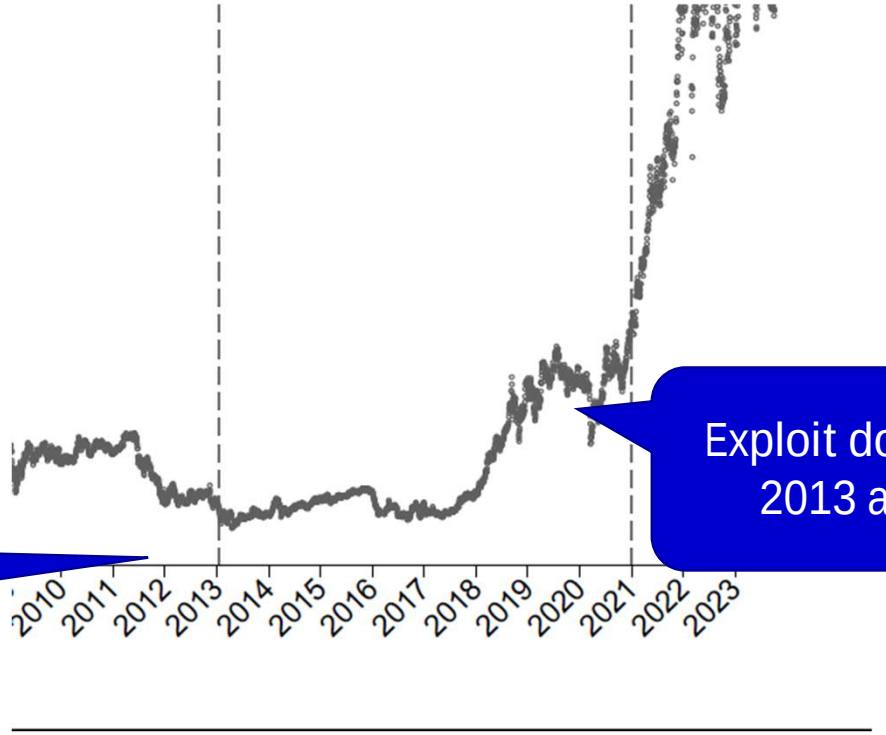


EU ETS exposure across industry



Methodology + Results

Current design
Base year

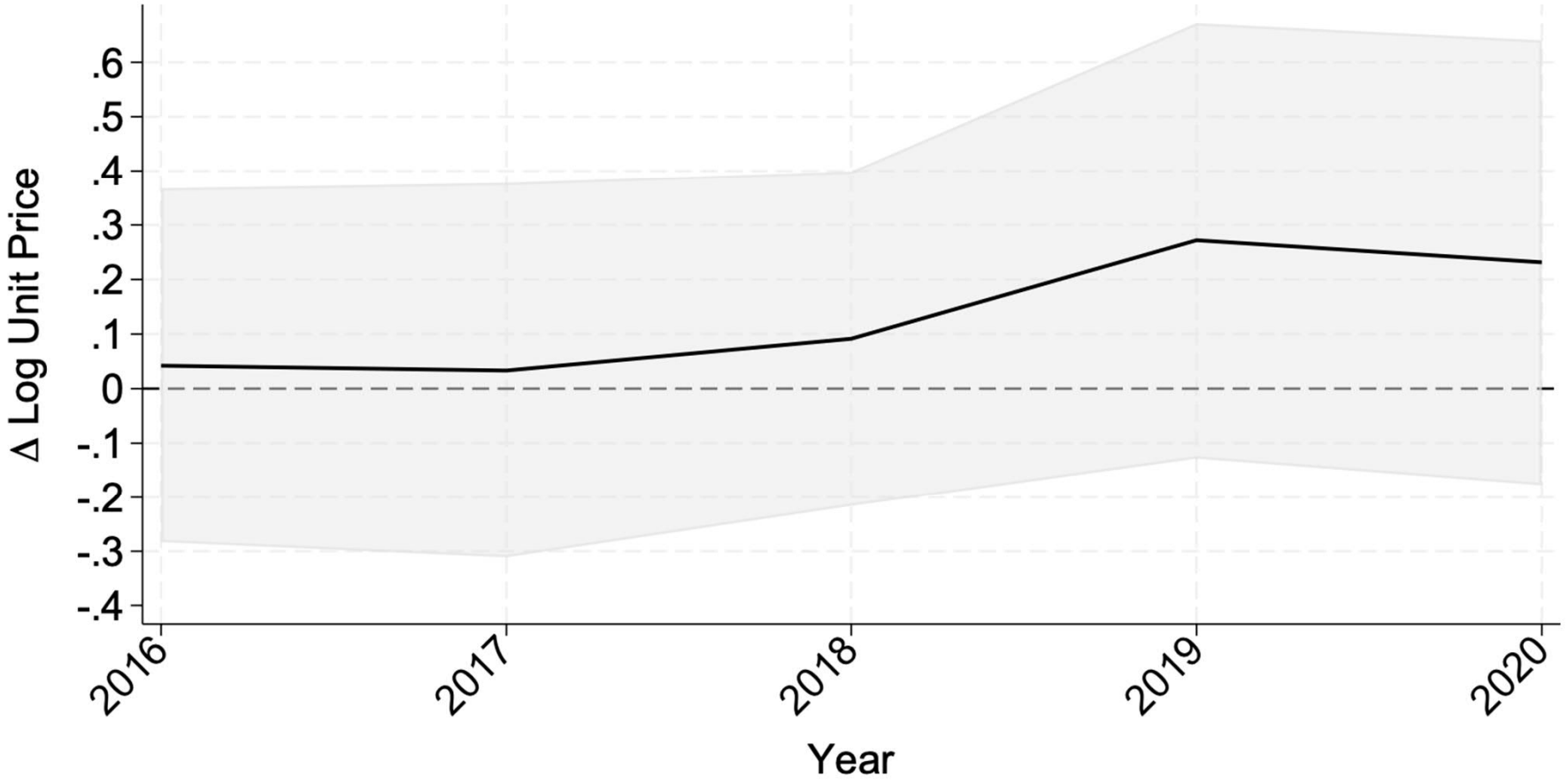


Compute ETS exposure based on 2012 data

Exploit doubling of ETS price between 2013 and 2017/18/19/20/21/22

Impact on product prices
Prodcom data

$$\Delta \text{UnitPrice}_{i,t} = \beta_1 \text{ETS}_i + \alpha_t + \alpha_n + \epsilon_{i,t}$$

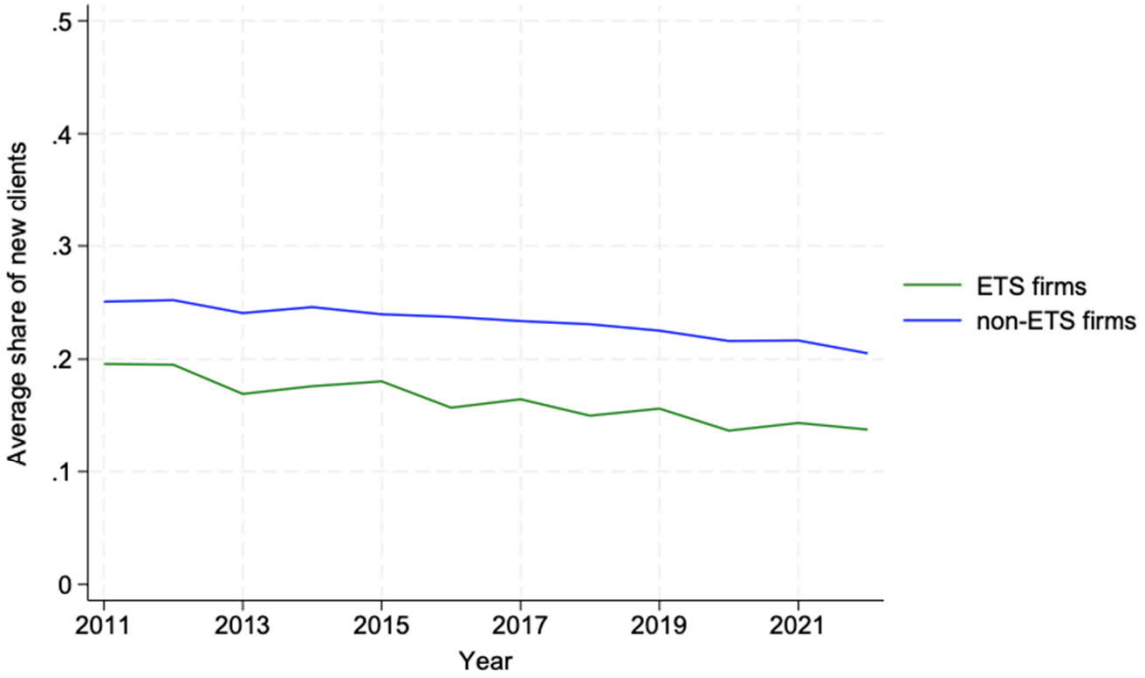


Upstream and Downstream effects

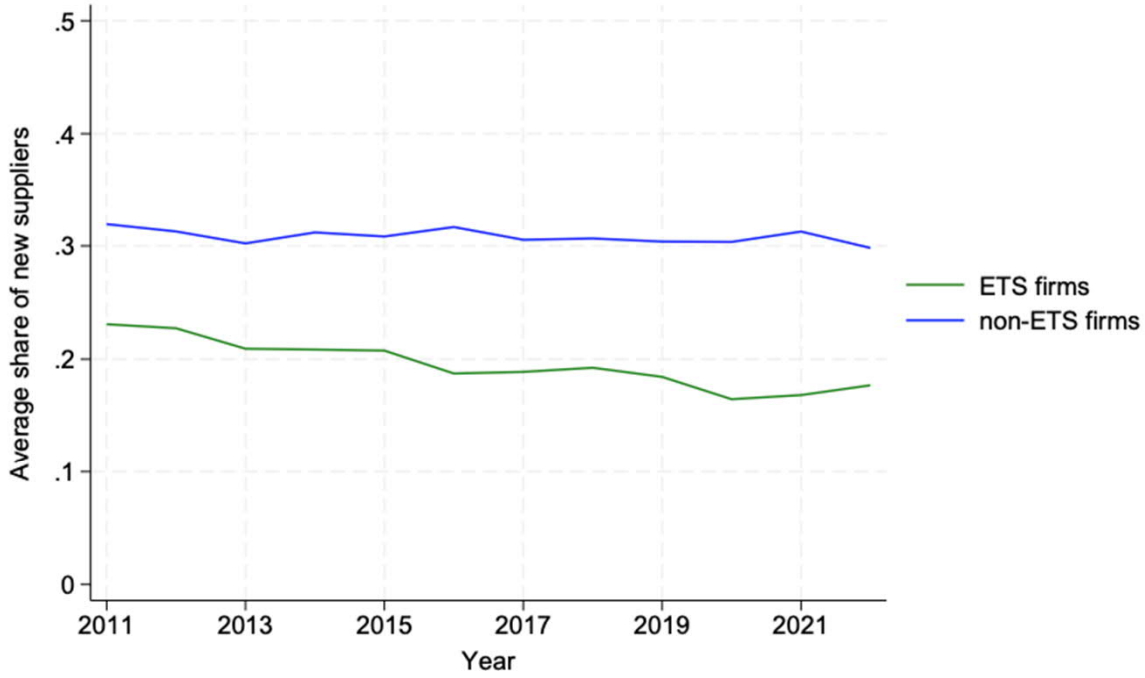
Share of Purchases and Sales from/to ETS firms

	(1) Δln(Value-Added)	(2) Δln(Employment)	(3) Δln(Investment)	(4) Δln(Exports)	(5) Δln(Imports)
ETS (Direct)	0.028	0.002	0.114	-0.177	-0.026
	(0.021)	(0.017)	(0.083)	(0.121)	(0.118)
Upstream (Share of Purchases from ETS firms)	-0.026	-0.003	0.132	-0.203	-0.272
	(0.018)	(0.017)	(0.102)	(0.211)	(0.203)
Downstream (Share of Sales to ETS firms)	0.006	-0.013	-0.071	0.068	-0.157
	(0.011)	(0.011)	(0.057)	(0.127)	(0.108)
Year Controls	Yes	Yes	Yes	Yes	Yes
Sector Controls	Yes	Yes	Yes	Yes	Yes
Observations	376,547	376,547	284,453	44,126	66,583
Firms	72,634	72,634	59,958	9,033	14,077

Dynamics of the supply chain
Network variation



Share of new clients



Share of new suppliers

Dynamics of the supply chain
Network variation

	(1) Δ Share of New Suppliers	(2) Δ Share of New Clients
ETS (Direct)	-0.007 (0.005)	0.009 (0.010)
Upstream (Share of Purchases from ETS firms)	0.018*** (0.006)	0.028*** (0.009)
Downstream (Share of Sales to ETS firms)	0.009** (0.004)	-0.008 (0.007)
Year and Sector Controls	Yes	Yes
Observations	376,547	376,547
Firms	72,634	72,634

Impact on Innovation
Total and Clean Patents

	(1) Δ Total Patents	(2) Δ Total Patents	(3) Δ Clean Patents	(4) Δ Clean Patents
ETS (Direct)	0.146***	0.144***	0.082***	0.081***
	(0.042)	(0.042)	(0.023)	(0.023)
Upstream (Share of Purchases from ETS firms)		0.013		0.002
		(0.010)		(0.003)
Downstream (Share of Sales to ETS firms)		0.009		0.007**
		(0.008)		(0.003)
Year and 2-digit Sector Controls	Yes	Yes	Yes	Yes
Observations	203,789	203,789	203,789	203,789
Firms	50,823	50,823	50,823	50,823

Conclusions

First conclusions

- To understand the full impact of emissions trading we need to look beyond the regulated firms
- The production network is a key dimension in this respect
- First paper to explore this
- First results suggest evidence no cost pass through, nor any effect on value-added or employment
- Impacts on the extensive structure of suppliers and clients
- We find that a higher share of sales to an ETS firm leads to an increase in clean innovation.

The Road Ahead

- Wider variety of indicators representing more nuanced aspects of the production network and ETS exposure
- More outcomes: more nuanced innovation measures and green investment
- Impact on production network structure: Changing to clean suppliers?
- Heterogeneity of effects further
- Deal with non-domestic part of network

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Thank you

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