

# The Effect of Mandatory Carbon Disclosure along Global Supply Chains

Jin Deng

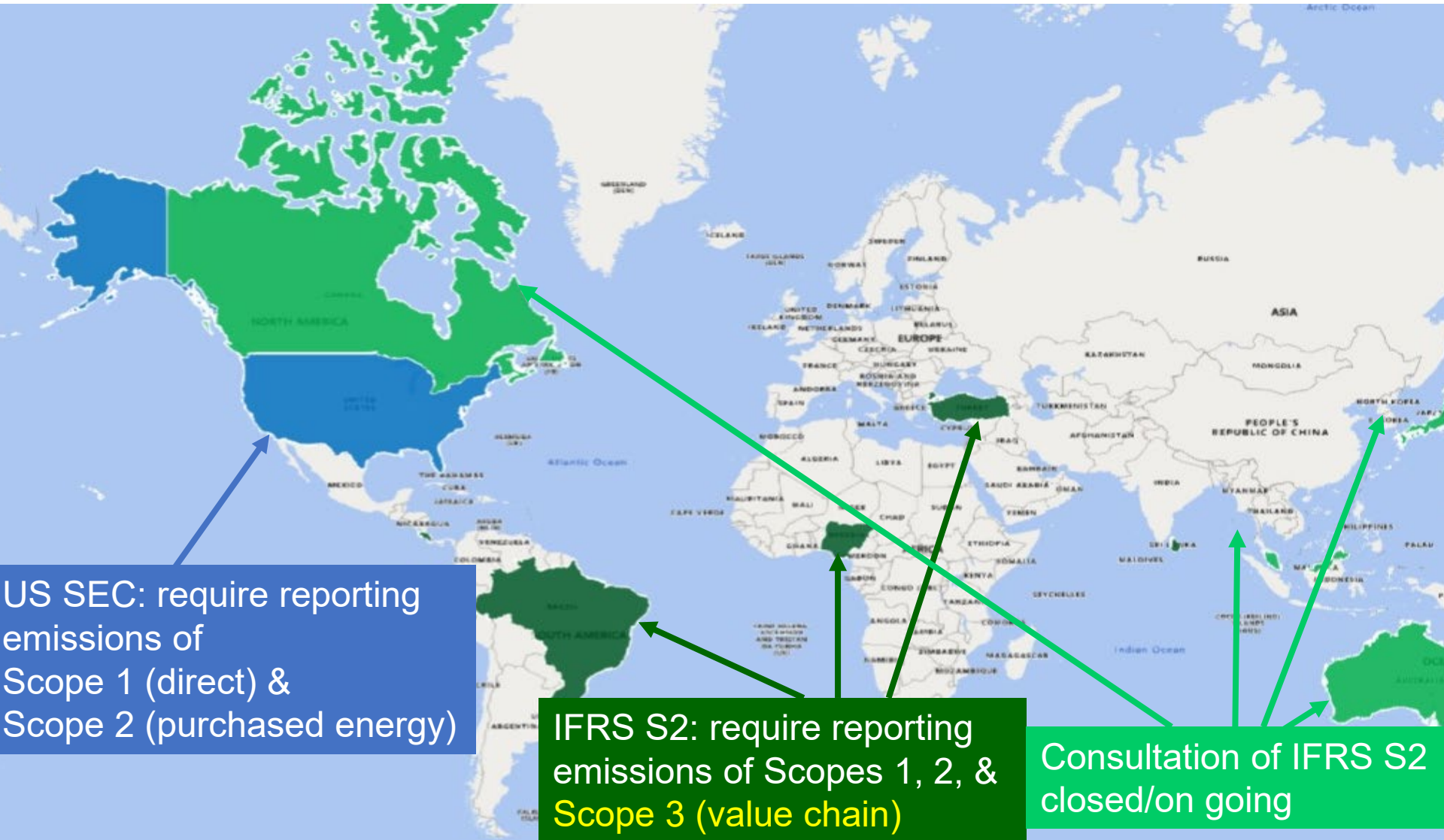
Mingyi Hung

Shiheng Wang

2024 ABFER Annual Conference

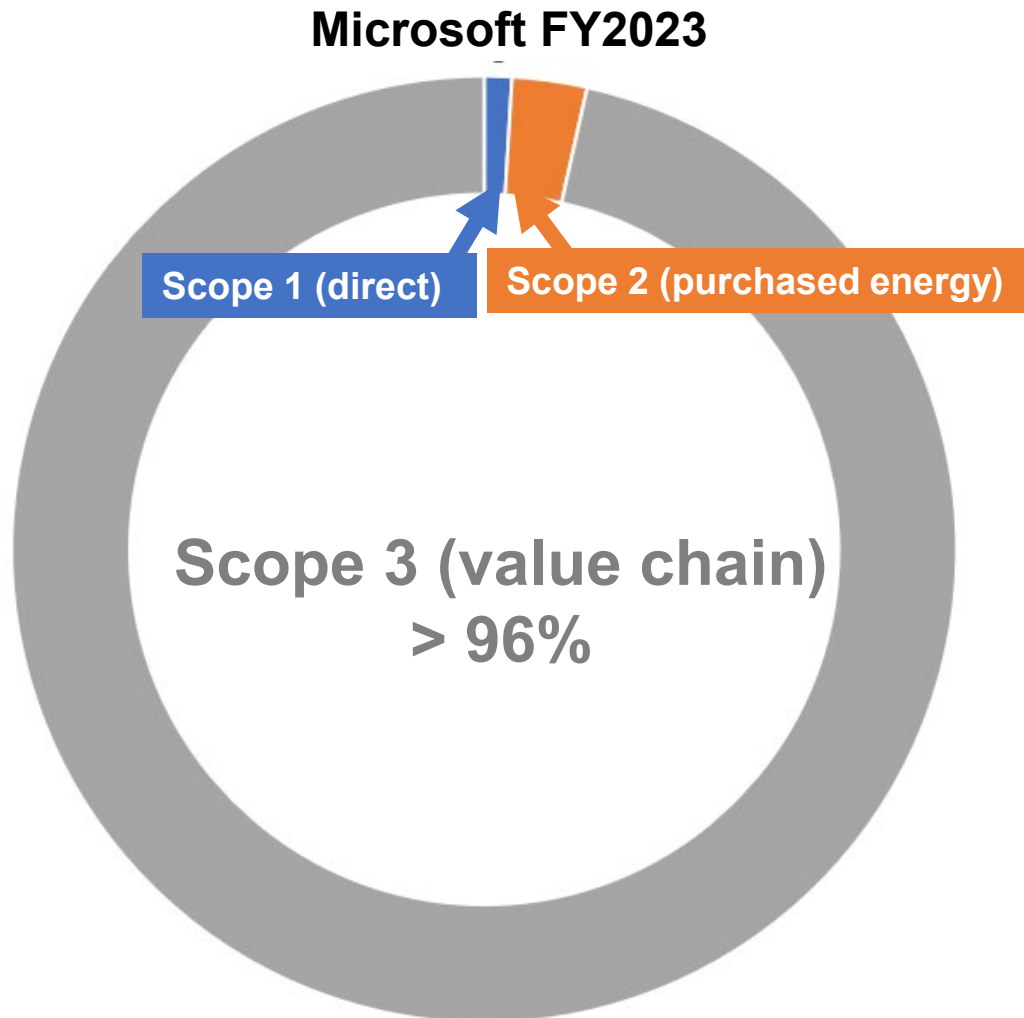
# Motivation

## Global regulatory push on climate-related disclosures



# Motivation

## Importance of Scope 3 (value chain) emissions



**Microsoft's emissions jump almost 30% as it races to meet AI demand**

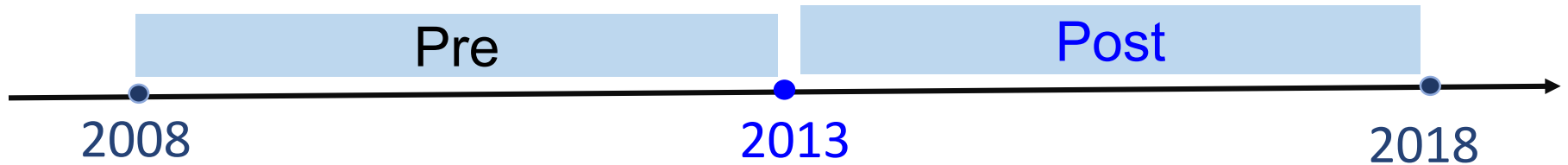
“emissions from its supply chain —which comprise the vast majority of its total emissions — jumped by 30.9 per cent.”

FT May 16 2024

## ***Opponents***

# Setting

## 2013 UK carbon disclosure mandate



The Companies Act 2006 Regulations 2013  
Require reporting of Scopes 1 and 2, **NOT Scope 3**

Global GHG emissions data  
for the year ended 31 March 2014

Tonnes of CO<sub>2</sub>e  
2014

### Emissions from:

|  |               |
|--|---------------|
| Combustion of fuel and operation of facilities (Scope 1)             | 64,062        |
| Electricity, heat, steam and cooling purchased for own use (Scope 2) | 27,387        |
| <b>Total</b>   | <b>91,449</b> |
| <b>Company's chosen intensity measurement<sup>1</sup></b>            | <b>418.1</b>  |

# Research Questions

*RQ: Does the disclosure mandate lead to carbon outsourcing?*

*What do we know about the effect of this disclosure mandate?*

**Downar et al. (2021)**

Scope 1 ↓

for UK firms with plants under EU ETS

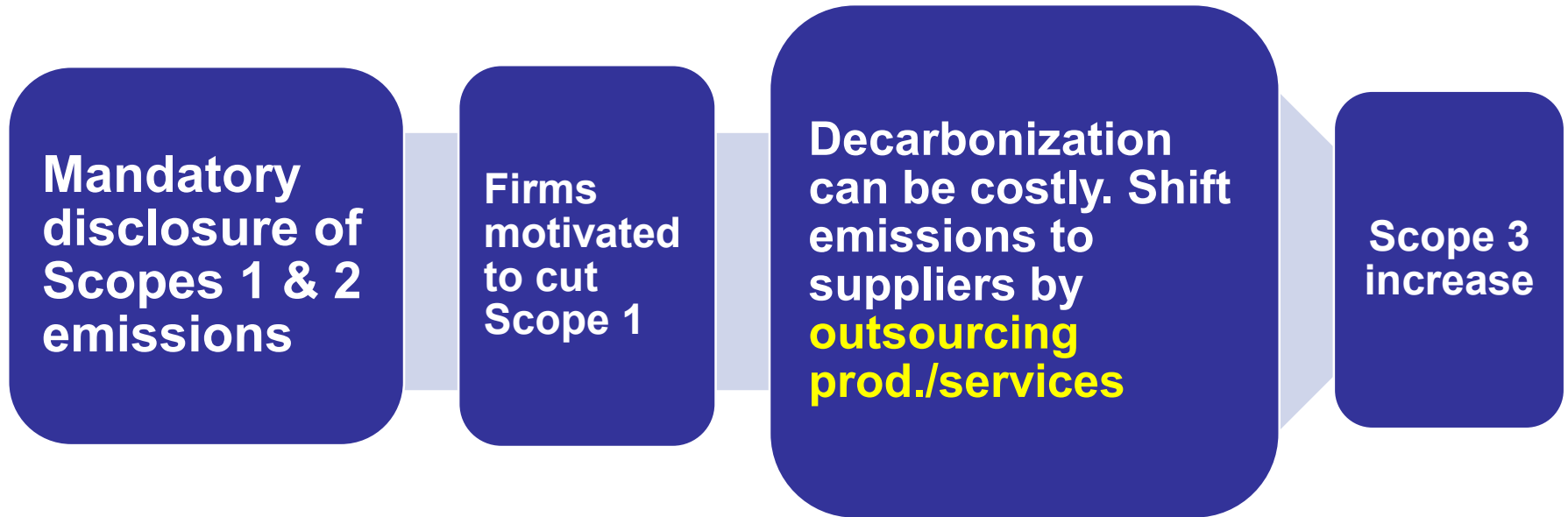
**Jouvenot and Krueger (2021)**

Scopes 1 & 2 ↓

Scope 3 (placebo test?) insignificant  
for voluntary UK emission disclosers

# Hypothesis 1

*H1: Scope 3 emissions of UK customer firms increase following the UK carbon disclosure mandate*



**H1 may not hold, because**

- Customer firms' improved awareness of climate risk
- More intensive monitoring of suppliers' emissions by stakeholders
- Suppliers' concern of their own emissions

# Hypothesis 2

*H2: Scope 1 emissions of exposed suppliers that do not provide carbon disclosures increase following the UK carbon disclosure mandate, relative to other suppliers*



**H2 may not hold, because**

- lack of data on changes in emissions of private firms
- alternative measures (e.g., divestment to non-suppliers)



# Sample and Data

Trucost provides emission estimates when firms do not disclose

Customer sample, Scope 3

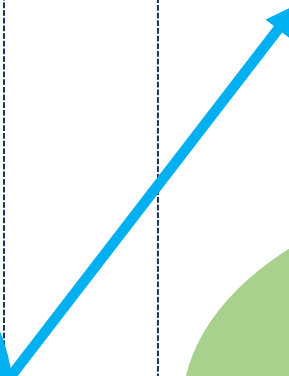
**UK firms  
(Treatment  
firms)**

**Non-UK firms  
(Benchmark firms,  
entropy-balanced  
EEA firms. or  
propensity score  
matched global firms)**

Supplier sample, Scope 1

**Non-UK exposed  
supplier**

**Non-UK benchmark  
supplier  
(Entropy balanced or  
Propensity score  
matched)**



# Summary of Findings

- Following the UK carbon disclosure mandate, **firms** exhibit
  - an increase in **Scope 3** emissions
  - an decrease in Scope 1 emissions but little change in total emissions
- **Exposed non-UK suppliers** have a greater **increase in Scope 1 emissions** than benchmark non-UK suppliers
- Scope 3 emissions increase more when **firms** have:
  - **higher carbon emissions** before the mandate
  - a higher proportion of **private or horizontally linked suppliers**
  - **weaker** environmental protection policies
- Scope 1 emissions increase more when **suppliers** have:
  - **a greater proportion** of UK customers
  - **smaller firm size**
  - higher proportion of **horizontally linked** UK customers
  - **fewer** environmental protection policies

# Results for H1 Test, T3A

UK customer firm's upstream Scope 3

Parallel trends assumption

| Dep Var =                   | Ln(Scope 3)     |                |          |                 |                 |          |
|-----------------------------|-----------------|----------------|----------|-----------------|-----------------|----------|
| Sample =                    | EB sample       |                |          | PSM sample      |                 |          |
|                             | (1)             | (2)            | (3)      | (4)             | (5)             | (6)      |
| <b>Post × Treat</b>         | <b>0.292***</b> | <b>0.153**</b> |          | <b>0.274***</b> | <b>0.122***</b> |          |
|                             | (0.090)         | (0.060)        |          | (0.060)         | (0.040)         |          |
| <b>Post</b>                 | -0.044          |                |          | -0.010          |                 |          |
|                             | (0.076)         |                |          | (0.037)         |                 |          |
| <b>Treat</b>                | 0.037           |                |          | 0.170**         |                 |          |
|                             | (0.100)         |                |          | (0.068)         |                 |          |
| <b>Year -5 × Treat</b>      |                 |                | -0.030   |                 |                 | -0.025   |
|                             |                 |                | (0.048)  |                 |                 | (0.041)  |
| <b>Year -4 × Treat</b>      |                 |                | -0.068   |                 |                 | -0.014   |
|                             |                 |                | (0.059)  |                 |                 | (0.039)  |
| <b>Year -3 × Treat</b>      |                 |                | -0.048   |                 |                 | -0.035   |
|                             |                 |                | (0.051)  |                 |                 | (0.032)  |
| <b>Year -2 × Treat</b>      |                 |                | -0.111   |                 |                 | -0.007   |
|                             |                 |                | (0.079)  |                 |                 | (0.025)  |
| <b>Year 1 × Treat</b>       |                 |                | 0.054    |                 |                 | 0.102*** |
|                             |                 |                | (0.033)  |                 |                 | (0.038)  |
| <b>Year 2 × Treat</b>       |                 |                | 0.127*** |                 |                 | 0.137*** |
|                             |                 |                | (0.037)  |                 |                 | (0.041)  |
| <b>Year 3 × Treat</b>       |                 |                | 0.142*** |                 |                 | 0.108**  |
|                             |                 |                | (0.049)  |                 |                 | (0.046)  |
| <b>Year 4 × Treat</b>       |                 |                | 0.165**  |                 |                 | 0.087*   |
|                             |                 |                | (0.078)  |                 |                 | (0.050)  |
| <b>Year 5 × Treat</b>       |                 |                | 0.031    |                 |                 | 0.098*   |
|                             |                 |                | (0.055)  |                 |                 | (0.057)  |
| <b>Firm characteristics</b> | Yes             | Yes            | Yes      | Yes             | Yes             | Yes      |
| <b>Industry FE</b>          | Yes             | No             | No       | Yes             | No              | No       |
| <b>Firm FE, Year FE</b>     | No              | Yes            | Yes      | No              | Yes             | Yes      |
| <b>#Firm-years</b>          | 4,159           | 4,159          | 4,159    | 3,847           | 3,847           | 3,847    |
| <b>Adj. R<sup>2</sup></b>   | 0.85            | 0.98           | 0.98     | 0.83            | 0.97            | 0.97     |

# Results for H2 Test, T6A

Suppliers' scope 1

| Dep Var=                        | Ln(Scope1)         |                 |          |                     |                 |          |
|---------------------------------|--------------------|-----------------|----------|---------------------|-----------------|----------|
| Sample=                         | EB supplier sample |                 |          | PSM supplier sample |                 |          |
|                                 | (1)                | (2)             | (3)      | (4)                 | (5)             | (6)      |
| <b>Post × Exposed_Suppliers</b> | <b>0.131**</b>     | <b>0.119***</b> |          | <b>0.193***</b>     | <b>0.167***</b> |          |
|                                 | (0.051)            | (0.039)         |          | (0.065)             | (0.053)         |          |
| Post                            | -0.209***          |                 |          | -0.247***           |                 |          |
|                                 | (0.032)            |                 |          | (0.051)             |                 |          |
| Exposed_Suppliers               | -0.180**           |                 |          | -0.200              |                 |          |
|                                 | (0.086)            |                 |          | (0.131)             |                 |          |
| Year -5 × Exposed_Suppliers     |                    |                 | -0.018   |                     |                 | -0.001   |
|                                 |                    |                 | (0.051)  |                     |                 | (0.072)  |
| Year -4 × Exposed_Suppliers     |                    |                 | -0.004   |                     |                 | -0.009   |
|                                 |                    |                 | (0.045)  |                     |                 | (0.061)  |
| Year -3 × Exposed_Suppliers     |                    |                 | -0.017   |                     |                 | -0.039   |
|                                 |                    |                 | (0.033)  |                     |                 | (0.042)  |
| Year -2 × Exposed_Suppliers     |                    |                 | -0.015   |                     |                 | 0.008    |
|                                 |                    |                 | (0.027)  |                     |                 | (0.033)  |
| Year 1 × Exposed_Suppliers      |                    |                 | 0.056*   |                     |                 | 0.071*   |
|                                 |                    |                 | (0.032)  |                     |                 | (0.038)  |
| Year 2 × Exposed_Suppliers      |                    |                 | 0.073*   |                     |                 | 0.091**  |
|                                 |                    |                 | (0.037)  |                     |                 | (0.046)  |
| Year 3 × Exposed_Suppliers      |                    |                 | 0.101**  |                     |                 | 0.136**  |
|                                 |                    |                 | (0.044)  |                     |                 | (0.067)  |
| Year 4 × Exposed_Suppliers      |                    |                 | 0.175*** |                     |                 | 0.273*** |
|                                 |                    |                 | (0.056)  |                     |                 | (0.088)  |
| Year 5 × Exposed_Suppliers      |                    |                 | 0.174**  |                     |                 | 0.263*** |
|                                 |                    |                 | (0.072)  |                     |                 | (0.096)  |
| Firm characteristics            | Yes                | Yes             | Yes      | Yes                 | Yes             | Yes      |
| Country FE, Industry FE         | Yes                | No              | No       | Yes                 | No              | No       |
| Firm FE, Year FE                | No                 | Yes             | Yes      | No                  | Yes             | Yes      |
| # Firm-years                    | 17,138             | 17,138          | 17,138   | 4,916               | 4,916           | 4,916    |
| Adj. R2                         | 0.71               | 0.96            | 0.96     | 0.72                | 0.96            | 0.96     |

Parallel trends assumption

# Incentives, Bargaining Power, Opportunities, T7A

Customer firms

Incentives

Bargaining power

Opportunities

| Dep Var =  | Ln(Scope 3)     |                    |                 |                    |
|--|-----------------|--------------------|-----------------|--------------------|
| Sample =   | EB sample       |                    | PSM sample      |                    |
|  | (1)             | (2)                | (3)             | (4)                |
| <b>Intensity of Scope 1 emissions before the mandate</b>   |                 |                    |                 |                    |
|  | High            | Low                | High            | Low                |
| <b>Post × Treat</b>  | <b>0.271***</b> | <b>-0.025</b>      | <b>0.249***</b> | <b>0.013</b>       |
|  | (0.090)         | (0.048)            | (0.066)         | (0.044)            |
| <i>Difference (chi-square)</i>                             |                 | 0.296***<br>(8.54) |                 | 0.236***<br>(8.89) |
| #Firm-years  | 2,260           | 1,899              | 1,953           | 1,894              |
| Adj. R <sup>2</sup>  | 0.98            | 0.99               | 0.97            | 0.98               |
| <b>Percentage of private suppliers</b>                     |                 |                    |                 |                    |
|  | High            | Low                | High            | Low                |
| <b>Post × Treat</b>  | <b>0.372***</b> | <b>0.018</b>       | <b>0.238***</b> | <b>-0.010</b>      |
|  | (0.113)         | (0.039)            | (0.065)         | (0.048)            |
| <i>Difference (chi-square)</i>                             |                 | 0.354***<br>(8.93) |                 | 0.248***<br>(9.60) |
| #Firm-years  | 1,478           | 1,647              | 1,233           | 1,262              |
| Adj. R <sup>2</sup>  | 0.97            | 0.99               | 0.98            | 0.98               |
| <b>Percentage of horizontally linked foreign suppliers</b> |                 |                    |                 |                    |
|  | High            | Low                | High            | Low                |
| <b>Post × Treat</b>  | <b>0.374***</b> | <b>0.100*</b>      | <b>0.188***</b> | <b>0.034</b>       |
|  | (0.116)         | (0.057)            | (0.065)         | (0.052)            |
| <i>Difference (chi-square)</i>                             |                 | 0.274**<br>(4.56)  |                 | 0.154*<br>(3.51)   |
| #Firm-years  | 1,265           | 1,860              | 942             | 1,553              |
| Adj. R <sup>2</sup>  | 0.98            | 0.99               | 0.98            | 0.98               |
| <b>#Environmental management policies</b>                  |                 |                    |                 |                    |
|  | High            | Low                | High            | Low                |
| <b>Post × Treat</b>  | <b>0.038</b>    | <b>0.212***</b>    | <b>0.067</b>    | <b>0.149**</b>     |
|  | (0.044)         | (0.066)            | (0.056)         | (0.058)            |
| <i>Difference (chi-square)</i>                             |                 | -0.174**<br>(4.91) |                 | -0.082*<br>(2.91)  |
| #Firm-years  | 1,460           | 878                | 869             | 879                |
| Adj. R <sup>2</sup>  | 0.99            | 0.98               | 0.98            | 0.98               |

# Incentives, Bargaining Power, Opportunities, T7B

Suppliers

| Dep Var =  | Ln(Scope 1)        |                 |                     |                 |
|--|--------------------|-----------------|---------------------|-----------------|
| Sample =   | EB supplier sample |                 | PSM supplier sample |                 |
|  | (1)                | (2)             | (3)                 | (4)             |
| <b>Supplier's reliance on UK customers (%UK Customers)</b> |                    |                 |                     |                 |
|  | High               | Low             | High                | Low             |
| <b>Post × Exposed_Suppliers</b>                            | <b>0.205***</b>    | <b>0.018</b>    | <b>0.230***</b>     | <b>0.027</b>    |
|  | (0.053)            | (0.044)         | (0.059)             | (0.049)         |
| <i>Difference (chi-square)</i>                             |                    | <b>0.187***</b> |                     | <b>0.203***</b> |
|  |                    | <b>(9.05)</b>   |                     | <b>(10.15)</b>  |
| #Firm-years  | 15,984             | 15,757          | 5,132               | 4,902           |
| Adj. R <sup>2</sup>  | 0.96               | 0.96            | 0.96                | 0.96            |
| <b>Supplier firm size (total assets)</b>                   |                    |                 |                     |                 |
|  | Small              | Large           | Small               | Large           |
| <b>Post × Exposed_Suppliers</b>                            | <b>0.189***</b>    | <b>0.054</b>    | <b>0.255***</b>     | <b>0.080</b>    |
|  | (0.059)            | (0.051)         | (0.074)             | (0.075)         |
| <i>Difference (chi-square)</i>                             |                    | <b>0.135*</b>   |                     | <b>0.175*</b>   |
|  |                    | <b>(2.97)</b>   |                     | <b>(2.81)</b>   |
| #Firm-years  | 9,399              | 7,739           | 2,429               | 2,487           |
| Adj. R <sup>2</sup>  | 0.96               | 0.96            | 0.95                | 0.95            |
| <b>Percentage of horizontally linked UK customers</b>      |                    |                 |                     |                 |
|  | High               | Low             | High                | Low             |
| <b>Post × Exposed_Suppliers</b>                            | <b>0.216***</b>    | <b>0.100**</b>  | <b>0.263***</b>     | <b>0.114**</b>  |
|  | (0.081)            | (0.042)         | (0.088)             | (0.047)         |
| <i>Difference (chi-square)</i>                             |                    | <b>0.116*</b>   |                     | <b>0.149*</b>   |
|  |                    | <b>(3.73)</b>   |                     | <b>(2.83)</b>   |
| #Firm-years  | 15,004             | 16,737          | 4,172               | 5,862           |
| Adj. R <sup>2</sup>  | 0.96               | 0.97            | 0.96                | 0.96            |
| <b>#Environmental management policies</b>                  |                    |                 |                     |                 |
|  | High               | Low             | High                | Low             |
| <b>Post × Exposed_Suppliers</b>                            | <b>0.061</b>       | <b>0.299***</b> | <b>0.270*</b>       | <b>0.458***</b> |
|  | (0.071)            | (0.088)         | (0.156)             | (0.136)         |
| <i>Difference (chi-square)</i>                             |                    | <b>-0.238**</b> |                     | <b>-0.188*</b>  |
|  |                    | <b>(4.83)</b>   |                     | <b>(2.79)</b>   |
| #Firm-years  | 4,258              | 3,643           | 1,107               | 1,072           |
| Adj. R <sup>2</sup>  | 0.96               | 0.96            | 0.94                | 0.96            |

Bargaining power

# Additional Tests

For both H1 and H2:

- Use as **emission intensity**, **total emission** as alternative emission measures
- Use **[-5,-1]** vs. **[0,4]** and **[-3,-1]** vs. **[1,3]** as alternative event windows
- Use **country** clusters
- Placebo test for fiscal years 2007-2012

Additional analysis of divestments

Additional analysis of voluntary reporting firms

# Contributions

## Effects of mandatory carbon disclosure

- The disclosure mandate reduces reported emissions through energy savings and divestitures (Downar et al. 2021; Jouvenot and Krueger 2021; Ecker and Reeve 2023)
- **Our paper:** unreported emissions increase through carbon outsourcing

## Effect of sustainability information on supply chains

- Recent literature focuses on the impact of CSR rating coverage, voluntary Scope 3 disclosure, and other mandatory CSR disclosures on supply chains (Darendeli et al. 2022, She 2022, Cho et al. 2023; Lu et al. 2023)
- **Our paper:** impact of carbon disclosure mandate on suppliers' emissions

## Strategic responses to environmental regulations

- Prior studies provide extensive evidence on carbon leakage within a firm (Yang et al. 2021; Bartram et al. 2022; Jiang 2023)
- Weak evidence on carbon leakage to foreign suppliers (Ben-David et al. 2021), but more evidence is merging (Dai et al. 2021)
- **Our policy implications:** Global cooperation in mandating direct emissions



**Thank you**