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

Larissa Fuchs *(University of Cologne)*
Huyen Nguyen *(IWH Halle and FSU Jena)*
Trang Nguyen *(University of Bristol)*
Klaus Schaeck *(University of Bristol)*

Risk Management   (+ **Add to myFT**)

Banks face grilling over carbon emissions

Financial watchdogs are demanding greater transparency from lende[rs] 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
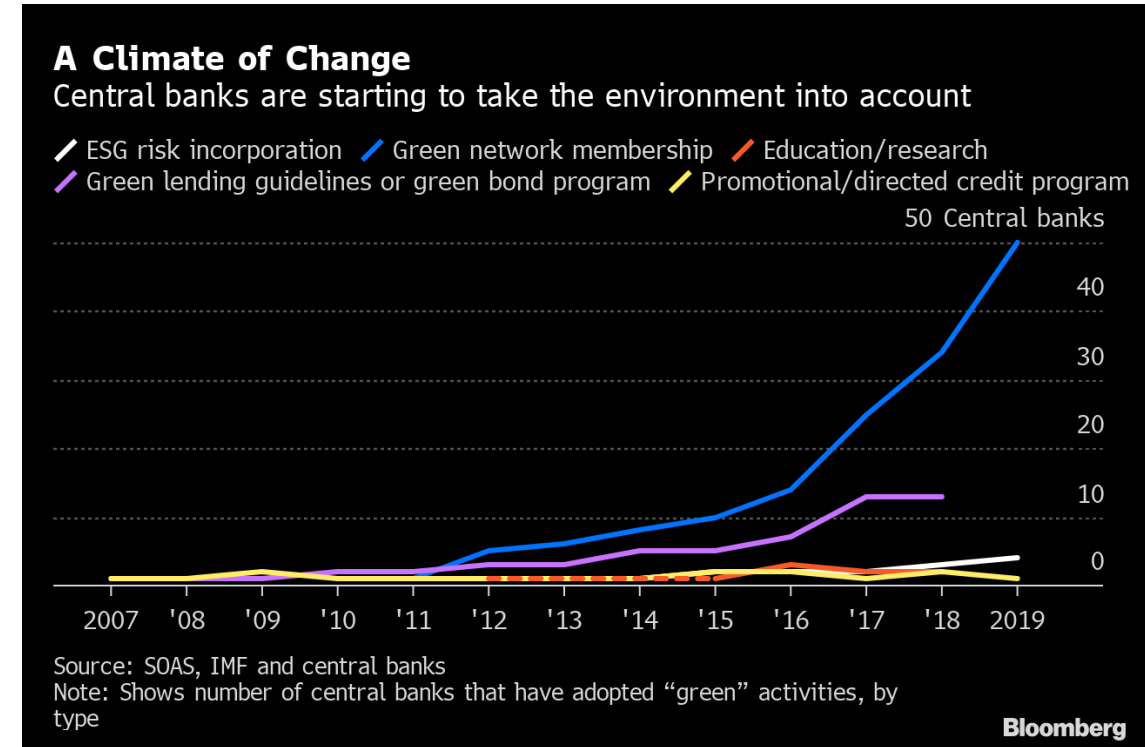
Towards a Green Eurozone: ECB Climate Risk Stress Test and Monetary Policy Changes

Motivation and Background

Intensive debate in literature and policy circles about carbon transition risks and what to do about them…

1. **Banks account for firms' carbon risks in their credit supply and risk management** (Kacperczyk and Peydro, 2021; Ivanov et al., 2022; Mueller and Sfrappini, 2022).

2. **Results are mixed** because **not all banks are well prepared for the green transition,** some have **private interests to protect brown customers** (Degryse et al. 2022), or **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)

A Climate of Change
Central banks are starting to take the environment into account

- ESG risk incorporation
- Green network membership
- Education/research
- Green lending guidelines or green bond program
- Promotional/directed credit program

Source: SOAS, IMF and central banks
Note: Shows number of central banks that have adopted "green" activities, by type

Bloomberg

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

Two research questions

Using the French climate pilot exercise of 2020 as a natural experiment, carbon emissions, borrower environmental performance from Refinitiv, and syndicated loans from Dealscan, we ask:

How do climate stress tests affect credit supply and the cost of credit for 'brown' firms?

- **Yes, without the climate pilot exercise, limited evidence** that banks reduce credit and ask for higher interest rates for brown firms.

- **Climate stress tests serve as an information collection and production exercise.**

  - Participating banks are better informed about how to evaluate transition risk in the long-run.

  - Banks **increase loan volumes to brown** firms but **charge higher interest rates**.

  - Participating banks **collect new information about climate risks** and are **more likely to originate green loans** for high carbon emitters.

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

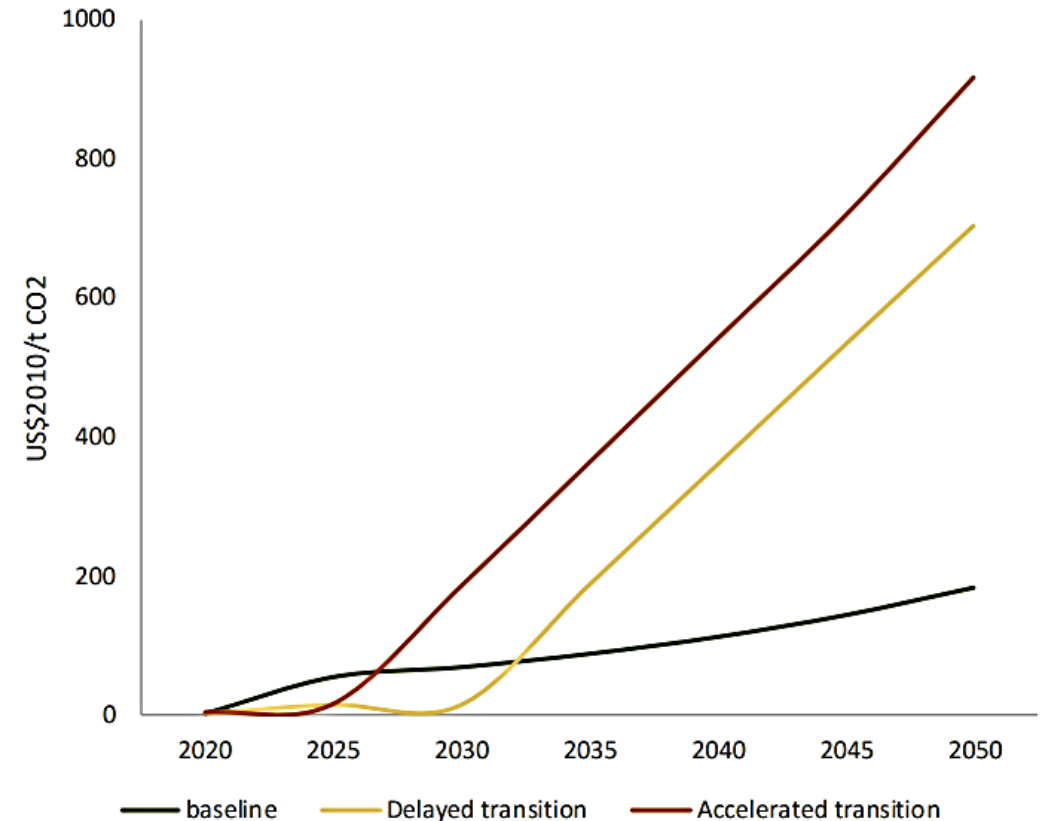- **Partially yes, but only in the short run.**

    Brown borrowers

    - are more likely to have eco-friendly products, develop emission policies, commit to carbon emission reduction targets, and have higher ESG scores

    - use higher shares of renewable energy

    - However, they do not (yet) display improvements in direct carbon emission intensities, and they do not seem to "green" their supply chains.
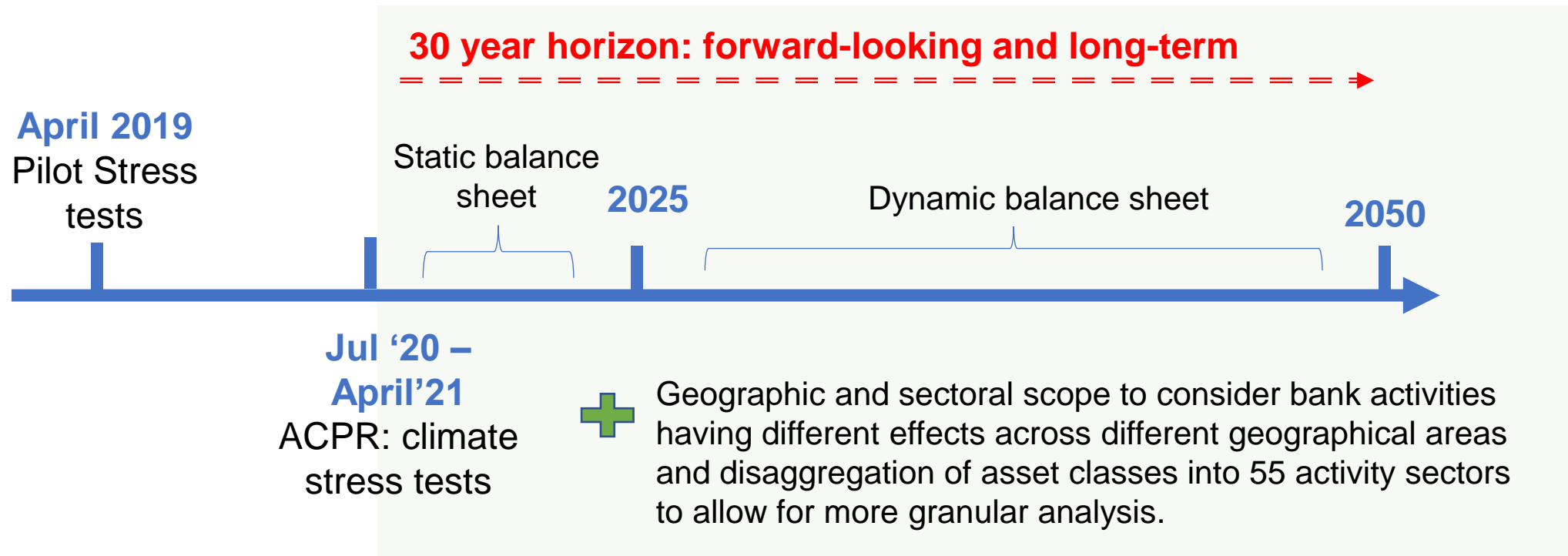
Institutional background

- Central banks conduct climate stress tests due to financial stability concerns. However, these exercises also inform participating banks (and indirectly their borrowers via feedback effects) about exposures to transition risk.

- From July 2020 to April 2021, the French Prudential Supervision and Resolution Authority (ACPR) was the first to challenge banks and insurers to assess risks associated with climate change. (Mainly physical risk for insurance companies, and mainly transition risk for banks).

- Objective of the climate pilot exercise: Measure consequences of climate transition risk using **different scenarios for increases in carbon prices** over the next 30 years.

- Nine 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

30 year horizon: forward-looking and long-term

April 2019
Pilot Stress tests

Static balance sheet

2025

Dynamic balance sheet

2050

Jul '20 – April'21
ACPR: climate stress tests

Geographic and sectoral scope to consider bank activities having different effects across different geographical areas and disaggregation of asset classes into 55 activity sectors to allow for more granular analysis.
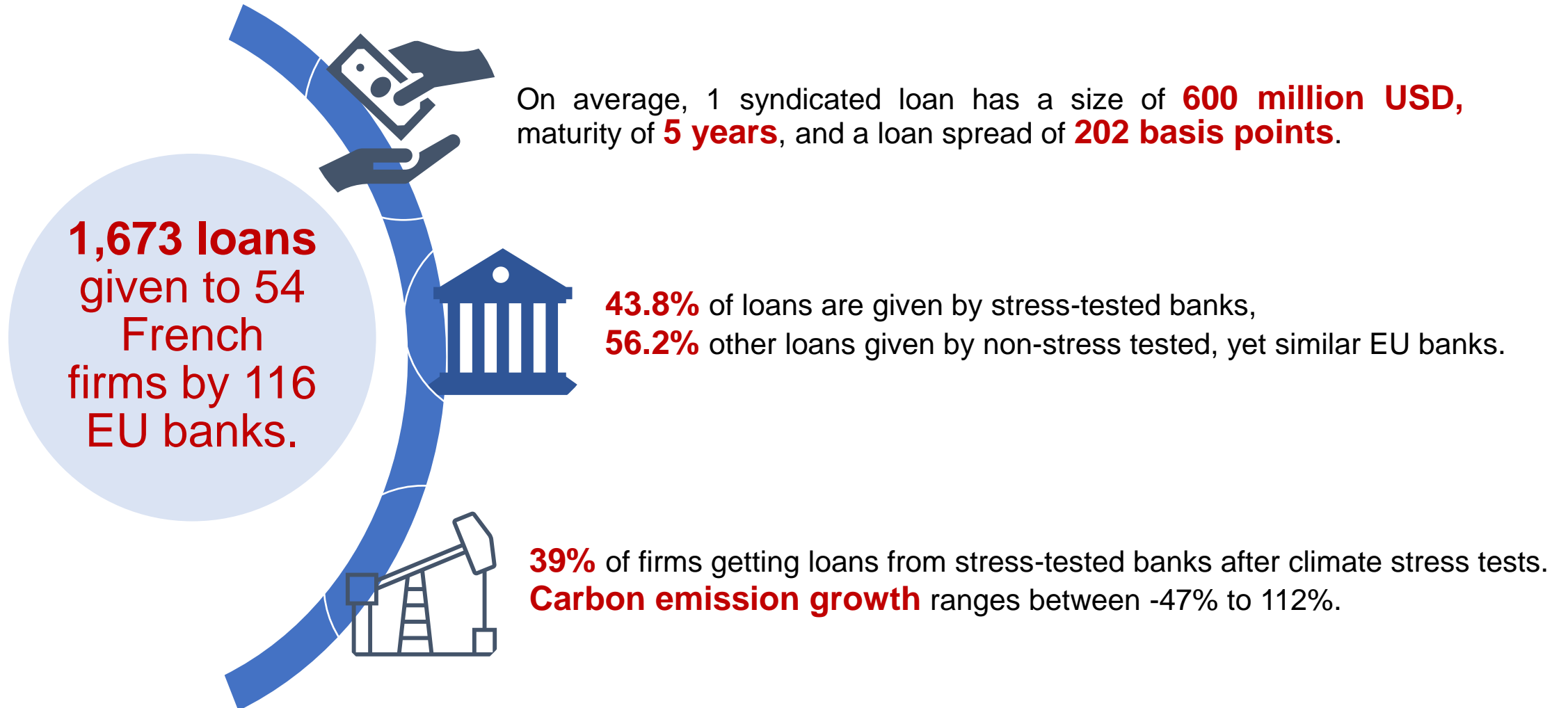
- The French climate pilot exercise does not identify "violators".
- It provides a platform for "two-way feedback" between supervisors and banks.
- It produces new information to improve banks' comprehension of long-run implications of climate change, allowing them to make headway in incorporating climate risks in risk management frameworks.

Data

- Sample includes all Euro-denominated syndicated loans to French borrowers (2015 – 2023) from LPC Dealscan.

- These loans are provided by French or foreign banks.

- SIC codes from 6000 to 6999 are removed (financial firms).

- We care about the lending decisions of lead arranger(s) only.

- Loan data merged with
  - Bank Compustat and Bank Focus to obtain lender characteristics.
  - Compustat Global for borrower characteristics.
  - Refinitiv data (2015 – 2023) on borrowers' carbon emissions and environmental performance.

- Conference call data and transcripts are from S&P Capital IQ

Summary statistics

On average, 1 syndicated loan has a size of **600 million USD,** maturity of **5 years**, and a loan spread of **202 basis points**.

1,673 loans given to 54 French firms by 116 EU banks.

43.8% of loans are given by stress-tested banks,
56.2% other loans given by non-stress tested, yet similar EU banks.

39% of firms getting loans from stress-tested banks after climate stress tests.
Carbon emission growth ranges between -47% to 112%.

Identification Strategy: Lending (1)

$$Y_{lbft} = \beta \times CarbonEmissions_{f,t-1} + \gamma F_{ft} + \theta L_{lbft} + \delta_b + \delta_l + \delta_{it} + \varepsilon_{lbft}$$

Y_{lbft}	Loan volume or loan spread for a given loan by bank b to borrower f at time t
$CarbonEmissions_{f,t-1}$	Carbon emissions (ln, tons) of borrower f at time t-1
F_{ft}	Borrower characteristics (firm size and leverage)
L_{lbft}	Loan maturity
δ_b	Bank-fixed effects to capture bank-specific time-invariant effects
δ_l	Loan-type fixed effects (revolving/term loans, to capture differences in contract features)
δ_{it}	Industry-time fixed effect to capture differences in loan demand across different industries over time during our sample period
ε_{lbft}	Error term

$$Y_{lbft} = \beta_1 \times HighEmitter_f \times Post_t \times Treated_b + \beta_2 \times HighEmitter_f \times Post_t + \beta_3 \times HighEmitter_f \times Treated_b$$

$$+\beta_4 \times HighEmitter_f + \beta_5 \times Post_t + \gamma F_{ft} + \theta L_{lbft} + \delta_b + \delta_l + \delta_{it} + \varepsilon_{lbft}$$

$HighEmitter_f$	Dummy taking on the value 1 if the average carbon emissions of borrower f before 2020 is above the median (0 otherwise)
$Post_t$	Dummy taking on the value 1 for the period after (2020Q3) 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: Loans originated by French banking groups that participate in the climate pilot exercise.

Control group: Loans provided by French and foreign banks that provide credit to these borrowers but do not or cannot participate in the climate pilot exercise.

Identification Strategy: Environment (2)

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

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

Short-term adjustments	*Long-term adjustments*
Eco-friendly product	**Renewable energy**
ESG score	**Total emissions growth**
Environmental score	**Direct emissions growth**
Emission score	**Having supply chain environmental policies**
Having emission policies	**Termination of environmentally unfriendly suppliers**
Having target emissions	**Materials sourcing environmental criteria**

$HighEmitter_f$ Dummy taking on the value 1 if the average carbon emissions of borrower *f* before 2020 is above the median (0 otherwise)

$Treated_{f-1}$ Dummy taking on the value 1 for a borrower receiving any loan from a climate stress-tested bank the year before (0 otherwise)

α_f Borrower-fixed effects

τ_t Time-fixed effects

How similar are participating banks and non-participating banks?

Prior to the stress tests, borrowers receiving loans from participating and non-participating banks have similar trends in loan characteristics.

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

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

Variable	Mean Treated	Mean Control	Diff.	t-stat
Loans Characteristics				
Δ Loan Amount (Ln)	-0.043	0.084	-0.126	-0.49
Δ Spreads (Ln)	0.099	0.186	-0.087	-0.48
Banks' characteristics				
Δ Share of High Emitting Borrowers	0.024	0.008	0.016	0.15
Δ Bank size	0.657	-0.222	0.881	0.98
Δ Equity/Total Assets	-0.093	-0.403	0.310	0.29
Δ Loans Growth (%)	-0.338	-0.391	0.052	0.06
Δ ROA	-0.018	-0.022	0.004	0.05
Firms' characteristics				
Δ Firm size	0.657	-0.222	0.880	0.98
Δ Leverage	-0.001	0.230	-0.232	0.05
Δ ROA	0.103	0.044	0.059	0.12

Banks' lending and borrowers' carbon emissions

	(1)	(2)	(3)	(4)
	Loan amount (Ln)		Spread (Ln)	
Carbon Emission (Ln)	0.066	0.068	-0.002	-0.005
	(0.042)	(0.042)	(0.023)	(0.024)
Maturity	0.016	0.018	0.063	0.066
	(0.103)	(0.106)	(0.052)	(0.049)
Borrower Size		0.006		0.017
		(0.014)		(0.014)
Borrower Leverage		-0.001		-0.001
		(0.004)		(0.003)
Borrower ROA		-0.028		-0.026
		(0.018)		(0.016)
Loan Amount (Ln)			-0.236**	-0.232***
			(0.088)	(0.083)
Loan Spread	-0.722***	-0.724***		
	(0.134)	(0.139)		
Observations	992	992	992	992
Bank FE	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.874	0.875	0.888	0.891

No evidence that banks reduce credit supply or increase loan rates to high transition firms.

Banks' reactions to climate pilot exercise

	(1)	(2)	(3)	(4)
	Loan amount (Ln)		Spread (Ln)	
Treat × High Emitter × Post	0.390**	0.380**	0.082**	0.080**
	(0.190)	(0.186)	(0.031)	(0.033)
Treat × High Emitter	-0.326*	-0.321*	-0.050*	-0.049*
	(0.179)	(0.176)	(0.027)	(0.028)
High Emitter × Post	-0.039	-0.039	-0.034***	-0.033**
	(0.059)	(0.059)	(0.009)	(0.013)
High Emitter	-0.256	-0.293	-0.394**	-0.419**
	(0.520)	(0.512)	(0.163)	(0.167)
Observations	1,673	1,673	1,673	1,673
Bank FE	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.855	0.856	0.906	0.907

First and third columns do not contain control variables

Following the climate pilot exercise

- loan volumes **increase** significantly for borrowers with **greater** transition risk.
- loan spreads also **increase** significantly.

Participating 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.

Does the pilot exercise aid the green transition?

Dependent Variable	(1) Loan Amount (Ln)	(2)	(3) Spreads (Ln)	(4)
Sample	> 3Y	<= 3Y	> 3Y	<= 3Y
Treat × High Emitter × Post	0.379**	-0.228	0.107***	0.021
	(0.180)	(0.145)	(0.039)	(0.026)
Treat × High Emitter	-0.259*	0.193	-0.067**	-0.018
	(0.154)	(0.137)	(0.032)	(0.024)
High Emitter × Post	0.257	0.000	0.167	0.000
	(0.880)	(0.000)	(0.208)	(0.000)
Treat × Post	-0.013	0.278	-0.004	-0.026
	(0.037)	(0.187)	(0.011)	(0.032)
High Emitter	-0.797	0.000	-0.324*	0.000
	(0.533)	(0.000)	(0.178)	(0.000)
Post	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1,288	408	1,288	408
Bank FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No
Year FE	No	No	No	No
Industry × Year FE	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes

Our findings are driven by loans with maturities above 3 years

➔ The lending activities that are of greater relevance for the green transition have **longer maturities**.

Fuchs, Nguyen, Nguyen, and Schaeck   14

Does the pilot exercise aid the green transition?

Dependent Variable	(5) P (Green)	(6) P (Green)	(7) Green Share	(8) Green Share
Sample	All	All	All	All
Treat × High Emitter × Post	0.076*	0.091*	0.046**	0.043**
	(0.041)	(0.051)	(0.022)	(0.018)
Treat × High Emitter	-0.025	-0.041	-0.026**	-0.023**
	(0.025)	(0.034)	(0.012)	(0.011)
High Emitter × Post	0.015	0.068	-0.112	-0.180**
	(0.154)	(0.145)	(0.075)	(0.069)
Treat × Post	-0.015	-0.008	-0.008	-0.009
	(0.014)	(0.014)	(0.006)	(0.010)
High Emitter	0.180	0.197*	-0.035	-0.024
	(0.113)	(0.103)	(0.033)	(0.034)
Post	-0.276***	-0.287***	-0.712***	-0.689***
	(0.097)	(0.084)	(0.054)	(0.091)
Observations	1,673	1,673	749	749
Bank FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	No	No
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	No	No	No
Loan Controls	Yes	Yes	Yes	Yes
Firm Controls	No	Yes	No	Yes

After the climate pilot exercise,

- treated banks are more likely to provide a green loan for high carbon emitters,
- the share of green loans over total loans that participating banks provide increases.

We define a loan to be for green purposes if its Loan Purpose Remark contains the following terms, words, or phrases:

- Wind Farms, Solar energy, Decarbonization, Sustainability-linked, Energy Efficiency, Renewable, Storage Battery, Science-based targets

Heterogeneities

Dependent Variable	(1) Loan Amount (Ln)	(2)	(3) Spreads (Ln)	(4)	(5) Loan Amount (Ln)	(6)	(7) Spreads (Ln)	(8)
Sample	UNEP	Non-UNEP	UNEP	Non-UNEP	High IO	Low IO	High IO	Low IO
Treat × High Emitter × Post	0.550**	0.241	0.107**	0.042	0.712**	0.093	0.105**	0.081
	(0.190)	(0.174)	(0.048)	(0.039)	(0.341)	(0.085)	(0.049)	(0.065)
Treat × High Emitter	-0.502***	-0.167	-0.082**	-0.023	-0.639*	0.013	-0.058	-0.042
	(0.150)	(0.174)	(0.035)	(0.041)	(0.316)	(0.026)	(0.041)	(0.038)
High Emitter × Post	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Treat × Post	-0.140	0.020	-0.051**	-0.037*	-0.113	-0.000	-0.056***	-0.004
	(0.107)	(0.038)	(0.022)	(0.020)	(0.093)	(0.040)	(0.019)	(0.028)
High Emitter	-0.257	-0.333	-0.415**	-0.335*	-0.098	-1.170***	-0.391**	-0.100
	(0.503)	(0.532)	(0.150)	(0.177)	(0.559)	(0.222)	(0.164)	(0.103)
Post	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	644	1037	636	1037	881	806	867	806
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	No	No	No	No	No
Year FE	No	No	No	No	No	No	No	No
Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The effects on loan volumes and spreads are concentrated in

- banks that are signatories of the UN Principles for Responsible Banking (UNEP),
- banks whose ownership structure is dominated by institutional investors

Mechanism: Information Production (1)

Snapshot on Earning Calls Q2 2020, Societe Generale

we call a vulnerability indicator. And this, of course, it's a long-term view we are taking on the way clients are exposed to transition risk and what impact it would have, the fact that they would not adapt to the objective of climate change, and in particular, taking into account a scenario, which is the sustainable development scenario. So at this stage, for us, it's a way to work on stress test on climate risk. It doesn't lead into additional capital yet. But of course, it prepares us to handle all the upcoming stress tests, which are going to be led by regulators and supervisors. It's part also of our disclosures, and it will prepare us also in terms of segmentation of clients that are information and reporting when we will have to align also with the various regulations.

Snapshot on Earning Calls Q2 2022, Societe Generale

but it may also expose some companies to another risk: that of losing value because of their incompatibility with the low carbon economy, a tire manufacturer without a green economy. So we've adopted different measures for measuring impact and assessing vulnerability to risk. And we carry our testing -- stress testing exercises for ourselves and under the leadership of regulators.

And what we are doing, very concretely taking, of course, a portfolio which is probably at the call the one which is the most questionable, is to commit to cut by 10% in the short-term 2025. So the horizon that we have in mind for our strategic road map. Our footprint in terms of the extraction of oil and gas, we will do that by also accompanying our clients in their own transition. There are some major companies which are doing the job. I have in mind the TAM, for example. And we will accompany them, including in the financing of gas that we see as a useful energy for the transition phase.

Mechanism: Information Production (2)

Snapshot on Earning Calls Q3 2021, BNP Paribas

And then when you look at the European Commission, when it comes to CSR. The thing is we are fully aligned on supporting the economy in those elements. And what I mean by that? So we are looking at it to make sure that we embark all of those criteria, and we also want to make sure that basically our clients over time embark those criteria. So that basically means that we are having an evolution of our criteria to underwrite clients, which includes all of these elements. It's -- and again, I'm not saying that they have to be carbon neutral tomorrow, but they have to have a -- can demonstrate that they have a trajectory on what they will do on the aligning with the overall strategy. So that is basically what we are aligned on. We are very active in that area. And so that's basically fine for us.

Snapshot on Earning Calls Q2 2022, BNP Paribas

And we also created the low carbon transition group, which ultimately will comprise 250 professionals. And in terms of financing of renewable energy sources, we've exceeded our objective. We stand at EUR 18.6 billion at the end of 2021, and our ambition is to achieve EUR 30 billion in 2025. That's an increase of 70% compared with 2020. Also, we're maintaining our position in the top 3 positions worldwide regarding green bonds.

Mechanism: Information Production (3)

This table reports how the climate pilot exercise affects the probability of banks discussing issues related to scenarios of climate stress tests, communication with borrowers on transition risk, and the number of times that banks discussed about carbon emissions in their earning calls. Data on discussions of these issues are hand-collected from earnings calls of all banks in our sample.

	(1) Mentioning Climate Stress Tests	(2) Communication with Borrowers on Transition Risk	(3) Discussion about Emissions
Post	0.031	0.018	-0.073
	(0.028)	(0.026)	(0.060)
Treat × Post	0.045**	0.097***	0.513*
	(0.022)	(0.017)	(0.281)
Observations	1,125	1,125	1,125
Bank FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Adjusted R^2	0.035	0.053	0.041

Firms' environmental performance: short term

	(1) Eco-Friendly Product	(2) ESG Score	(3) Env. Score	(4) Emission Score	(5) Emission Policies	(6) Target Emissions
Treat × Post × High Emitter	0.251*	0.129**	0.155*	0.202**	0.232**	0.404**
	(0.145)	(0.059)	(0.091)	(0.094)	(0.097)	(0.200)
Treat × Post	-0.059	0.016	0.046	0.061**	-0.035	-0.008
	(0.075)	(0.028)	(0.028)	(0.028)	(0.038)	(0.088)
Treat × High Emitter	-0.203	0.009	0.086	0.105	0.120	-0.183
	(0.196)	(0.072)	(0.092)	(0.112)	(0.107)	(0.191)
Post × High Emitter	-0.196*	-0.110**	-0.108	-0.157*	-0.158*	-0.348*
	(0.106)	(0.047)	(0.081)	(0.082)	(0.087)	(0.182)
Treat	0.264**	0.031	0.031	0.022	0.065	0.037
	(0.108)	(0.040)	(0.050)	(0.050)	(0.046)	(0.106)
High Emitter	0.114	-0.040	-0.094	-0.112	-0.147	0.196
	(0.156)	(0.063)	(0.081)	(0.099)	(0.101)	(0.153)
Observations	943	943	943	943	943	943
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.305	0.140	0.221	0.151	0.595	0.244
Number of Firms	151	151	151	151	151	151
Clustering	Firm	Firm	Firm	Firm	Firm	Firm

Following the climate pilot exercise, borrowers of participating banks are

- more likely to have eco-friendly products
- develop emission policies,
- commit to carbon emission reduction targets
- and have higher ESG, environmental and emission scores

Firms' environmental performance: Long-term

	(1) Renewable Energy (%)	(2) Total Emission Growth	(3) Direct Emission Growth	(4) Supply Chain Policy	(5) Termination of Env. Unf. Suppliers	(6) Materials Sourcing Criteria
Treat × Post × High Emitter	0.158*	-2.941	5.172	-0.022	0.076	0.241
	(0.084)	(13.116)	(9.987)	(0.097)	(0.149)	(0.155)
Treat × Post	-0.014	2.091	-2.674	0.142***	0.231**	-0.075
	(0.042)	(6.627)	(3.732)	(0.050)	(0.091)	(0.085)
Treat × High Emitter	0.029	-2.314	-5.117	0.176	0.145	-0.064
	(0.073)	(6.523)	(6.554)	(0.113)	(0.221)	(0.185)
Post × High Emitter	-0.066	-1.843	-8.287	0.027	-0.003	-0.142
	(0.065)	(10.719)	(8.031)	(0.085)	(0.117)	(0.130)
Treat	-0.006	4.142	4.297	0.040	-0.094	0.298***
	(0.045)	(3.967)	(2.660)	(0.070)	(0.117)	(0.106)
High Emitter	-0.059	-0.226	3.985	-0.115	-0.104	0.070
	(0.062)	(4.760)	(5.068)	(0.093)	(0.171)	(0.155)
Observations	943	943	943	943	943	943
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.150	0.024	0.011	0.458	0.153	0.330
Number of Firms	151	151	151	151	151	151
Clustering	Firm	Firm	Firm	Firm	Firm	Firm

Borrowers only seem to make short-term adjustments!

- Use higher shares of renewable energy.

- **No evidence** for improving their emissions scores.

- There is no suggestion that total emissions growth and direct emissions growth

- They do not terminate supply chain links to environmentally unfriendly suppliers or source environmentally-friendly materials.

Anticipation

	(1) Loan Amount (Ln)	(2) Spread (Ln)
Treat × High Emitter × Y2015	0.041	0.046
	(0.113)	(0.074)
Treat × High Emitter × Y2016	-0.127	0.022
	(0.168)	(0.069)
Treat × High Emitter × Y2017	-0.424	-0.042
	(0.335)	(0.124)
Treat × High Emitter × Y2018	-1.387	-0.128
	(0.914)	(0.191)
Treat × High Emitter × Y2019	0.000	0.053
	(0.123)	(0.064)
Observations	992	992
Loan Controls	Yes	Yes
Firm Controls	Yes	Yes
Bank FE	Yes	Yes
Loan Type FE	Yes	Yes
Industry × Year FE	Yes	Yes
Adjusted R^2	0.872	0.888

- No evidence of an anticipation effects from banks.

Falsification tests

	(1) Loan Amount (Ln)	(2) Spread (Ln)
Placebo Treat × High Emitter × Post	-0.030	0.007
	(0.106)	(0.066)
Observations	1,673	1,673
Loan Controls	Yes	Yes
Firm Controls	Yes	Yes
Bank FE	Yes	Yes
Loan Type FE	Yes	Yes
Industry × Year FE	Yes	Yes
Adjusted R^2	0.855	0.907

- **Randomly assigning** climate stress tested banks renders key coefficient insignificant.

Alternative measurements of transition risks

	(1) Emission Intensity		(3) Exposure to Transition Risk		(5) Reprisk Index	
	Loan Amount	Spread	Loan Amount	Spread	Loan Amount	Spread
Treat × Post × High Transition Risk	0.150***	0.031 ***	0.375***	0.113***	0.154*	0.095***
	(0.047)	(0.020)	(0.126)	(0.040)	(0.077)	(0.027)
Observations	1,673	1,673	1,673	1,673	1,673	1,673
Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry -Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.858	0.906	0.856	0.915	0.855	0.907

Taking into account firm sizes (scaled emissions with borrowers' total assets)

Exposure to climate risks by Sautner et al (2023)

Environmental Risk Index by Reprisk

Robustness: Borrowers' financial constraints

	(1) Loan Amount (Ln)	(2) Spread (Ln)
Treat × Post × High Emitter	0.226**	0.118***
	(0.103)	(0.038)
SA Index	-1.044**	1.229***
	(0.499)	(0.147)
Observations	1,425	1,425
Loan Controls	Yes	Yes
Firm Controls	Yes	Yes
Bank FE	Yes	Yes
Industry × Year	Yes	Yes
Loan Type FE	Yes	Yes
Adjusted R^2	0.855	0.949

Our inferences remain unaffected controlling for borrowers' financial constraints.

Robustness: Bank characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	Loan Amount (Ln)			Spread (Ln)		
Treat × Post × High Emitter	0.373**	0.357**	0.359**	0.086**	0.073**	0.073**
	(0.181)	(0.176)	(0.174)	(0.035)	(0.034)	(0.034)
Lender Size	-0.013	-0.009	-0.008	0.013***	0.016***	0.016***
	(0.019)	(0.015)	(0.015)	(0.004)	(0.006)	(0.006)
Lender Capital		0.002	0.005*		0.002**	0.002
		(0.001)	(0.003)		(0.001)	(0.001)
Lender ROA			-0.047*			0.002
			(0.027)			(0.013)
Observations	1,673	1,673	1,673	1,673	1,673	1673
Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year	Yes	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.856	0.856	0.856	0.907	0.907	0.907

Our inferences remain unaffected controlling for bank size, capital ratios, and ROA.

Disentangling climate stress tests: France vs. ECB

	(1)	(2)	(3)	(4)
	Loan amount (Ln)		Spread (Ln)	
Treat × High Emitter × Post	0.345**	0.333**	0.096***	0.094**
	(0.170)	(0.165)	(0.035)	(0.036)
Treat × High Emitter	-0.296*	-0.291*	-0.055*	-0.053*
	(0.168)	(0.165)	(0.029)	(0.030)
High Emitter × Post	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
High Emitter	-0.311	-0.350	-0.383**	-0.411**
	(0.499)	(0.493)	(0.173)	(0.176)
Observations	1,277	1,277	1,277	1,277
Loan controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.840	0.841	0.883	0.885

Our inferences remain unaffected after removing observations from 2022 onwards.

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, for green purposes with but simultaneously adjust their risk pricing in a non-favorable manner for the borrower.

- Following the changes in loan characteristics, borrowers of participating banks

    - are more likely to have eco-friendly products 😇

    - improve their ESG, Emission and Environmental scores 😇

    - are more likely to have emission policies and to have targets for their carbon emission reduction 😇

    - increase their usage of renewable energy 😇

    - there is little or no evidence that they terminate relationships with 'brown suppliers' or 😠

    - reduce total or direct emission growth, or use fewer 'brown' materials (adjustments in hard facts may take more time to become observable) 😠

THANK YOU

APPENDIX

Stress-test scenarios
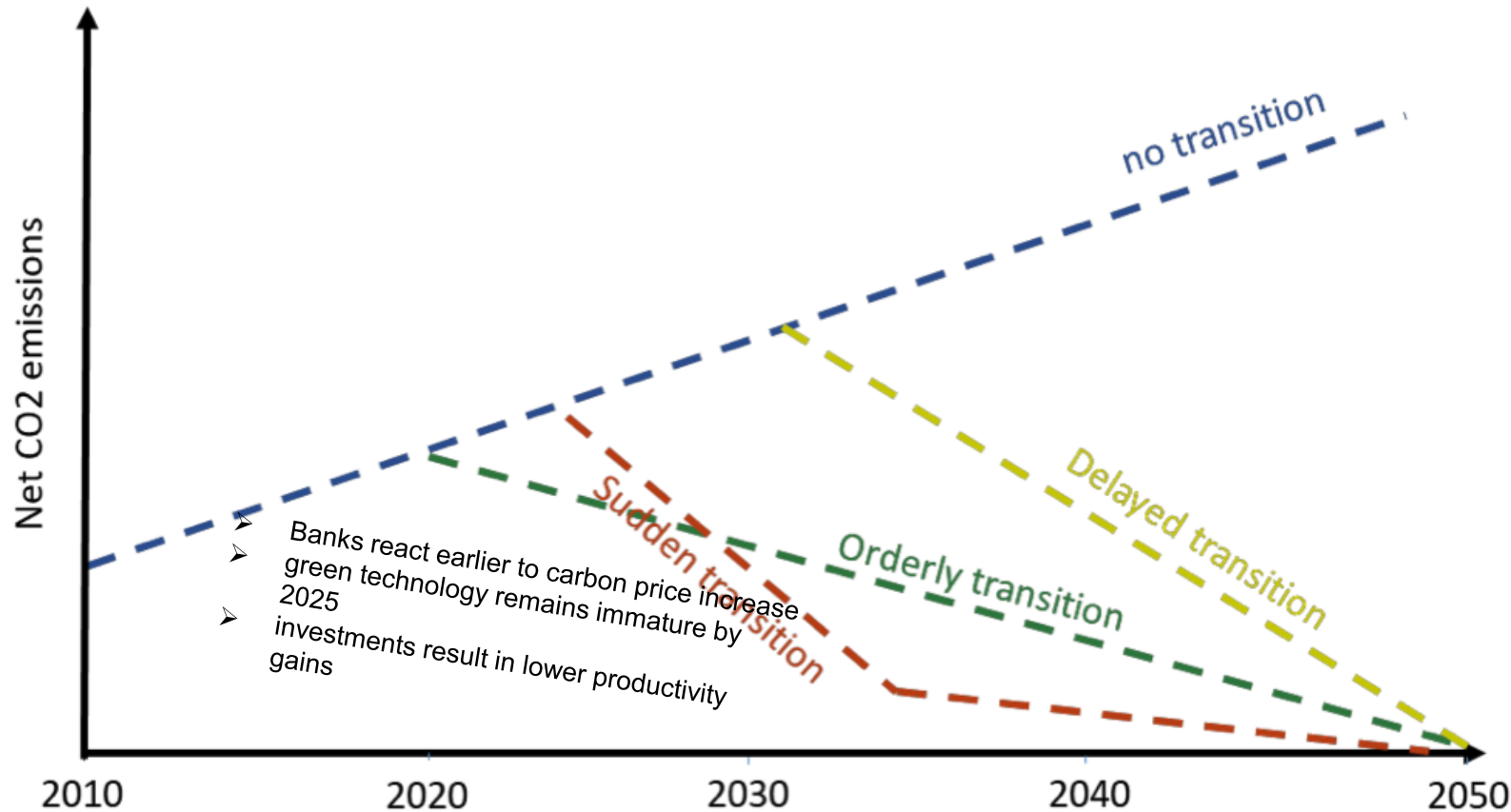
Scenarios vary in terms of carbon price adjustments and expected productivity of ‚green energy'.

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 CO_2 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.

Important: 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 pilot exercise participants

This table shows an overview about the 9 banking groups that participated in the French climate pilot exercise in 2020.

Number	Bank Name
1	AGENCE FRANÇAISE DE DÉVELOPPEMENT
2	BNP PARIBAS
3	BPCE
4	CAISSE DES DÉPÔTS
5	CREDIT AGRICOLE
6	CREDIT MUTUEL
7	LA BANQUE POSTALE
8	SOCIÉTÉ GÈNÉRALE
9	SOCIÉTÉ DE FINANCEMENT LOCALE

Heckman Selection Model

	(1)	(2)		(3)
	Second Stage Result			First Stage Result
Dept. Var.	Loan Amount (Ln)	Spreads (Ln)		P(Treat)
Treat × Post × High Emitter	0.350*	0.079**	Green Lender	0.503*
	(0.175)	(0.038)		(0.293)
Treat × High Emitter	-0.339*	-0.038	Lender Size	-0.247
	(0.184)	(0.038)		(0.377)
Treat × Post	0.185	-0.074	Lender Capital	-0.119
	(0.165)	(0.052)		(0.182)
High Emitter × Post	0.000	0.000	Lender Deposit	-0.031
	(0.000)	(0.000)		(0.040)
High Emitter	-0.394	-0.298**		
	(0.504)	(0.132)		
Post	0.000	0.000		
	(0.000)	(0.000)		
Inverse Mills Ratio	-0.073	0.015		
	(0.061)	(0.017)		
Observations	1,696	1,696		698
Loan Controls	Yes	Yes		No
Firm Controls	Yes	Yes		No
Bank FE	Yes	Yes		Yes
Industry Year FE	Yes	Yes		No
Year FE	No	No		Yes
Loan Type FE	Yes	Yes		No
Country FE	No	No		Yes
Adjusted R^2	0.837	0.884		-
Pseudo R^2	-	-		0.849
Clustering	Bank, Firm	Bank, Firm		Bank