

Climate stress tests, bank lending, and the transition to the carbon-neutral economy

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Risk Management

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Banks face grilling over carbon emissions

Financial watchdogs are demanding greater transparency from lende environmental impact of their clients

Finance and climate change risk: Managing expectations

Stijn Claessens, Nikola Tarashev, Claudio Borio / 7 Jun 2022

The financial sector has a key role to play in supporting the green transition, but it is unrealistic to expect that it can drive the required reallocation of resources in the absence of adequate environmental policymaking in the real economy.

Climate-Conscious Banks Stick With Distressed Polluters

Goldman Sachs, JPMorgan made public commitments to environmental sustainability but continue to finance struggling coal and oil-and-gas producers

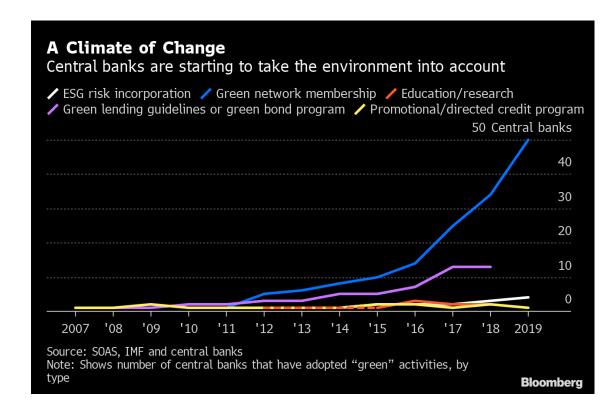
Towards a Green
Eurozone: ECB Climate
Risk Stress Test and
Monetary Policy
Changes



Motivation and Background

Intensive debate in literature and policy circles about climate risks and what to do about them...

- Banks account for firms' climate risks in their credit supply and risk management (Kacperczyk and Peydro, 2021; Ivanov et al., 2022; Mueller and Sfrappini, 2022).
- 2. The results are mixed because not all banks are well prepared for the green transition, some have private interest to protect brown customers (Degryse et al. 2022), or they shift transition risk away (by securitization (Mueller et al., 2022) or lending to brown borrowers abroad (Benincasa et al., 2022)).
- 3. Financing the green transition to "appear green" without adequate monitoring can lead to green bubbles (Claessens et al., 2022) or disconnection between sustainability reporting vs lending activities (Giannetti et al., 2023)



Can bank supervisors influence banks' decisions to support the green transition?

Research questions

Using French climate stress tests of 2020 as a natural experiment and RepRisk Firm Environmental Risk Index as a proxy for exposure to transition risk, we ask:

Q1. How do climate stress tests affect credit supply and the cost of credit for firms with high exposure to transition risk?

Yes, without climate stress tests, banks reduce credit for high transition risk firms but do not adjust loan prices. Climate stress tests serve as an information collection and production exercise: Stress tested banks are better informed about how to evaluate transition risk in the long-run, thus, banks increase loan volumes to high transition risk firms but charge higher interest rates, especially in the case of relationship lending.

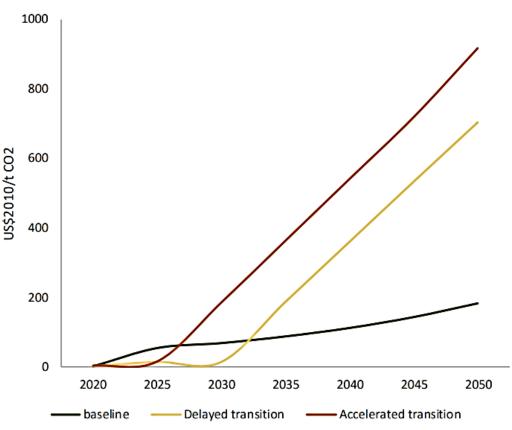
Q2. Do climate stress tests lead to improvements in borrowers' environmental performance?

Partially yes, but only in short-term performance: Higher transition risk borrowers are more likely to commit to carbon emission reduction targets, incorporate environmental evaluation in their projects, and have higher emission scores after receiving loans from stress-tested banks. However, we do not (yet) observe any improvement in their direct carbon emission intensities and we don't see that they "green" their supply chains.

Institutional background

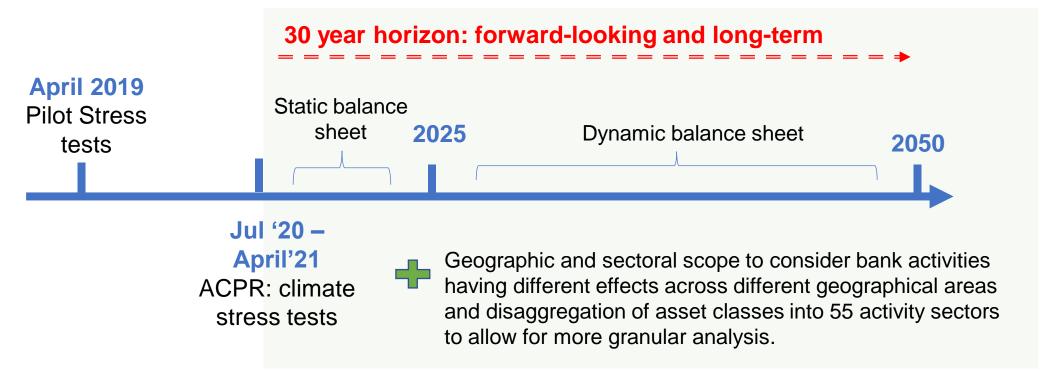
- Central banks conduct climate stress tests due to financial stability concerns. However, these exercises also inform participating banks about exposure to transition risk.
- From July 2020 to April 2021, the French Prudential Supervision and Resolution Authority (ACPR) was the first to challenge banking and insurance corporations to assess the risks associated with climate change. (Mainly physical risk for insurance companies, and mainly transition risk for banks).
- Objective of stress tests: measure consequences of climate transition risk for banks using different scenarios for sharp increases in carbon prices in 30 years.
- On a voluntary basis 9 banking groups [and 15 insurance groups] participated in these stress tests. These 9 banking groups represent 85 percent of French banks' total assets.

Carbon prices in different stress test scenarios



Source: ACPR

Institutional background



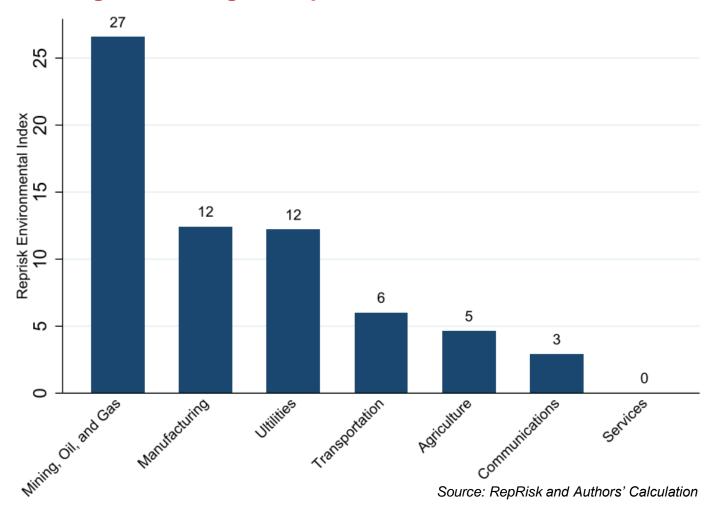
Climate stress tests do not identify "violators" but provide a platform for "two-way feedback" between supervisors and banks. They also produce new information that improve banks' comprehension of the long-run implications of climate change, allowing them to make headway in incorporating climate risks in their risk management frameworks.

Data

- Sample includes all Euro-denominated syndicated loans to French borrowers (2017 2022) from LPC Dealscan, i.e., loans may be provided by French and foreign banks.
- SIC codes from 6000 to 6999 are removed (financial firms).
- We care about lending decisions of lead arranger(s) only.
- Loan data merged with
 - Bank Scope to obtain lender characteristics.
 - Compustat Global and Amadeus files for borrower characteristics.
 - <u>Reprisk</u> provides Environmental Risk Index (ERI) based on proprietary algorithm ranging from [0 100] focused on news items related to carbon emissions and polluting incidents to capture transition risk (Duan et al. (forthcoming).
 - Refinitiv data (2019 2022) on firms' environmental performance such as carbon emissions, ESG scores, etc.
- Treatment group: 9 banks that participate in French climate stress tests and provide credit to French borrowers
- Control group: Foreign banks that provide credit to French borrowers

Stylized Facts: Environmental Risk Index

Higher ERI, higher exposure to transition risk



Summary statistics

On average, 1 syndicated loan has a size of **EUR 400 mil,**, maturity of **4 years**, and loan spreads of **50 basis points**.

1,758 loans given to 81 French firms by 126 EU banks.



42% of loans are given by stress-tested banks,58% other loans given by non-stress tested and similar EU banks.

30% of firms getting loans from stress-tested banks after climate stress tests. ERI indexes of these firms ranging between 0 and 27.

Carbon emission growth ranges between -47% to 112%.

Identification Strategy: Lending (1)

$$Y_{lbft} = \beta \times ERI_{f,t-1} + \gamma F_{ft} + \theta L_{lbft} + \delta_f + \delta_{bt} + \delta_l + \delta_p + \varepsilon_{lbft}$$

 Y_{lbft} Loan volume or loan spread for a given loan by bank b to borrower f at time t Environmental risk index related to transition risk for a borrower at time *t-1* $ERI_{f,t-1}$ Borrower characteristics (firm size, leverage, tangible assets, ROA) F_{ft} Loan maturity L_{lbft} δ_f Firm-fixed effects to capture firm-specific time-invariant effects (risk taking culture, loan demand) δ_{bt} Bank-time fixed effects to capture bank-specific time-varying effects δ_1 Loan-type fixed effects (whether the loan is revolving or term loans) δ_{n} Loan-purpose-fixed effects (investment purposes or buyouts, controlling for demand) $Y_{lbft} = \beta_1 \times ERI_f \times Post_t \times Treated_b + \beta_2 \times ERI_f \times Post_t + \beta_3 \times ERI_f \times Treated_b$ $+\gamma F_{ft} + \theta L_{lbft} + \delta_{bt} + \delta_{f} + \delta_{l} + \delta_{p} + \varepsilon_{lbft}$

Post_t Dummy taking on the value 1 for the period after the French climate stress tests (0 otherwise)Treated_b Dummy taking on the value 1 for a bank participating in the French climate stress tests (0 otherwise)

- Treatment group: 9 French banking groups that participate in climate stress tests.
- Control group: EU banks that provide credit to these borrowers but cannot participate in the climate stress tests.

Identification Strategy: Environment (2)

$$Y_{ft} = \beta_1 \times ERI_f \times Post_t \times Treated_{f,t-1} + \beta_3 \times ERI_f \times Post_t + \beta_4 \times ERI_f \times Treated_{f,t-1} + \gamma F_{ft} + \alpha_f + \tau_t + \varepsilon_{ft}$$

 Y_{ft} Short/long-term adjustments in environmental performance for borrower f at time t

Short-term adjustments

- CO2 reduction targets
- Environmental training
- Resource usage efficiency targets
- Environmental restoration initiatives
- Environmental project evaluation

Long-term adjustments:

- Carbon Emission Growth (Total and Scope 1)
- Emission scores
- Termination of environmentally unfriendly suppliers
- Materials sourcing environmental criteria

How similar are stress-tested banks and non-stress tested banks?

Prior to the stress tests, borrowers receiving loans from stress-tested and non-stress tested banks have similar environmental profiles.

Characteristics of stresstested and non-stress tested banks evolve in similar trends before stress tests.

	Tre	ated	Cor	ntrol	Treated - Control
Variable		SD	Mean	SD	Norm. diff.
Firms' Environmental Performance					
Δ ERI	0.468	3.613	0.435	5.808	0.00
Banks' characteristics					
Δ Bank size		0.049	-0.003	0.022	0.00
△ Equity/Total Assets	0.018	0.148	-0.000	0.030	0.12
Δ Loans/ Total Assets	0.077	1.623	0.217	0.491	-0.08
Δ Deposits/ Total Liabilities	-0.112	2.738	0.075	3.886	-0.01
ΔNII	-0.000	0.001	-0.000	0.000	-0.05
Firms' characteristics					
Δ Firm size	0.386	1.806	-0.090	1.806	0.19
Δ Leverage	0.361	15.110	1.309	21.068	-0.04
Δ ROA	-0.001	0.015	-0.000	0.015	-0.02

Characteristics of borrowers receiving loans from stress-tested and non-stress tested banks before the stress tests also satisfy parallel trends.

Banks' lending and borrowers' ERI

Loan volumes

decline significantly.

	(1)	(2)	(3)	(4)
I	Loan amount (Ln)	Loan amount (Ln)	Spread	Spread
ERI	-0.070***	-0.139***	-0.896	-1.916
	(0.015)	(0.019)	(1.223)	(1.695)
Firm Size		-0.014***		-0.489
		(0.003)		(0.339)
Firm Leverage		0.050***		3.119***
		(0.009)		(0.512)
Firm Tangibility		0.017		0.124
		(0.034)		(1.013)
Firm ROA		-0.296***		28.138***
		(0.072)		(3.413)
Maturity		0.061**		4.159
		(0.024)		(2.610)
Observations	1,228	1,228	1,228	1,228
Firm FE	Yes	Yes	Yes	Yes
Bank-Time FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Adjusted \mathbb{R}^2	0.862	0.868	0.723	0.727
Number of Banks	110	110	110	110
Number of Firms	75	75	75	75
Clustering	Bank	Bank	Bank	Bank

Loan **spreads** are **not** significantly affected.

Banks' reactions to climate stress tests

	(1)	(2)	(3)	(4)
	Loan amount (Ln)	Loan amount (Ln)	Spread	Spread
Treated \times ERI	-0.008	-0.010	-0.866	-0.733
	(0.013)	(0.014)	(0.942)	(0.889)
$ERI \times Post$	-0.053*	-0.037	-8.156*	-6.561*
	(0.030)	(0.034)	(4.376)	(3.897)
$\mathrm{Treat} \times \mathrm{ERI} \times \mathrm{Post}$	0.053**	0.059***	9.464*	9.836**
	(0.023)	(0.022)	(4.799)	(4.307)
Firm Size		0.004		-0.784***
		(0.002)		(0.205)
Firm Leverage		-0.012		-1.584
		(0.009)		(1.105)
Firm Tangibility		0.030		1.136
		(0.019)		(1.022)
Firm ROA		0.042		-11.936
		(0.069)		(7.615)
Maturity		0.013		4.212**
		(0.015)		(1.681)
Observations	1,758	1,758	1,758	1,758
Firm FE	Yes	Yes	Yes	Yes
Bank-Time FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.838	0.838	0.716	0.722
Number of Banks	126	126	126	126
Number of Firms	81	81	81	81
Clustering	Bank	Bank	Bank	Bank

Following the climate stress tests

- loan volumes <u>increase</u> significantly for borrowers with <u>greater</u> transition risk.
- loan spreads also increase significantly.

Stress tested banks seem to aid borrowers in the transition towards greener activities but also adjust the risk pricing to reflect the greater transition risk in sticking with such borrowers.

Heterogeneous adjustments?

	(1) Loan	(2) amount (Ln)	(3)	(4) Spread
	No Rel	Long-term Rel.	No Rel.	Long-term Rel.
$ERI \times Treat \times Post$	0.032 (0.035)	0.426*** (0.081)	3.263* (1.910)	6.484** (3.262)
Observations	1,300	458	1,300	458
Loan Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Bank-Time FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.850	0.844	0.697	0.868
Number of Banks	122	53	122	53
Number of Firms	73	28	73	28
Clustering	Bank	Bank	Bank	Bank

Long-term relationships (> 2 loans over last 5 years) matter!

Von Thadden (1995) argues banks might tolerate shortterm bad results as long as they can extract long-term rents from lending relationships.

- Banks only increase loan amount for firms that they have long-term relationships with but adjust interest rates for both types of borrowers.
- Interest rates are also higher for these relationship borrowers.

Remember!

Climate-Conscious Banks Stick With Distressed Goldman Sachs, JPMorgan made public commitments to environmental sustainability but continue **Polluters** to finance struggling coal and oil-and-gas producers

Climate stress tests and firms' environmental performance

	(1) Resource Efficiency Objectives	(2) Env. Management Training	(3) Env. Restoration Initiatives	(4) Emission Reduction Commitment	(5) CO2 Reduction Production Target	(6) Env. Project Evaluation
Treated \times Post \times ERI	0.001* (0.001)	0.014** (0.005)	0.016** (0.006)	0.013*** (0.002)	0.007* (0.004)	0.005* (0.003)
Observations	749	749	749	749	749	749
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted \mathbb{R}^2	0.161	0.806	0.789	0.485	0.304	0.891
Number of Firms	184	184	184	184	184	184
Clustering	Firm	Firm	Firm	Firm	Firm	Firm

Following the climate stress tests borrowers of participating banks

- significantly increase resource efficiency objectives, boost environmental management training,
- strengthen environmental restoration initiatives, bolster emission reduction commitments,
- strengthen environmental project evaluation.

Climate stress tests and environmental performance: Long-term

	(1)	(2)	(3)	(4)	(5)	(6)
	Emissions	Total	Direct	ESG	Termination of	Materials
	Score	Emissions	Emission	Score	Env. Unfriendly	Sourcing
		Growth	Growth		Suppliers	Env. Criteria
Treated \times Post \times ERI	0.467^{*}	-0.442	-1.108	0.172	0.001	0.002
	(0.280)	(1.116)	(0.691)	(0.122)	(0.011)	(0.007)
Observations	749	749	749	749	749	749
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted \mathbb{R}^2	0.907	0.060	0.022	0.944	0.878	0.867
Number of Firms	184	184	184	184	184	184
Clustering	Firm	Firm	Firm	Firm	Firm	Firm

Borrowers only seem to make short-term adjustments!

- (Weak) evidence on improving their emissions scores.
- There is no suggestion that total emissions growth, (direct) emissions growth, or ESG scores improve.
- They do not terminate supply chain links to environmentally unfriendly suppliers or source environmentally-friendly materials.

Falsification tests

	(1)	(2)	(3)	(4)
	Loan	Spread	Loan	Spread
	amount (Ln)		amount (Ln)	
Fal_Treated	-0.001	13.188**		
	(0.044)	(6.083)		
Fal_Treated \times ERI	-0.006	-2.270**		
	(0.009)	(1.034)		
$Fal_Treated \times Post$	0.108	-13.374		
	(0.107)	(9.766)		
$ERI \times Post$	0.024	-1.689		
	(0.036)	(4.160)		
$Fal_Treated \times ERI \times Post$	-0.013	5.262		
	(0.031)	(5.388)		
$ERI \times Post_Fal$			-0.064**	-3.036
			(0.025)	(1.907)
$Treated \times ERI \times Post_Fal$			-0.000	-0.701
			(0.008)	(1.891)
Treated \times ERI				0.612
				(0.507)
Observations	1,720	1,720	1,758	1,758
Loan Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Bank-Time FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Adjusted \mathbb{R}^2	0.836	0.716	0.839	0.721
Number of Banks	125	125	126	126
Number of Firms	81	81	81	81
Clustering	Bank	Bank	Bank	Bank

- Randomly assigning climate stress tested banks renders key coefficient insignificant.
- Assigning year of stress test to non-stress test year also renders key coefficient insignificant.

Next steps

- Explore heterogeneities across different industries, and bank characteristics.
- Account for banks' commitments to protecting the climate (Science Based Targets Initiative/Net Zero Banking Alliance).
- External validity tests using EU climate stress tests as natural experiments.
- Controlling for institutional investors' pressure/expectations.
- Investigating other dimensions of firms' environmental profiles such as green investments, green technologies, and green innovations.
- Sensitivity checks using different measures of firms' exposure to transition risk such as carbon emission intensities, and regulatory/supervisory transition risk indexes.

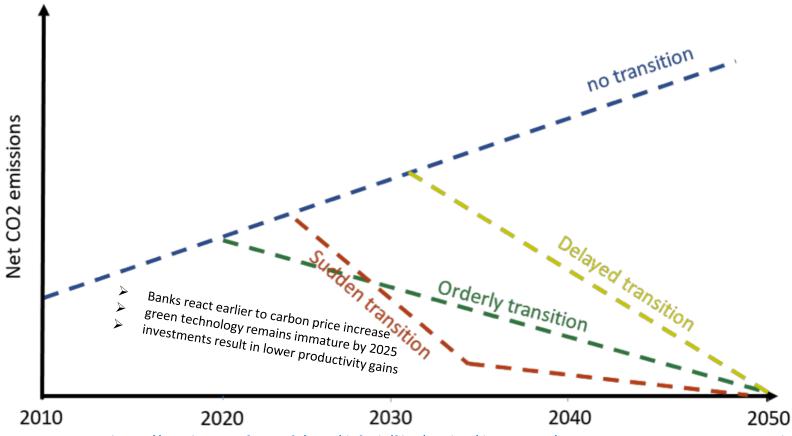
Conclusion

- We are the first to examine how banks respond after climate stress tests to borrowers' exposure to transition risk.
- Novel evidence that climate stress-tested banks increase lending to higher transition risk borrowers, in case of longterm relationships with but simultaneously adjust their risk pricing in a non-favorable manner for the borrower.
- Following the changes in loan characteristics, borrowers of stress-tested banks
 - are more likely to have environmental restoration plans
 - enroll employees in environmental trainings
 - have CO2 reduction targets and environmental evaluation of their projects but
 - there is little or no evidence that they terminate relationships with 'brown suppliers' or
 - reduce carbon emissions relative to total revenue or use fewer 'brown' materials (either greenwashing or adjustments in hard facts take more time to become observable)

... to be continued.

APPENDIX

Stress-test scenarios



Scenarios vary in terms of carbon price adjustments and expected productivity of ,green energy'.

Source: https://acpr.banque-france.fr/sites/default/files/medias/documents/20200717 main assumptions and scenarios of the acpr climate pilot exercise.pdf

Literature

Loan contract terms, especially spreads, and volumes vary based on whether borrowers are 'brown' or 'green'

• Chava (2014); Delis et al. (2021); Degryse et al. (2021); Ehlers et al. (2021); Kacperczyk and Peydro (2021); Ivanov et al. (2021); Reghezza et al. (2022)

Pricing of mortgages also varies with exposure to environmental risk

Nguyen et al. (2022)

Equity markets, bond markets, and credit rating agencies respond to carbon risk

Ramelli et al. (2019); Bolton and Kacperczyk (2021); Choi et al. (2020); Engle et al. (2020); Lent et al. (2022); Huynh and Xia (2020);
 Seltzer et al. (2022)

→ Our paper:

- Confirms work showing that borrowers whose activities harm the environment receive less credit but
- offers novel evidence that borrowers whose banks take a long-term perspective about transition risk grant more credit to aid the transition to less environmentally harmful activities to long-term borrowers, but banks simultaneously price the greater risk and
- shows that such borrowers improve in many 'soft' dimensions in terms of increasing CO2 reduction targets, environmental training of employees while failing to adjust 'hard' dimensions of transitioning towards greener activities such as using environmentally friendly materials.

Theory and hypothesis development

Transition into a low-carbon economy can lead to climate-related financial stability risks.

Equivalent to a carbon tax to curb climate change (Nordhaus 1992, 1994) banks can penalize high emitters via higher loan rates.



Loan pricing may aid the transition to the net-zero economy, equivalent to taxing carbon dioxide emissions.

<u>Important:</u> The stress test looks at adverse scenarios where carbon prices rise to unexpected levels, thus giving rise to greater transition risk.

If banks correctly evaluate borrowers' transition risk, one would not expect high-emitting firms to attract higher cost of capital or experience funding constraints after the stress tests.

Alternatively, if stress tests act as a channel for banking supervisors to **inform participating banks** on what to expect when evaluating transition risk, then stress tests may influence credit supply and pricing decisions of banks.

Appendix Table B.1. French climate stress test participants

This table shows an overview about business models of 9 banking groups that participated in the French Climate Stress Tests of 2020.

	(1)	(2)	(3)	(4)
Bank Name	Business Model	Science Based Targets Initiative	NetZero Banking	${\bf SSM~Supervision}$
AGENCE FRANÇAISE DE DÉVELOPPEMENT	Public development bank	Not a member	Not a member	No
BNP PARIBAS	Universal bank	Member	Member	Yes
BPCE	Universal bank	Not a member	Member	Yes
CAISSE DES DÉPÔTS	Public development bank	Not a member	Not a member	No
CREDIT AGRICOLE	Universal bank	Member	Member	Yes
CREDIT MUTUEL	Universal bank	Not a member	Member	Yes
LA BANQUE POSTALE	Public retail bank	Member	Member	Yes
SOCIÉTÉ GÈNÉRALE	Universal bank	Member	Member	Yes
SOCIÉTÉ DE FINANCEMENT LOCALE	${\bf Public\ Development\ Bank}$	Not a member	Not a member	No

Climate stress tests, bank lending, and the transition to the carbon-neutral economy

RepRisk - Example

Company name	Publication date of the risk incident (news)	All issues linked
Renault SA	16/03/2017	Violation of national legislation; Products (health and environmental issues); Fraud

Renault shares drop after reports of potential emissions fine

Michael Stothard MARCH 16 2017

Michael Stothard MARCH 16 2017

Shares in Renault fell as much as 6 per cent on Thursday following media reports that the carmaker could face fines for breaching emissions rules, as regulators continue to crack down on carmakers following the Volkswagen scandal.

Return