Climate Risk, Bank Lending and Monetary Policy

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26 April 2024

Inaugural Conference of the ESCB Research Network on
Challenges for Monetary Policy Transmission in a Changing World ("ChaMP")

Research questions

1. **Do banks price firms' climate risk when granting loans**?
   - in assessing climate risk, do they take into account only **current** emissions or also firms' **plans** to reduce 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

     $\rightarrow$ prompts banks to **raise rates** more to **green** firms
   - **risk-taking channel**: monetary tightening discourages banks' risk-taking

     $\rightarrow$ prompts banks to **raise rates** more to **brown** firms

Outline

Research on the pricing of climate in financial markets

- Evidence that **security markets** price climate (esp. transition) risk:
  - stock market, option markets, bond markets
- Instead, for **credit markets** the evidence (limited to syndicated loans) is ambiguous as to whether banks price climate risk:
  - NO: Beyen, De Greiff, Delis and Ongena (2021)
  - YES, after the 2015 Paris Agreement: Ehlers, Packer and De Greiff (2021)
- Also, no consensus on whether **banks committed to environmental policies** lend preferentially to low-emission firms:
  - NO: Ehlers, Packer and De Greiff (2021) and Giannetti, Jasova, Loumioti and Mendicino (2023)
  - YES: Degryse, Goncharenki, Theunisz and Vadasz (2020) and Kacperczyk and Peydrò (2021)
- No evidence on the **impact of monetary policy** on the pricing of climate risk

Research 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
- Several theoretical contributions on why expansionary MP should be associated with more risk-taking, for instance
  - Acharya and Naqvi (2012): to elicit loan officers' effort, their pay is tied to loan volume → abundant liquidity induces more risk taking
- 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**

Research 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
- Prediction: **monetary policy tightening more restrictive for GREEN firms than for brown ones**

Outline

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

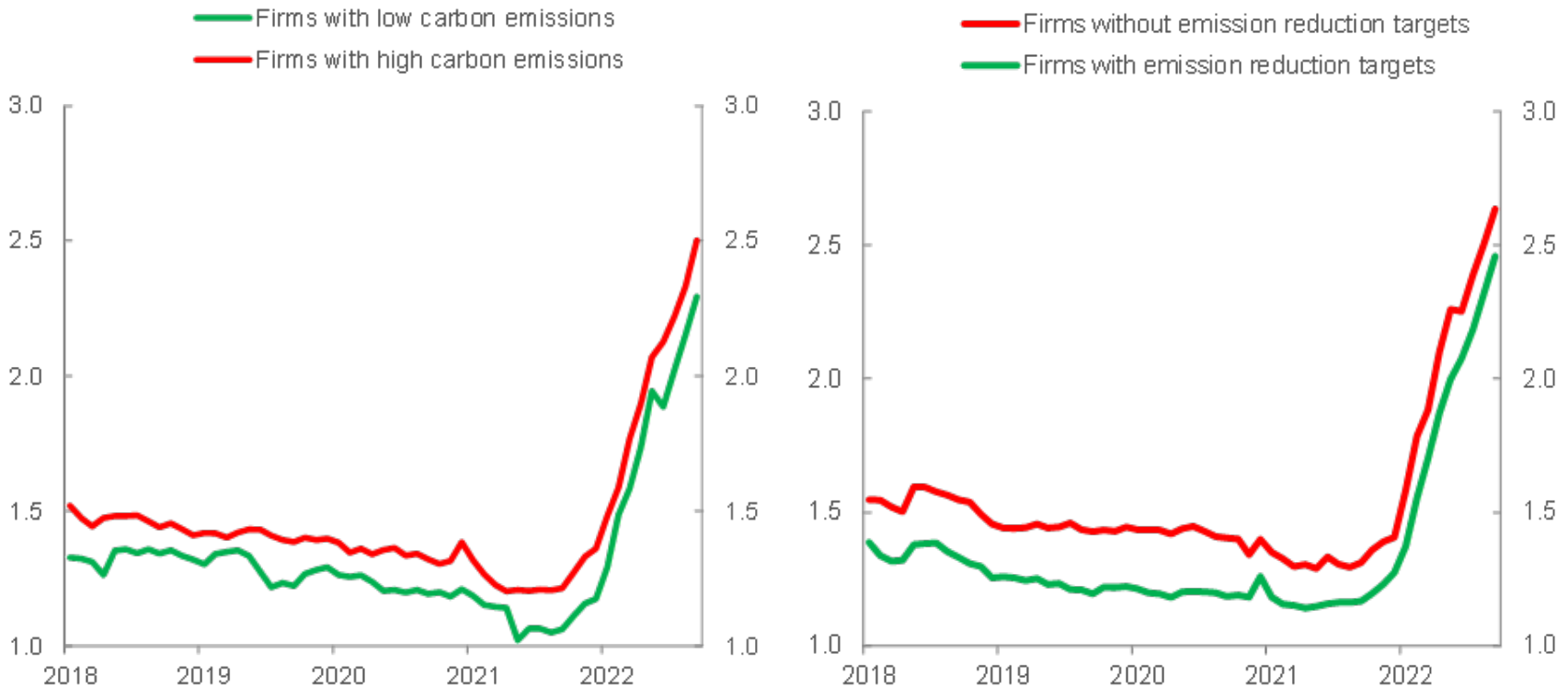
- We complement these data with:
  - information about banks' environmental commitment, by identifying signatories of a commitment letter in the context of the Science Based Targets initiative (SBTi), which promotes net-zero climate targets (following Kacperczyk and Peydrò, 2021)
  - a monthly time series 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), Jarocìnski 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

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***
	(0.0005)	(0.0006)	(0.0006)	(0.0008)	(0.0008)	(0.0006)	(0.0006)
$Carbon_{f,t}$	0.071***	0.020***	0.043***	0.019***	0.090***	0.033**	0.086***
	(0.0026)	(0.0061)	(0.0088)	(0.0066)	(0.0118)	(0.0169)	(0.0201)
$Target_{f,t}$	-0.103***	-0.067***	-0.068***	-0.067***	-0.078***	-0.034***	-0.034***
	(0.0024)	(0.0025)	(0.0026)	(0.0028)	(0.0032)	(0.0034)	(0.0034)
$Carbon_{f,t} \times$			-0.032***		-0.103***		-0.045***
$Target_{f,t}$			(0.008)		(0.0139)		(0.0086)
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 (90^{th} percentile)
- 10 bp discount (13% of SD) for firms committed to reduce emissions
- 3 bp premium (4% of SD) on firms with high PD (90^{th} percentile)

Climate risk and PD

- Concern: what if PD already encompass climate risk?
- Reasons why one would not expect it:
  - Climate risk tends to materialize on a longer horizon
  - Banks have no incentives to incorporate climate risk in PD
  - It may be difficult to take it into account in internal risk models
- In our data:
  - Zero correlation between PD and carbon emissions
  - Robustness test: estimates for climate risk variables are unchanged if we replace PD with firm financials (lagged liquidity, leverage, assets)

Bank commitment & climate risk pricing: panel estimates

	(1)	(2)	(3)	(4)	(5)
$PD_{f,t}$	0.0248***	0.0176***	0.0270***	0.00512***	
	(0.000566)	(0.000627)	(0.000794)	(0.000660)	
$Carbon_{f,t}$	0.0414***	0.0313***	0.0815***	0.0823***	
	(0.00730)	(0.00907)	(0.0121)	(0.0200)	
$Target_{f,t}$	-0.0913***	-0.0591***	-0.0750***	-0.0238***	
	(0.00267)	(0.00267)	(0.00331)	(0.00340)	
$Commit_{b,t}$	0.241***	0.207***	0.0175	0.213***	0.0133
	(0.0247)	(0.0235)	(0.0223)	(0.0234)	(0.0210)
$Carbon_{f,t} \times Target_{f,t}$	0.0328***	-0.0229***	-0.0999***	-0.0394***	
	(0.00767)	(0.00796)	(0.0139)	(0.00852)	
$Commit_{b,t} \times PD_{f,t}$	-0.00669***	-0.00744***	-0.00772***	0.000438	0.00500***
	(0.00174)	(0.00151)	(0.00152)	(0.00149)	(0.00144)
$Commit_{b,t} \times Carbon_{f,t}$	0.0336***	0.0339***	0.0310***	0.00158	0.00907
	(0.0115)	(0.0115)	(0.00936)	(0.0124)	(0.0100)
$Commit_{b,t} \times Target_{f,t}$	-0.166***	-0.157***	-0.0572***	-0.163***	-0.0431***
	(0.0194)	(0.0203)	(0.0154)	(0.0205)	(0.0146)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	-	Yes	-
ILS Fixed Effects	-	Yes	-	-	-
ILS × Time Effects	-	-	Yes	-	-
Firm Fixed Effects	-	-	-	Yes	-
Firm × 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***
	(0.000724)	(0.000546)	(0.000593)	(0.000769)	(0.000643)
$Carbon_{f,t}$		0.0506***	0.0425***	0.0893***	0.0856***
		(0.00758)	(0.00885)	(0.0118)	(0.0201)
$Target_{f,t}$		-0.103***	-0.0688***	-0.0780***	-0.0349***
		(0.00252)	(0.00260)	(0.00323)	(0.00340)
$Carbon_{f,t} \times Target_{f,t}$		-0.0260***	-0.0308***	-0.102***	-0.0443***
		(0.00788)	(0.00806)	(0.0139)	(0.00862)
MP_t	0.0150***				
	(0.000876)				
$MP_t \times PD_{f,t}$	0.000263**	0.000399***	0.000348***	0.000340**	0.000274***
	(0.000118)	(0.000110)	(0.000105)	(0.000154)	(0.0000914)
$MP_t \times Carbon_{f,t}$		0.00111*	0.00107*	0.00233*	0.000990*
		(0.000673)	(0.000587)	(0.00138)	(0.000585)
$MP_t \times Target_{f,t}$		-0.00329***	-0.00205***	-0.000509	-0.00162***
		(0.000575)	(0.000554)	(0.000686)	(0.000528)
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

Impact effect of monetary policy shocks on loan premia

- Note: the monetary policy shock is defined as an unexpected *increase* in the policy rate (as proxied by the OIS), i.e., a tightening
- Column 1: a 25 bp surprise increase in the policy rate results in a 35 bp increase in banks' credit spreads
- Subsequent columns: baseline impact absorbed by time effects, but we can still estimate the differential impact on premia across firms
- Column 3 (with bank, time and ILS effects): a 25 bp surprise increase in the policy rate results in
  - 1.4 additional rise in premia for high emitters (90^{th} percentile)
  - 5 bp smaller rise in premia for firms committed to lower emissions

But monetary policy acts with "long and variable lags"...

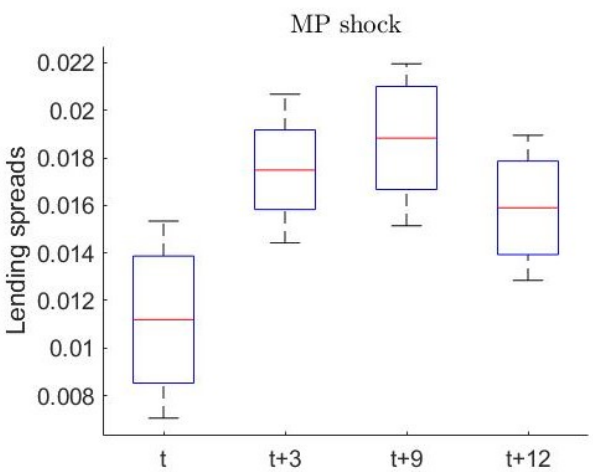
- Credit supply: banks may take time to adjust their lending policies to changes in monetary policy
- Credit demand: firms may take time to adjust their investment, hiring and production decisions – hence their demand for loans – to changes in the cost of credit
- Use local projection estimates to capture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

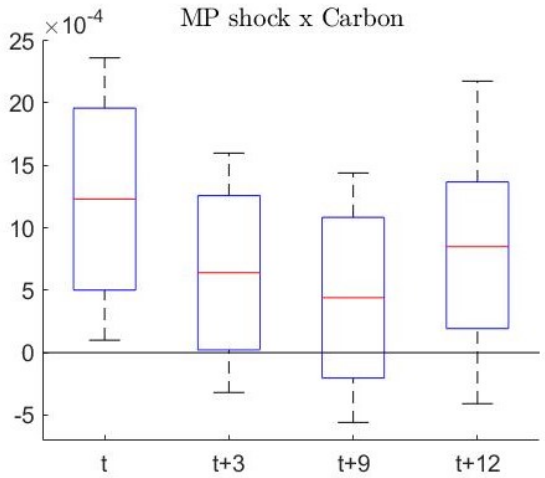
$$y_{b,f,t+h} = \lambda_{1h} MP_t + \lambda_{2h} MP_t \times Carbon_{f,t} + \lambda_{3h} MP_t \times Target_{f,t} + \theta_b + \epsilon_{f,b,t+h},$$

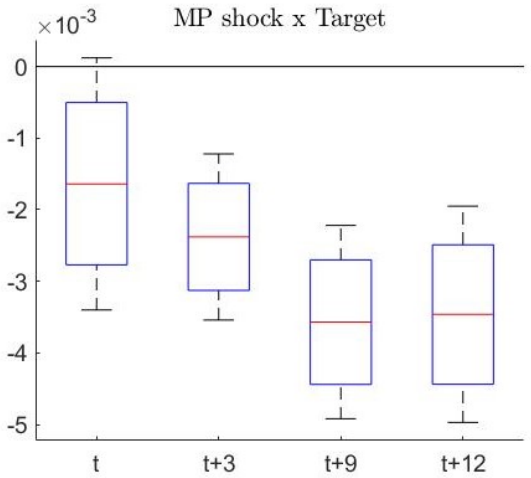
where the outcome variable $y_{b,f,t+h}$ is either the lending spread or the (logarithm of the) loan given by bank b to firm f between month t and month $t+h$; MP_t is the monetary policy shock; θ_b are bank fixed effects.

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:



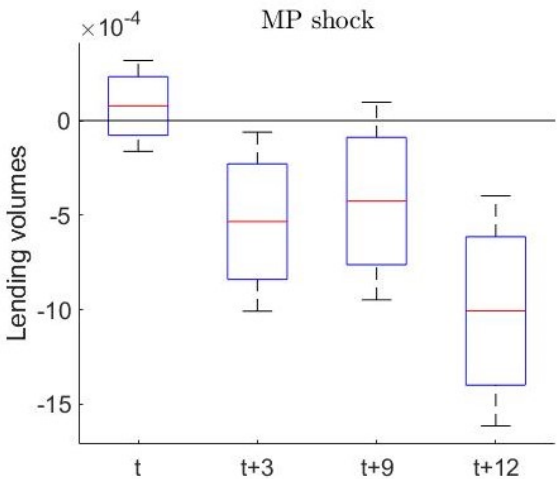


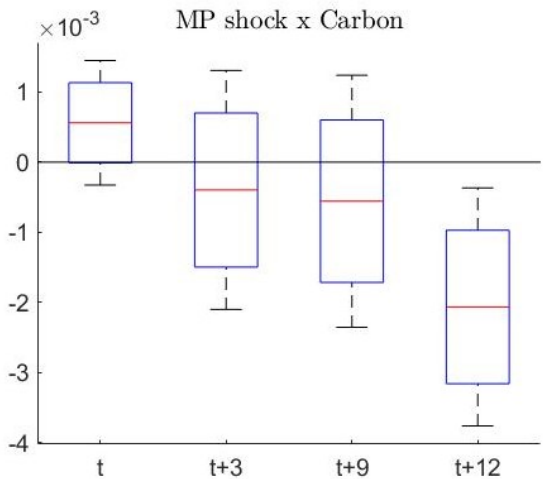


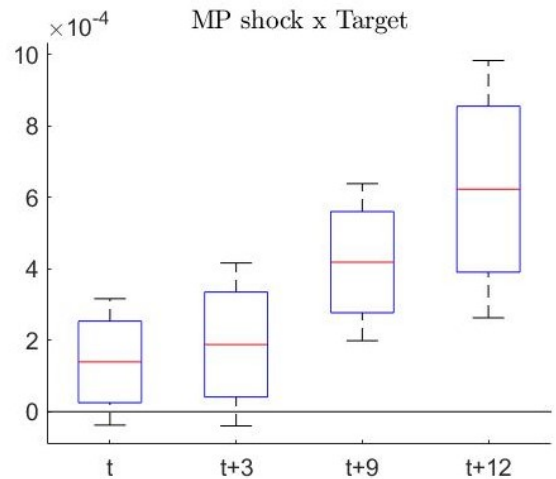
- 1st figure: 25 bp surprise tightening $\rightarrow$ 39 bp rise in premia after 12 months
- 2nd figure: additional 2 bp for high emitters (90th percentile)
- 3rd figure: 5 bp mitigation effect for committed firms, 9 bp after 12 months

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:







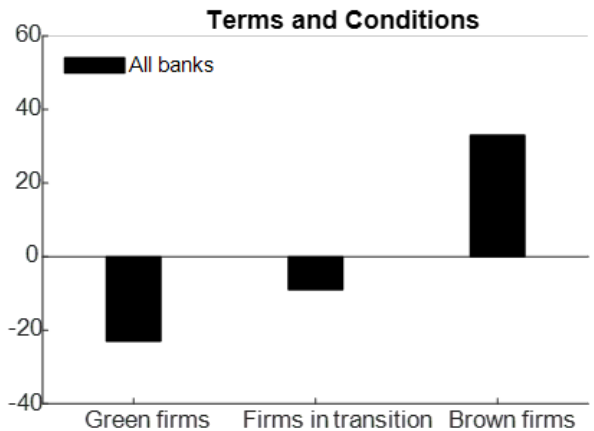
- 1st figure: 25 bp surprise tightening $\rightarrow$ negligible impact effect, gradual drop in lending by 2.5% after 12 months
- 2nd figure: additional 2.7% drop for high emitters after 12 months
- 3rd figure: 1.5% mitigation effect for committed firms after 12 months

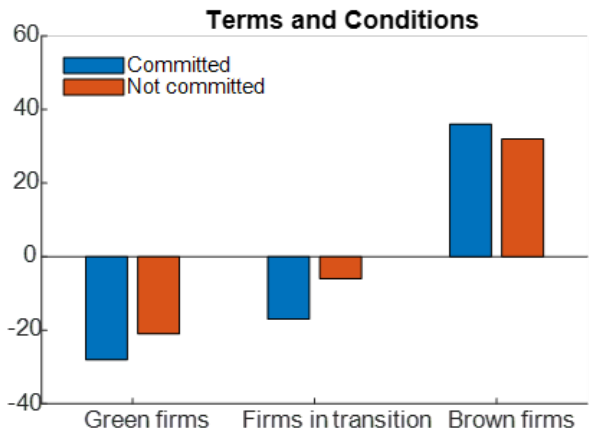
Alternative identification strategy

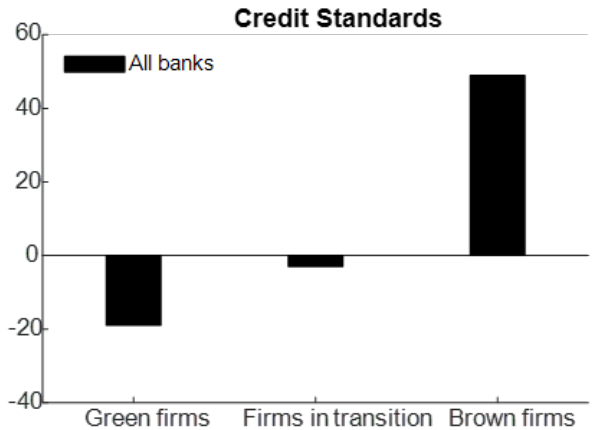
- Similar results if we adopt a diff-in-diff strategy around two episodes
  - December 2021: end of net purchases under PEPP and reduction of APP net purchases
  - July 2022: first rate hike by the ECB

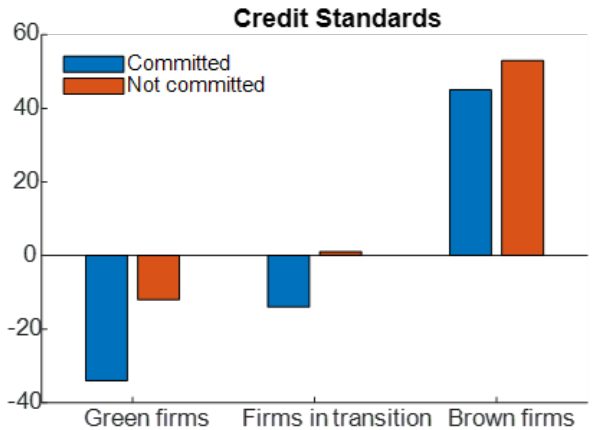
Survey evidence dovetails with previous results

- 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









Outline

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!