



EUROPEAN CENTRAL BANK

EUROSYSTEM

# The low-carbon transition, climate disclosure and firm credit risk



International Conference on "Statistics  
for Sustainable Finance"  
September 14-15, 2021

**Carbone, Giuzio, Kapadia, Krämer, Nyholm, Vozian**

Disclaimer: The views expressed are those of the authors only and do not necessarily reflect the views  
of the European Central Bank or the Eurosystem.

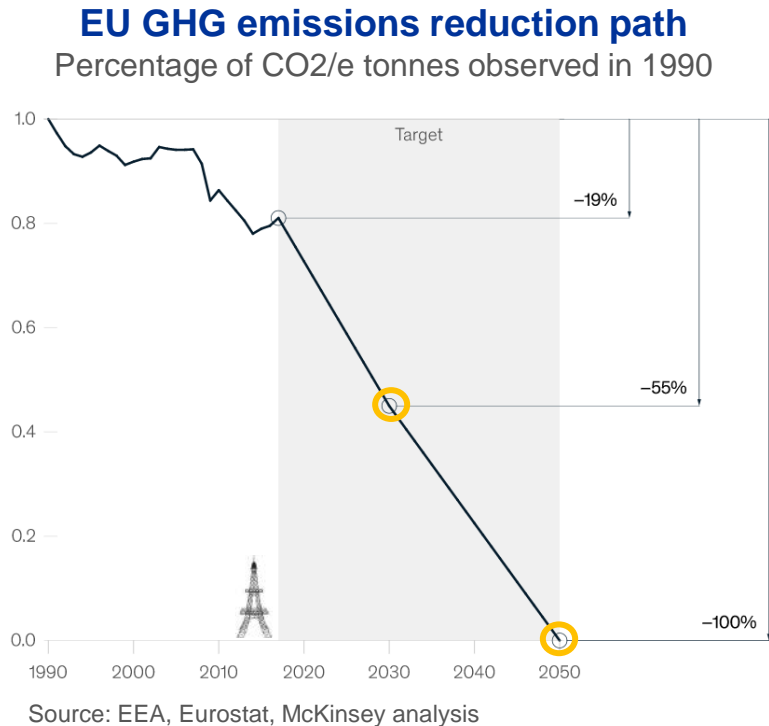
# The transition to the low-carbon economy requires firms to significantly reduce their emissions

## Issue:

- **Climate-related transition risk** arises from uncertainties surrounding the timing and speed of transition to a low-carbon economy. This risk can affect firm's **credit risk**.

## Motivation:

- Understanding **whether and how** transition risk is reflected in measures of credit risk is important for firms, banks, investors, and regulators.



# Research question and Hypotheses

*How is climate-related transition risk reflected in firm credit risk estimates?*

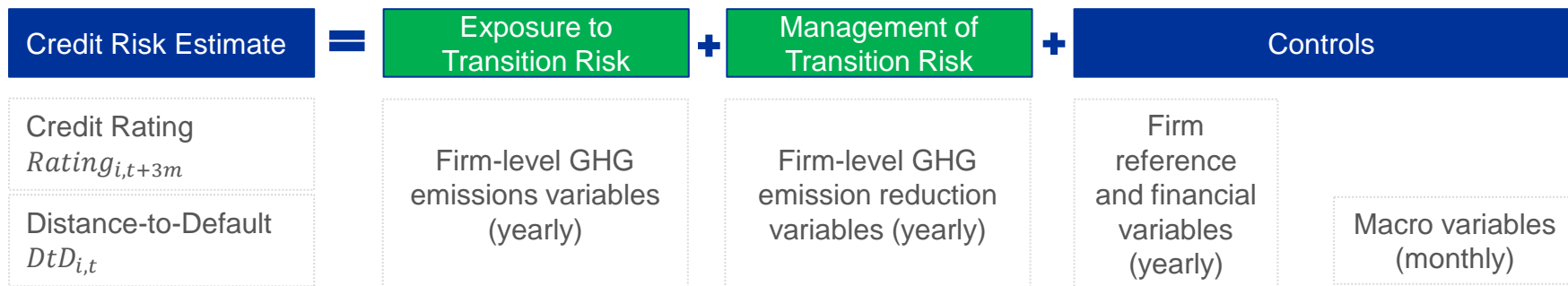
**H1:** There is a positive relationship between a **firm's exposure to transition risk**, as proxied by GHG emissions, and its credit risk, as proxied by Credit Ratings and Distance-to Default.

**H2:** The interaction between firms' GHG emissions and its decision to **disclose** GHG emissions has a significant impact on credit risk estimates.

**H3:** There is a negative relationship between **firm's management of transition risk**, as proxied by disclosed GHG emission reduction targets and actual GHG emission reduction, and credit risk estimates.

# A novel dataset

- Firms: non-financial firms of S&P 500 and of STOXX Europe 600
- Period: 2010 - 2019
- Geography: USA and Europe
- Sources: Refinitiv, Urgentem, Bloomberg, SBTi, ECB Ratings Database, ICE, Eurostat



\*The higher the *Rating* (or *DtD*), the lower the Credit Risk associated with the firm

# H1: Regression Credit Rating and Emissions

$$Rating_{i,t+3m} = \alpha + \beta_1 Scope\ 1_{i,t} + \beta_2 Scope\ 2_{i,t} + \beta_3 Scope\ 3_{i,t} + \sum_{j=1}^6 \gamma_j FinancialControls_{j,i,t} + \rho SectorFE_i + \tau TimeFE_t + \sigma CountryFE_i + \epsilon_{i,t}$$

Variable	(1 - int., OLS)	(2 - int., logit)	(3 - levels, OLS)	(4 - levels, logit)
Scope 1 GHG intensity	-66.6** (29.4)	-194** (93.0)		
Scope 2 GHG intensity	259 (283)	900 (918)		
Scope 3 GHG intensity	-2.01** (0.86)	-6.26** (2.71)		
Scope 1 GHG level			-0.0037*** (0.0012)	-0.012*** (0.0038)
Scope 2 GHG level			0.0017 (0.0023)	0.0058 (0.0073)
Scope 3 GHG level			-0.000093 (0.00016)	-0.00024 (0.00050)
Controls	Y	Y	Y	Y
Time fixed-effects	Y	Y	Y	Y
Sectoral fixed-effects	Y	Y	Y	Y
Country fixed-effects	Y	Y	Y	Y
Observations	4,201	4,201	4,194	4,194
R-squared	0.343	0.1697	0.343	0.1698

# H1: Regression DtD and Emissions

$$\log DtD_{i,t} = \alpha + \beta_1 \text{Scope 1 and 2}_{i,t} + \beta_2 \text{Scope 3}_{i,t} + \sum_{j=1}^N \gamma_j \text{Controls}_{j,i,t} + \rho \text{SectorFE}_i + \tau \text{TimeFE}_t + \sigma \text{CountryFE}_i + \delta \text{RatingFE}_i + \epsilon_{i,t}$$

- Lower **Scope 1 and 2 intensities** are generally associated to lower credit risk estimate
- Also **Scope 3 intensities** lead to lower credit risk estimate

2010-2019		
Scope 1 and 2 GHG intensities	-0.0233 (0.0020)	***
Scope 3 GHG intensity	-0.0250 (0.0019)	***
Time fixed-effects	Y	
Sectoral fixed-effects	Y	
Country fixed-effects	Y	
Observations	40037	
R-squared	0.4629	

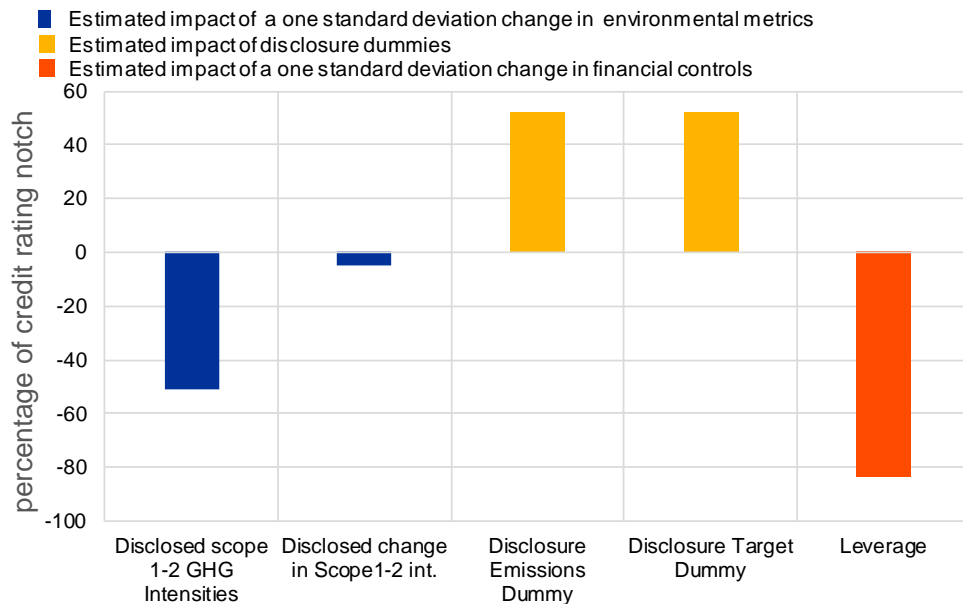
# H1: TripleDiD Ratings & High-polluters Europe vs US

$$\begin{aligned} CreditRating_{i,t} = & \alpha + \beta_0 Treatment_i \times TransitionPolicy_i \times postParis_t + \\ & \beta_1 Treatment_i \times postParis_t + \\ & \beta_2 TransitionPolicy_i \times postParis_t + \\ & \sum_{j=1}^N \gamma_j Controls_{j,i,t} + \rho FirmFE_i + \tau TimeFE_t + \epsilon_{i,t} \end{aligned}$$

Variable	(1)	(2)	(3)	(4)	(5)	(6)	
Top GHG NACE x Transition-policy x post-Paris	-1.06*** (0.23)			-0.91*** (0.21)			European firms
Top GHG intensity x Transition-policy x post-Paris		-0.55** (0.25)			-0.53** (0.22)		
Top GHG level x Transition-policy x post-Paris			-0.57** (0.24)			-0.49** (0.20)	
Top GHG NACE x post-Paris	0.51*** (0.16)			0.39*** (0.14)			US firms
Top GHG intensity x post-Paris		0.38** (0.16)			0.28** (0.14)		
Top GHG level x post-Paris			0.25 (0.17)			0.11 (0.14)	
Firm-level controls	N	N	N	Y	Y	Y	
Time fixed-effects	N	N	N	Y	Y	Y	
Firm fixed-effects	N	N	N	Y	Y	Y	
Observations	3,807	3,807	3,807	3,643	3,643	3,643	
Number of firms	423	423	423	422	422	422	
R-squared	0.026	0.010	0.008	0.094	0.081	0.081	

# H2 & H3: Credit Rating and Climate Disclosure

$$Rating_{i,t+3m} = \alpha + \beta_1 DiscloseGHG\_d_{i,t} + \beta_2 DiscloseGHG\_d_{i,t} * Scope\ 1\ and\ 2_{i,t} + \beta_3 DiscloseGHG\_d_{i,t} * Scope\ 3_{i,t} + \beta_4 YoY\ Scope\ 1\ and\ 2_{i,t} + \beta_5 Target_{i,t} + \sum_{j=1}^6 \gamma_j Controls_{j,i,t} + \rho SectorFE_i + \tau TimeFE_t + \sigma CountryFE_i + \epsilon_{i,t}$$



- Firms with **lower disclosed GHG intensity** and **actual GHG reduction** tend to have better ratings.
- Firms **disclosing emissions** and a **forward-looking target** to reduce emissions tend to have better ratings.
- The **magnitude** of the effect of disclosed GHG intensity is comparable to that of traditional determinants of rating
- Endogeneity:** results remain robust under alternative specifications.



## H2 & H3: DtD and Climate Disclosure

$$\log DtD_{i,t} = \alpha + \beta_1 DiscloseGHG_{d_{i,t}} + \beta_2 DiscloseGHG_{d_{i,t}} * Scope\ 1\ and\ 2_{i,t} + \beta_3 DiscloseGHG_{d_{i,t}} * Scope\ 3_{i,t} + \beta_4 YoY\ Scope\ 1\ and\ 2_{i,t} + \beta_5 Target_{i,t} + \sum_{j=1}^6 \gamma_j Controls_{j,i,t} + \rho SectorFE_i + \tau TimeFE_t + \sigma CountryFE_i + \epsilon_{i,t}$$

2010-2019		
Fwd-looking commitment	0.0176 (0.0051)	***
Disclosure	-0.0100 (0.0265)	
Disclosed Scope 1 and 2 GHG intensities	0.0065 (0.0026)	***
Disclosed Scope 3 GHG intensity	0.0039 (0.0033)	
Change in disclosed Scope 1 and 2 GHG intensities	0.0026 (0.0035)	
Time fixed-effects	Y	
Sectoral fixed-effects	Y	
Country fixed-effects	Y	
Observations	40795	
R-squared	0.4648	

# H3: Rating, DtD and Quantitative Targets

Credit Rating  
 $Rating_{i,t+3m}$

Variable	(1 - int., OLS)	(2 - int., OLS)	(3 - levels, OLS)	(4 - levels, OLS)
Scope 1 GHG intensity	-66.0 (42.0)	-49.6 (88.4)		
Scope 2 GHG intensity	66.7 (271)	-21.5 (516)		
Scope 3 GHG intensity	5.58 (12.2)	27.6* (16.1)		
Disclosed intensity change	0.023 (0.036)	-0.014*** (0.0049)		
Scope 1 GHG level			-0.0033** (0.0017)	-0.0044 (0.0039)
Scope 2 GHG level			0.0076 (0.0086)	0.018 (0.023)
Scope 3 GHG level			0.00045 (0.00039)	0.00045 (0.00031)
Disclosed level change			0.0013** (0.00049)	0.0014*** (0.00053)
TargetPerc Ref	0.0036** (0.0015)		0.0036** (0.0015)	
TargetYear Ref	-0.0024 (0.0066)		-0.0025 (0.0064)	
TargetPerc CDP		0.0032** (0.0014)		0.0031** (0.0015)
TargetYear CDP		0.0027 (0.0042)		0.0031 (0.0041)
TargetBaseYear CDP		-0.014* (0.0083)		-0.013 (0.0084)
Constant	4.80*** (0.21)	11.2 (19.7)	4.80*** (0.21)	6.72 (21.2)
Firm-level controls	Y	Y	Y	Y
Time fixed-effects	Y	Y	Y	Y
Sectoral fixed-effects	Y	Y	Y	Y
Country fixed-effects	Y	Y	Y	Y
Observations	815	1,116	808	1,111
R-squared	0.335	0.395	0.333	0.394

Distance-to-Default  
 $DtD_{i,t}$

2010-2019	
Emission target percentage	0.1397 *** (0.0205)
Emission target arrival, in years	-0.0033 *** (0.0008)
Time fixed-effects	Y
Sectoral fixed-effects	Y
Country fixed-effects	Y
Observations	8900
R-squared	0.3884

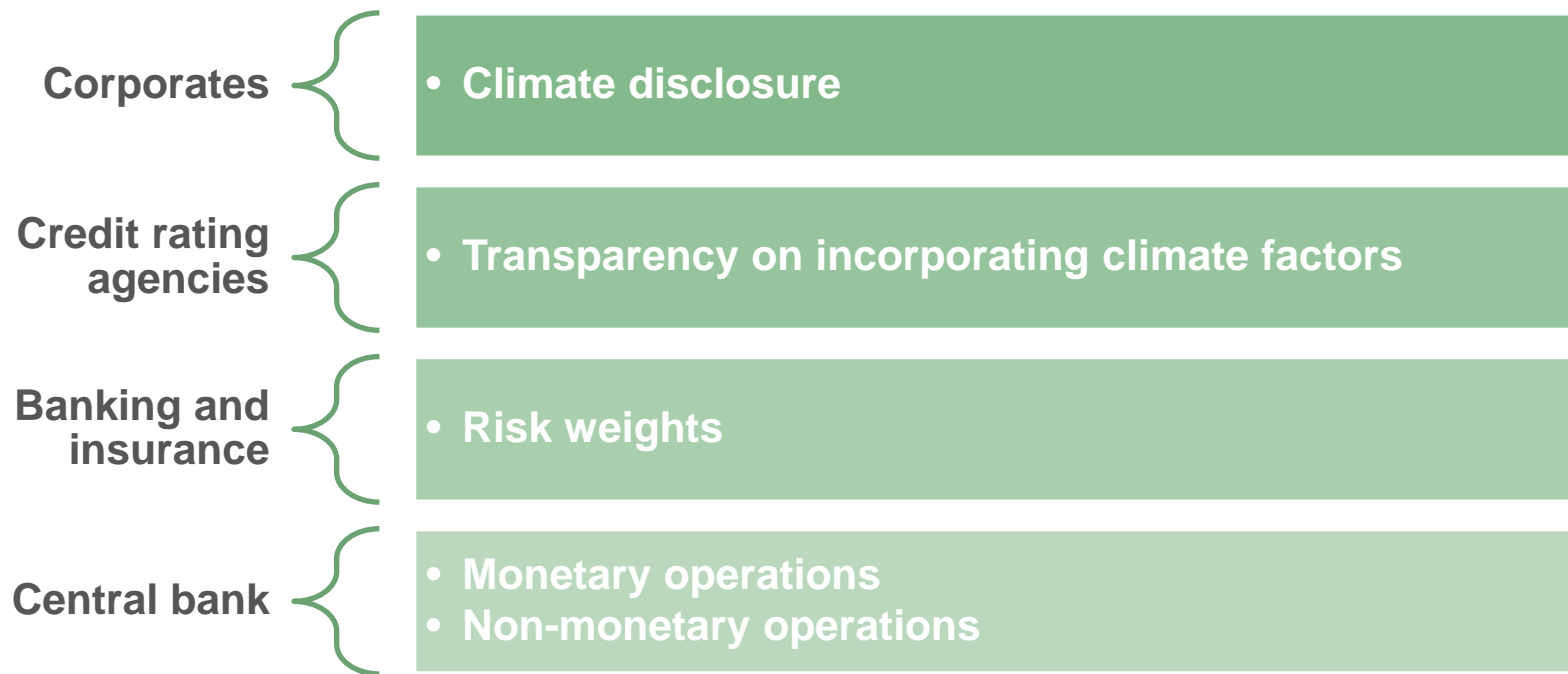
# Conclusion

## *How is climate-related transition risk reflected in firm credit risk?*

Caveats: Availability, reliability, and comparability of disclosed and inferred metrics of transition risk.

- ✓ High emissions are already associated to some extent with higher credit risk, both ratings and DtD.
- ✓ Governments' low-carbon transition policies affect transition risk, and affect the ratings.
- ✓ Disclosing emissions moderates the relation between emissions and ratings.
- ✓ Disclosing commitment to reduce emissions is associated with lower credit risk, both ratings and DtD.

# Policy relevance of this work



# The low-carbon transition, climate disclosure and firm credit risk

**Katia Vozian**  
**(ECB, Helsinki GSE)**  
**[kvozian@ecb.europa.eu](mailto:kvozian@ecb.europa.eu)**

**Joint work with Carbone, Giuzio, Kapadia, Krämer, Nyholm**

Disclaimer: The views expressed are those of the authors only and do not necessarily reflect the views of the European Central Bank or the Eurosystem.

# Appendix

# Why it matters?

Transmission channel

## **Drivers of transition risk:**

Government policy, technological change, market sentiment urge firms to adapt to a low-carbon economy and to reduce their GHG emissions



## **Firms' credit risk:**

Reduced ability of the borrower to repay and service debt



## **Banks and investors' risk of losses:**

Reduced ability to fully recover the value of an investment in the event of default\*

**Policy relevance: Climate disclosure, Risk weights, Central bank operations**

\* BCBS (2021). Climate-related risk drivers and their transmission channels

# Contribution

## Literature on Credit Risk and Climate-related Transition Risk

### Assessment by **Credit Rating Agencies:**

#### External Credit Rating

Safiullah et al. (2021) // Emissions (US)  
Kiesel and Lucke (2019) // Text  
Devalle et al. (2017) // E-Score  
Attig et al. (2013) // E-Score  
Seltzer et al. (2020) // E-Score, Emissions (US)  
Stellner et al. (2015) // E-Score

### Assessment by **Financial Markets:**

#### Market-implied DtD, Bond yield spread, CDS spread

Kabir et al. (2021) // Emissions  
Kölbel et al. (2020) // Text  
Barth et al. (2020) // E-Score  
Capasso et al. (2020) // Emissions  
Höck et al. (2020) // Emissions  
Seltzer et al. (2020) // E-score, Emissions (US)  
Stellner et al. (2015) // E-Score

**This paper: Novel dataset, Common framework Rating and DtD, Europe vs US Transition**



# Data: Backward-looking environmental variables

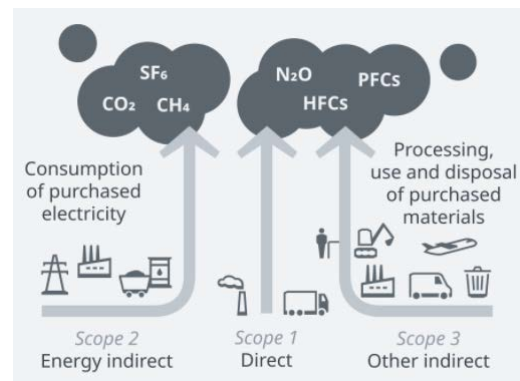
$Scope\ 1_{i,t}$	Scope 1 GHG emissions of a firm per unit of revenue. May be self-disclosed or 3 <sup>rd</sup> -party-estimated.	Urgentem
$Scope\ 2_{i,t}$	Scope 2 GHG emissions of a firm per unit of revenue. May be self-disclosed or 3 <sup>rd</sup> -party-estimated.	Urgentem
$Scope\ 3_{i,t}$	Scope 3 GHG emissions of a firm per unit of revenue. May be self-disclosed or 3 <sup>rd</sup> -party-estimated.	Urgentem
$DiscloseGHG_{d_{i,t}}$	Dummy indicating whether a firm's Scope 1, 2, &/or 3 GHG emissions are self-disclosed	Urgentem
$InferGHG_{d_{i,t}}$	Dummy indicating whether a firm's 1, 2, &/or 3 GHG emissions are inferred (not self-disclosed), i.e. $(1 - DiscloseGHG_{d_{i,t}})$	Constructed
$YoY\ Scope\ 1\ and\ 2_{i,t}$	Year-on-year change in self-disclosed Scope 1 and 2 GHG emissions of a firm per unit of revenue.	Urgentem

Legend:

Backward-looking metrics

Forward-looking metrics

## Scope 1, 2, 3 Green House Gas (GHG) emissions



Source: GHG protocol

# Data: Forward-looking environmental variables

<i>DiscloseTarget<sub>d<sub>i,t</sub></sub></i>	Dummy indicating whether a firm discloses a GHG emissions reduction target	Refinitiv
<i>TargetPerc<sub>i,t</sub></i>	Percentage by which the firm commits to reduce GHG emissions	Refinitiv
<i>TargetYear<sub>i,t</sub></i>	Number of years until reaching the target year by which firm commits to reduce GHG emissions	Refinitiv
<i>SBTi<sub>d<sub>i,t</sub></sub></i>	Dummy indicating whether the firm has a 2050-temperature-goal	SBTi
<i>Audited<sub>d<sub>i,t</sub></sub></i>	Dummy indicating whether the non-financial statement of the firm has been audited.	Refinitiv

Legend:

Backward-looking metrics

Forward-looking metrics

# H1: DiD Ratings and High-polluters in Europe

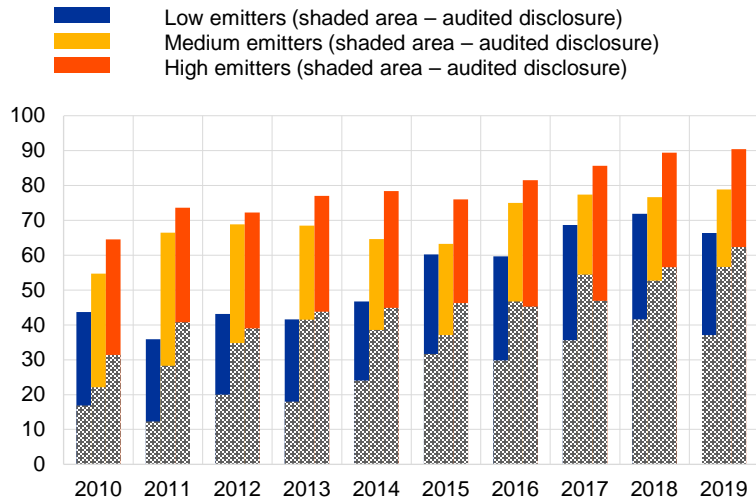
$$CreditRating_{i,t} = \alpha + \beta_0 Treatment_i \times postParis_t + \sum_{j=1}^N \gamma_j Controls_{j,i,t} + \rho FirmFE_i + \tau TimeFE_t + \epsilon_{i,t}$$

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Top GHG NACE x post-Paris	-0.55*** (0.17)			-0.53*** (0.16)		
Top GHG intensity x post-Paris		-0.16* (0.086)			-0.28 (0.18)	
Top GHG level x post-Paris			-0.32* (0.17)			-0.38** (0.16)
Top GHG NACE	0.84** (0.34)					
Top GHG intensity		-0.58* (0.35)				
Top GHG level			0.20 (0.39)			
Controls	N	N	N	Y	Y	Y
Time fixed-effects	N	N	N	Y	Y	Y
Firm fixed-effects	N	N	N	Y	Y	Y
Observations	1,530	1,530	1,530	1,474	1,474	1,474
Number of firms	170	170	170	170	170	170
R-squared	0.028	0.003	0.012	0.063	0.044	0.054

# H2 & H3: Stylised facts

## Firms disclosing GHG emissions

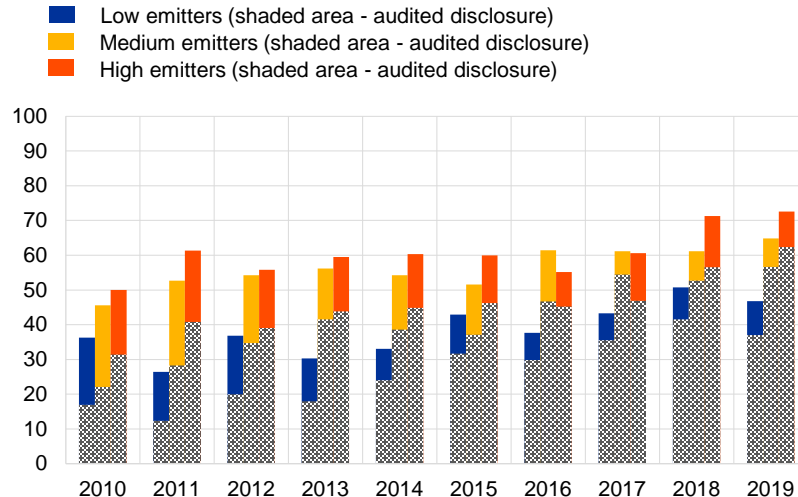
Lhs: Percentage of firms in the respective emitters tercile out of 859 listed NFCs



Sources: Urgentem, Refinitiv, and ECB calculations

## Firms disclosing emissions reduction targets

Lhs: Percentage of firms disclosing emission reduction targets in the respective emitters tercile out of 859 listed NFCs



# H2 & H3: Endogeneity: what may drive firm's adoption of climate disclosure?



Country

Regulation in a certain country ...

➤ Country FE



Sector

Public environmental scrutiny of a certain sector ...

➤ Sector FE



Year

Public scrutiny in years before the Paris Agreement...

➤ Year FE



Governance

Value(s)-driven management of the firm...

➤ Governance as control



High emitters

Public scrutiny of high-emitters...

➤ High-emitters robustness



Other firm-specifics

Firms preferences for green...

➤ Firm FE robustness