

Climate Risk, Bank Lending and Monetary Policy

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The opinions in this presentation are those of the authors and do not necessarily reflect the views of the European Central Bank and the Eurosystem

Research questions

- 1 **Do banks price firms' climate risk over and above credit risk, when granting loans?** E.g., because banks' IRMs do not fully account for climate risk or banks have reputational concerns
 - in assessing climate risk, do they take into account firms' **plans** to reduce emissions (in addition to current emissions)?
 - do banks **committed** to environmental protection charge a higher lending premium on climate risk?
- 2 **Does monetary policy affect banks' pricing of climate risk and, if so, how?** Two alternative views, with opposite predictions:
 - **financial frictions channel:** as low-emission firms have fewer tangible assets, hence less collateral, monetary tightening discourages more lending to them
→ prompts banks to **raise rates** more to firms **less exposed to climate risk**
 - **risk-taking channel:** monetary tightening discourages banks' risk-taking
→ prompts banks to **raise rates** more to firms **more exposed to climate risk**

Main findings

- 1 **Do banks price firms' climate risk over and above credit risk, when granting loans? YES**
 - banks charge higher interest rates to firms with greater carbon emissions, controlling for firms' probability of default
 - they also charge lower rates to firms that commit to lower emissions
 - both effects are larger for banks committed to decarbonization
- 2 **Does monetary policy affect banks' pricing of climate risk? YES**
 - consistently with a "climate risk-taking channel of monetary policy", tighter policy induces banks to increase both credit risk premia and carbon emission premia → more penalizing for more polluting firms
 - comparative statement: restrictive monetary policy increases the cost of credit to all firms, but its contractionary effect is milder for (i) firms with low emissions than for those with high emissions and (ii) for those that commit to decarbonization than for those that don't

Outline

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Research on the pricing of climate in financial markets

- Evidence that **security markets** price climate (esp. transition) risk:
 - stock market: Bolton and Kacperczyk (2021, 2022), Hsu, Li and Tsu (2023)
 - option markets: Ilhan, Sautner and Vilkov (2020)
 - bond markets: Huyn and Xia (2021), Baker et al (2021)
- For **credit markets** the evidence (limited to syndicated loans) is ambiguous:
 - NO: Beyen, De Greiff, Delis and Ongena (2021)
 - YES, after the 2015 Paris Agreement: Ehlers and De Greiff (2021)
- Also, no consensus on whether **banks committed to environmental policies** lend preferentially to low-emission firms:
 - NO: Ehlers and De Greiff (2021) and Giannetti, Jasova, Loumiotis and Mendicino (2023)
 - YES: Degryse, Goncharenki, Theunisz and Vadasz (2020) and Kacperczyk and Peydrò (2021)
- No evidence on the **impact of MP** impact of MP on the pricing of climate risk

Literature on financial frictions channel of monetary policy

- Bernanke and Gertler's (1989, 1995) idea that monetary policy has different effect on firms depending on their collateral capacity:
 - in the presence of incentive problems, banks provide less credit to firms with lower ratio of tangible assets to future cash flow
 - restrictive monetary policy worsens problem: banks restrict credit relatively more to collateral-poor firms than to collateral-rich ones
- Iovino, Martin and Sauvagnat (2021): firms with low carbon emissions have a lower fraction of tangible assets, hence can offer less collateral
- Combining this fact with the role of financial frictions in monetary policy:
 - monetary expansion → looser lending standards, esp. for low-emission firms
 - monetary restriction → tighter lending standards, esp. for low-emission firms
- Prediction: **monetary policy tightening more restrictive for GREEN firms than for brown ones**

Literature on risk-taking channel of monetary policy

- Idea is that monetary policy affects banks' yield-seeking incentives:
 - monetary expansion → looser lending standards, esp. for riskier firms
 - monetary tightening → tighter lending standards, esp. for riskier firms
- Due to interaction between monetary policy and banks' informational issues:
 - Acharya and Naqvi (2012): to elicit loan officers' effort, their pay is tied to loan volume → abundant liquidity induces more risk taking
 - Dell'Ariccia, Laeven and Marquez (2014): costly monitoring of loan portfolio → drop in risk-free rate induces banks to cut monitoring → take more risk
- Evidence:
 - Dell'Ariccia, Laeven and Suarez (2017): U.S. banks lower their internal risk rating of new loans when short-term interest rates rise
 - Jiménez, Ongena, Peydrò and Saurina (2014): as overnight rates drop, less capitalized Spanish banks relax lending standards to risky firms
 - Anderson and Cesa-Bianchi (2023): a monetary tightening triggers a larger rise in credit spreads for high-leverage firms, mainly due to a higher risk premium
- Prediction: **monetary policy tightening more restrictive for BROWN firms than for green ones**

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Merging AnaCredit loan and carbon emission data

- We draw monthly loan-level data from September 2018 to December 2022 from the AnaCredit database, covering all euro-area countries
- For each credit instrument, we have data for:
 - the interest rate charged by the issuing bank
 - its estimate of the probability of default (PD)
- For listed firms, we merge these data with Refinitiv data for
 - firm-level current carbon (CO₂ and CO₂ equivalent) Scope 1 and Scope 2 emission data (in thousand tonnes per million USD of net revenues)
 - the firm's commitment to reduce future emissions, namely, a dummy indicating if the firm has disclosed an emission reduction target
- Firm commitment is associated with carbon emissions reduction according to Carbone et al. (2022) and Bolton and Kacperczyk (2023). They also find greater sign-up in Europe by high emitters than in North America and Asia

Data about bank commitment and monetary policy shocks

- We complement these data with:
 - information about banks' environmental commitment, by identifying signatories of a commitment letter in the context of the Science Based Targets initiative (SBTi), which promotes net-zero climate targets (following Kacperczyk and Peydrò, 2021)
 - a monthly time series of high-frequency monetary policy surprises from the Euro Area Monetary Policy Event-Study Database (EA-MPD) developed by Altavilla et al. (2019)
 - interest rate changes in a 30-minute window around ECB press conferences, expressed on a monthly basis
 - as in Gurkaynak, Sack and Swanson (2005), Jarocinski and Karadi (2020) and Anderson and Cesa-Bianchi (2023)

Descriptive statistics

Variables	Observations	Mean	St. Dev.	p5	p10	p25	p50	p75	p90	p95
$Spread_{b,f,t}$	325,180	1.51	0.76	0.18	0.54	1.08	1.55	2.00	2.41	2.76
$PD_{f,t}$	442,469	0.96	3.49	0.07	0.09	0.15	0.26	0.50	1.18	2.48
$Carbon_{f,t}$	435,263	0.18	0.47	0.00	0.00	0.01	0.03	0.09	0.53	0.82
$Target_{f,t}$	453,231	0.58	0.49	0.00	0.00	0.00	1.00	1.00	1.00	1.00
$Commit_{b,t}$	453,231	0.11	0.31	0.00	0.00	0.00	0.00	0.00	1.00	1.00
MP_t (b.p.)	453,231	1.09	5.56	-1.53	-1.20	-0.53	0.00	0.06	4.21	14.14

Outline

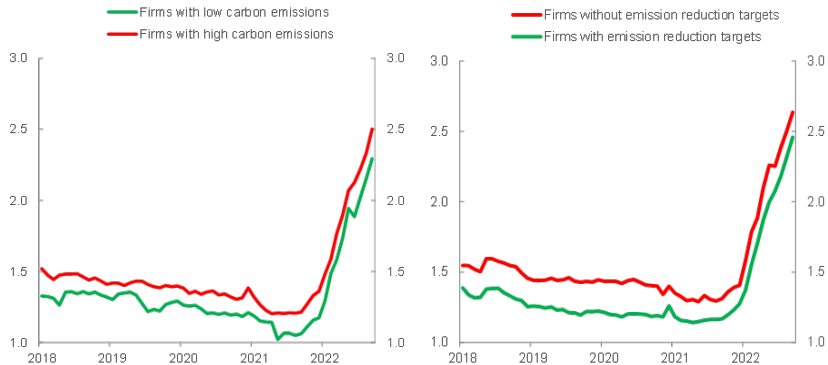
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Bank pricing of climate risk: descriptive evidence



Bank pricing of climate risk: panel estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$PD_{f,t}$	0.024***	0.017***	0.017***	0.026***	0.026***	0.005***	0.005***
$Carbon_{f,t}$	0.071***	0.020***	0.043***	0.019***	0.090***	0.033**	0.086***
$Target_{f,t}$	-0.103***	-0.067***	-0.068***	-0.067***	-0.078***	-0.034***	-0.034***
$Carbon_{f,t} \times Target_{f,t}$			-0.032***		-0.103***		-0.045***
Fixed Effects:							
Bank	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	-	-	Yes	Yes
ILS	-	Yes	Yes	-	-	-	-
ILS \times Time	-	-	-	Yes	Yes	-	-
Firm	-	-	-	-	-	Yes	Yes
Observations	306871	306788	306788	305401	305401	306864	306864
R^2	0.468	0.550	0.550	0.602	0.603	0.617	0.617

Economic significance, based on Column 1:

- 4 bp premium (5% of SD) for firms with high emissions (90th percentile)
- 10 bp discount (13% of SD) for firms committed to reduce emissions
- 3 bp premium (4% of SD) on firms with high PD (90th percentile)

Climate risk and PD

- Concern: what if PD already incorporates climate risk considerations?
- Theoretically:
 - Different horizons
 - No incentives to incorporate climate risk in PD
 - May be difficult to incorporate in internal models
- Empirically
 - Zero correlation of the two variables
 - Robustness test: we find same results on climate risk variables if we remove PD and add list of firm observables

Bank commitment & climate risk pricing: panel estimates

	(1)	(2)	(3)	(4)	(5)
$PD_{f,t}$	0.0248***	0.0176***	0.0270***	0.00512***	
$Carbon_{f,t}$	0.0414***	0.0313***	0.0815***	0.0823***	
$Target_{f,t}$	-0.0913***	-0.0591***	-0.0750***	-0.0238***	
$Commit_{b,t}$	0.241***	0.207***	0.0175	0.213***	0.0133
$Carbon_{f,t} \times Target_{f,t}$	0.0328***	-0.0229***	-0.0999***	-0.0394***	
$Commit_{b,t} \times PD_{f,t}$	-0.00669***	-0.00744***	-0.00772***	0.000438	0.00500***
$Commit_{b,t} \times Carbon_{f,t}$	0.0336***	0.0339***	0.0310***	0.00158	0.00907
$Commit_{b,t} \times Target_{f,t}$	-0.166***	-0.157***	-0.0572***	-0.163***	-0.0431***
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	-	Yes	-
IIS Fixed Effects	-	Yes	-	-	-
IIS \times Time Effects	-	-	Yes	-	-
Firm Fixed Effects	-	-	-	Yes	-
Firm \times Time Effects	-	-	-	-	Yes
Observations	306871	306788	305401	306864	303466
R-squared	0.469	0.551	0.603	0.618	0.694

Economic significance, based on Column 2: committed banks charge

- 16 bp (21% of SD) less than uncommitted banks in lending to firms with target
- 2 bp (3% of SD) more to firms with high emissions (90th percentile)

Monetary policy & climate risk pricing: panel estimates

	(1)	(2)	(3)	(4)	(5)
$PD_{f,t}$	0.00777***	0.0242***	0.0168***	0.0261***	0.00540***
$Carbon_{f,t}$		0.0506***	0.0425***	0.0893***	0.0856***
$Target_{f,t}$		-0.103***	-0.0688***	-0.0780***	-0.0349***
$Carbon_{f,t} \times Target_{f,t}$		-0.0260***	-0.0308***	-0.102***	-0.0443***
MP_t	0.0150***				
$MP_t \times PD_{f,t}$	0.000263**	0.000399***	0.000348***	0.000340**	0.000274***
$MP_t \times Carbon_{f,t}$		0.00111*	0.00107*	0.00233*	0.000990*
$MP_t \times Target_{f,t}$		-0.00329***	-0.00205***	-0.000509	-0.00162***
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	-	Yes	Yes	-	Yes
ILS Fixed Effects	-	-	Yes	-	-
ILS \times Time Fixed Effects	-	-	-	Yes	-
Firm Fixed Effects	Yes	-	-	-	Yes
Observations	321331	306871	306788	305401	306864
R-squared	0.366	0.468	0.550	0.603	0.617

25 bp surprise increase in the policy rate (Column 3) leads to:

- 1.4 additional rise in premia for high emitters (90th percentile)
- 5 bp smaller rise in premia for firms committed to lower emissions

But monetary policy acts with “long and variable lags” ...

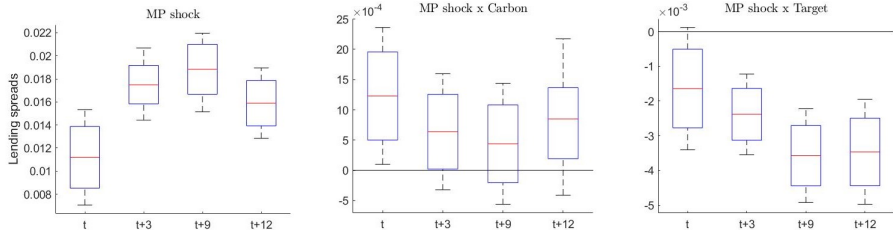
- Credit supply: banks may take time to adjust their lending policies to changes in monetary policy
- Credit demand: firms may take time to adjust their investment, hiring and production decisions – hence their demand for loans – to changes in the cost of credit
- Use local projection estimates to capture these dynamic effects:

$$y_{b,f,t+h} = \lambda_{1h} MP_t + \lambda_{2h} MP_t \times Carbon_{f,t} + \lambda_{3h} MP_t \times Target_{f,t} + \theta_b + \epsilon_{f,b,t+h},$$

where the outcome variable $y_{b,f,t+h}$ is either the lending spread or the (logarithm of the) loan given by bank b to firm f between month t and month $t + h$; MP_t is the monetary policy shock; θ_b are bank fixed effects.

Dynamic effects of monetary policy on loan premia

- Local projection coefficient estimates at month 0, 3, 9 and 12
- Monetary tightening has initially small but gradually increasing effect on premia, slightly greater for high-emission firms, less so for committed ones:

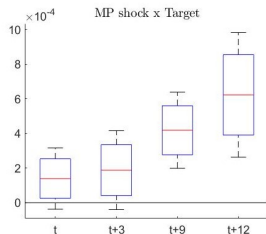
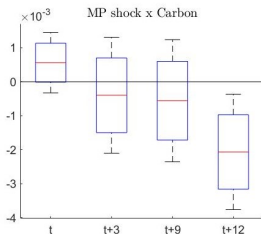
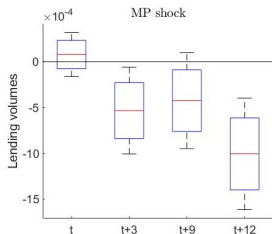


25 bp surprise tightening leads to

- Additional 2 bp rise in risk premia for high emitters (90th percentile)
- 5 bp mitigation effect for committed firms, 9 bp after 12 months

Dynamic effects of monetary policy on loan volumes

- Local projection estimates are mirror images of those in previous slide
- Monetary tightening gradually reduces lending, more so for high-emission firms, less so for committed ones:



25 bp surprise tightening leads to

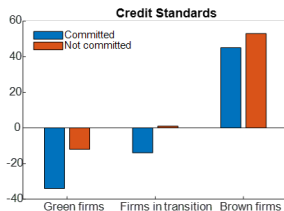
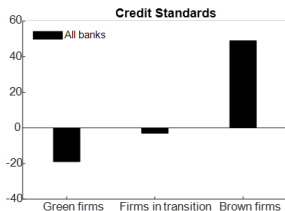
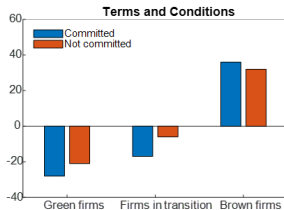
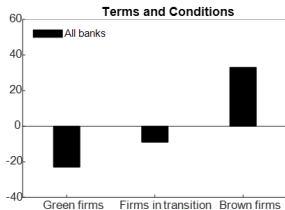
- Additional 2.7% drop in lending for high emitters after 12 months
- 1.5% mitigation effect for committed firms after 12 months

Alternative identification strategy

- Similar results if we adopt a diff-in-diff strategy around two episodes
 - December 2021: end of net purchases under PEPP and reduction of APP net purchases
 - July 2022: first rate hike

Survey evidence dovetails with previous results

- July 2023 BLS asked banks if in the previous year they changed their lending policies differently for “brown” firms, “green” firms and firms “in transition”
- Note: previous year had seen a large and persistent monetary tightening



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Conclusions

- Euro area **banks price climate risk**: they charge **higher rates to firms with larger emissions**, and **lower rates to firms that commit to green transition**
- Banks' **commitment matters**: **Committed banks** provide **cheaper loans to firms that commit** to decarbonization and **penalize more polluting firms**
- **Climate risk-taking channel of monetary policy**: **contractionary monetary policy** shocks lead to
 - **higher premia and lower volumes** to high emission firms
 - **mitigating** effects for **firms committed** to decarbonization
- **Bottom line**:
 - restrictive monetary policy increases the cost of credit to all firms...
 - ...but its contractionary effect is milder for firms with low emissions and those committed to reducing them

Thank you!