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The impact of ECB Banking Supervision on climate risk and sustainable finance

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Abstract

This paper provides a first empirical analysis of the impact of the European Central Bank's (ECB's) climate-risk-related supervisory efforts on (i) climate risk exposure and related risk management of banks; and (ii) on the induced shifts in banks' portfolio choices with regard to additional green finance. From 2020 onwards, the ECB has introduced various measures to enhance climate-risk-related supervisory efforts. Our identification strategy exploits the fact that the ECB's efforts on climate supervision has only been introduced for selected banks within the European Union i.e., the Significant Institutions under the Single Supervisory Mechanism. Other banks (i.e., the Less Significant Institutions) have remained unaffected. We set up a difference-in-difference setup based on a novel data set and find a significant impact on both improvements in climate risk exposure and management and on an increase in banks' green finance activities.

Keywords: Banking Supervision, Climate Stress Test, Green Lending, Sustainable Finance

JEL Classification: D25, G21, G28.

Non-technical Summary

Climate change and climate risk have become key concerns for policy makers at central banks and in banking supervision. It is widely acknowledged that climate risks impose an increasing challenge for transmission mechanisms of central banks' monetary policy, as well as to the financial sector. Furthermore, financial institutions in general, and banks in particular, are supposed to play a central role in providing capital to finance the transition to an environmentally sustainable economy. To the end of addressing this issue, the ECB has 2020 initiated its efforts to supervise climate risk with the communication of its "Guide on C&E Risks" and its subsequent implementation of a climate-related supervisory review, such as the first climate risk stress test in 2022. The goal of this climate-risk-related supervision is to enhance the banking industry's awareness of and preparedness for managing climate-related and environmental risks. Hence, with the introduction of the climate-risk-related supervision in 2020, we expect to observe, firstly, an improvement in banks' risk exposure and management, and secondly, changes in banks' capital allocation behavior towards increased green finance activities—at least to an extent to which this is motivated by a change in their risk assessment strategies.

Testing this relationship between climate-risk-related banking supervision on the one hand and climate risk and climate finance within the banking sector on the other hand, we find a significant impact on both, improvements in climate risk exposure and management and on an increase in banks' green finance activities. While these findings do not allow to draw any normative conclusions e.g. whether or not the changes in the banks' behavior are sufficient to fulfill the expectations formulated in the Guide on C&E Risks, we can nevertheless provide evidence that the ECB's supervisory efforts have an effect on banks' behavior, which is in line with the ECB's intensions. However, environmental data availability needs to be significantly improved to better understand and estimate the effects. Additional regulatory and policy efforts

will be necessary to improve the assessment and evaluation of banks' climate risk exposure and management and banks' contribution towards financing a green transition.

List of Abbreviations

AUM	Assets under management
CRST	Climate Risk Stress Test
DiD	Difference-in-difference
ECB	European Central Bank
EU	European Union
ESG	Environmental, social and governance
E-Score	Environmental Score
FI	Financial institutions
GB	Green bonds
GHG	Greenhouse gas
LSI	Less significant institutions
OLS	Ordinary least squares
SFDR	Sustainable Finance Disclosure Regulation
SI	Significant institutions
YY	Year-over-year

1 Introduction

Climate change and climate risk have become key concerns for policy makers at central banks and in banking supervision. It is widely acknowledged that climate risks impose an increasing challenge to the transmission mechanisms of central bank's monetary policy, as well as to the financial sector (e.g., Garbarino and Guin, 2021; De Marco, 2023). Furthermore, financial institutions in general, and banks in particular, are supposed to play a central role in providing capital to finance the transition to an environmentally sustainable economy, i.e., to provide green or, more specifically, climate finance (EC, 2023). In this paper we focus on the relationship between banking supervision on the one hand and climate risk and climate finance within the banking sector on the other hand.

Banks are affected by climate risk due to two classes of risk: physical and transition risk. Physical risk affects banks because their assets are exposed to risks due to natural disasters induced by climate change. Transition risks, in contrast, emerge due to measures imposed by energy and climate policy and regulation. Even though climate risk analysis is dealing with the pricing of hypothetical future events, there is plenty of recent anecdotical evidence where both classes of climate risk have already materialized[1]. A systematically inadequate and insufficient identification and pricing of these risks in banks' risk identification, assessment and management processes could impose major threats to the stability of the financial system (as argued, e.g., in Monasterolo, 2020; Dafermos and Nikolaidi, 2022)[2]. At the same time, a

[1] Examples in Germany are the recent 2021 flood disaster in the German *Ahrtal*, during which real estate of entire villages got destroyed within hours; the river Rhine's low water levels in summer interrupting supply chains; or the political ambition of the German federal government to speed up the planned phase out of coal-fired power generation from 2034 to 2030 (Bundesregierung, 2023) and, thus, assets becoming stranded earlier than expected (Battiston et al., 2017, 2020; Semienuk et al., 2020; Van der Ploeg and Rezai, 2020).

[2] There are several reasons why banks may not independently internalize physical and transition risks related to climate change despite the clear and present danger these risks represent. Decision-makers within banks often face short-term incentives such as short-term revenue maximization targets. Climate-risk-related information and capabilities are not (fully) available and need to be generated and build-up. This is associated with immediate costs, while climate-related risks might only materialize in the more distant future. Also, immediate regulatory

successful global implementation of a carbon-neutral economy to reach certain emission targets requires considerable investments. For instance, the IPCC (2018) estimates that limiting global warming to 1.5 °C will require worldwide annual investments of approximately 2.4 trillion (tr) USD into the energy system until 2035; BCG (2021) forecasts the annual investments to be 100 billion (bn) EUR until 2030 for Germany only. The private financial sector, including the banking sector, is assigned a central role in mobilizing, and financing these investments, thereby contributing to steer the carbon-neutral transition of economies worldwide. In this sense, Article 2.1c of the 2015 Paris Agreement calls for "making finance flows consistent with a pathway towards low greenhouse gas (GHG) emissions and climate-resilient development" (UN, 2015; 2022).

Regarding the reduction of climate risk in the banking sector, competent authorities, which are responsible for banking supervision, play a key role in ensuring an adequate reflection of climate risk in banks' overall risk identification, assessment, and management[3]. In the euro area, the ECB has introduced a set of activities in 2020 to address climate risks also via banking supervision. These activities—i.e., a 'Climate Risk Stress Test' (CRST), a 'Thematic Review' and a 'Short-Term Exercise', see Section 3—have been carried out for the first time in 2022. Also in other jurisdictions, banking supervisory authorities have conducted similar exercises, such as the US Federal Reserve in 2023, Canada's Office of the Superintendent of Financial Institutions in 2020, or the Australian Prudential Regulation Authority in 2021 (Oliver Wyman, 2023). Potentially, these supervisory efforts have an impact also on banks' capital allocation

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penalties to ignore long-term climate risks are still absent. This might cause short-sighted decision-makers to delay their action. Furthermore, technological conservatism within financial institutions (i.e., a preference for established practices) may slow down banks to adopt new technologies or methodologies that could capture climate-related risks (e.g., Dafermos, 2022; De Marco and Limodio, 2023).

[3] In the Eurozone, the ECB is responsible for the supervision of the most system-relevant Significant Institutions (SI); National Competent Authorities are responsible for the supervision of Less Significant Institutions (LSI). Climate-risk-related supervision is guided by the Basel Committees principles on climate-related financial risk (BIS, 2022).

behavior—at least to an extent to which this is motivated by a change in their risk assessment strategies.

This paper sheds light on two research questions: Firstly, do climate-risk-related supervisory activities of the ECB have an effect on the climate risk exposure and management of the affected banks? Secondly, do those activities have an impact on green capital allocation of banks? We empirically assess these two questions by means of a difference-in-difference (DiD) approach. Doing so, we take advantage of the introduction of the Single Supervisory Mechanism SSM from 2012 to 2014[4], mandating the ECB to directly exercise prudential supervision of banks headquartered in the euro area and classified as Significant Institutions (SIs) via the ECB's own supervisory arm. Meanwhile, banks classified as Less Significant Institutions (LSIs) have remained under the supervision of the national competent authorities[5] (Ampudia et al., 2023). This setup allows us to take the ECB's climate-risk-related supervisory efforts as an external shock to the SIs only and compare the observed effects to the ones observed for the LSIs as a control group. This has the advantage that the treatment and the control groups operate in a very similar environment, thus limiting the number of other potential factors influencing a deviating behavior after the shock. To account for the fact that SIs and LSIs have, nevertheless, also differences (especially in terms of their size), where possible, we include banks headquartered in all EU-non-euro-area economies as a second control group in our analyses. We assess the impact of the introduction of the ECB's climate-risk-related supervision on SIs' climate risk rating (Bloomberg), as well as on SIs' green bond (GB)

[4] See https://www.bankingsupervision.europa.eu/about/thessm/html/index.en.html (accessed 09/2023).

[5] The criteria for a bank being classified as an SI are: size (total value of assets > EUR30 bn); economic importance (for the specific country or the EU economy as a whole); cross-border activities (total value of assets > EUR5 bn; ratio of cross-border assets/liabilities in more than one other participating Member State to its total assets/liabilities > 20); direct public financial assistance (has requested or received funding from the European Stability Mechanism or the European Financial Stability Facility), see https://www.bankingsupervision.europa.eu/banking/list/criteria/html/index.en.html (accessed 11/2023) (Ampudia et al., 2023).

issuance, their 'environmental, social and governance assets under management' (ESG-AUM) and their lending to green vs. brown debtors. We find statistically significant impacts on both a decrease of climate risk and on an increase in climate finance (as represented by GB issuance, ESG-AUM and green lending)[6]. Apart from these main findings, a key lesson learnt from our research is that coverage, quality, standardization, and granularity of environmental data have to be improved significantly in order to gauge the impact of supervisory measures more diligently. More comprehensive policy, legislative and regulatory efforts will be necessary in particular regarding standardization and harmonization of disclosed data.

The remainder of the paper is structured as follows: Section 2 provides an overview of the current state-of-the-art research and our contribution. Section 3 lays out the theoretical foundations underlying the treatment effects. Section 4 specifies the empirical framework, and Section 5 the data and descriptive statistics underlying our analysis. Section 6 expounds our analyses' results. Section 7 concludes and provides some policy recommendations.

2 Current State of Research and our Contribution

Our paper contributes to two strands of research. Firstly, we contribute to the literature that deals with banking regulation and supervision; secondly, our paper provides new results in the field of sustainable finance (i.e., climate finance).

The literature strand dealing with banking regulation and supervision sheds light on the impact and optimal design of both climate-unrelated and climate-related supervisory activities. Amongst the climate-unrelated literature in this field, the closest to our paper's assessments are analyses of the impact of stress tests on banks' risk exposure and their security holdings and issuance. For instance, Neretina et al. (2015) empirically assess US supervisory banking stress

[6] Note that the results obtained are purely positive and do not allow any direct conclusion regarding the normative requirements to the banks' level of climate risk reduction set, for instance, in the ECB Guide on climate-related and environmental risk and assessed during the benchmarking processes.

test effects on banks' credit risk, systematic risk, and systemic risk and find a lagged mitigating effect of the stress testing on systemic risk. Luu and Vo (2021), similarly, empirically assess the impact of US supervisory stress tests on banks' risk-taking behavior, finding that banks which are subject to annual supervisory stress tests tend to reduce their overall risk by choosing asset portfolios of lower risk exposures. Archarya et al. (2018), Argawal et al. (2020), Cortés et al. (2020) and Kok et al. (2023) reach similar conclusions for different economies including the EU. Nguyen et al. (2020) examine the effect of US supervisory stress tests on banks' risk exposures to meet higher capital requirements by means of liquidity creation, finding that stress tests have a negative effect on both on- and off-balance sheet bank liquidity creation and asset-side liquidity creation. In contrast, Gambetta et al. (2019) assess the connection between banks' risk factors and the macro stress testing results and find that financial institutions, which are comparatively inefficient or complex, operating at low profitability levels and having a small loan portfolio, receive more negative results in the stress tests. Furthermore, Morgan et al. (2014) and Flannery et al. (2017) study the information generation effect of competent authorities' stress tests and find a significant positive impact. Ellahie (2013) analyzes the consequences of EU supervisory stress tests on the information availability and distribution in capital markets and finds a reducing effect of both the announcement and the implementation of stress tests on information uncertainty and asymmetry in capital markets. Based on a similar reasoning, Borges et al. (2019) assess the impact of information generation of EU bank stress tests on bank behavior and find the most impactful element of the stress testing process on banks being the disclosure of the information on the stress testing methodology. Finally, Bassett and Berrospide (2018) quantify the impact of the stress tests on the amount of loans issued, finding that the 'capital gap', i.e., the delta between the capital implied by the supervisory stress tests and the level of capital implied by the banks' own models has no restricting effect on loan growth. While these climate-unrelated contributions provide some insights regarding the mechanisms of interdependency related to our research questions, literature explicitly assessing the effect of CRST is still very scarce—a lacuna to which our paper contributes. Nguyen et al. (2023) assess the impact of a French CRST pilot exercise performed with a group of nine French banks on the banks' sustainable lending. They find that the nine climate-stress-tested banks increase lending to low-carbon debtors, and, at the same time, charge higher interest rates for borrowers with high transition risk. Gianetti (2023) assesses the interrelation of increased ESG disclosure of banks on their sustainable behavior, finding that banks with better ESG disclosure do not necessarily increase their lending to green borrowers, pointing to greenwashing issues. Some other contributions assess other potential undesired effects within climate-related supervisory activities: for instance, Beck et al. (2023) analyze effects of incomplete coverage in climate-related supervisory cooperation and cooperation externalities. Benincasa et al. (2022) assess the impact of domestic climate policy on green and brown cross-border lending. Both find evidence for arbitrage activities, i.e., increased brown lending to borrowers based in economies lacking strict climate-related regulation and supervision of the banking sector. More broadly, and assessing other supervisory tools than CRST, Oehmke and Opp (2022) provide a theoretical framework to assesses the impact of green capital requirements in the form of either a green supporting factor or a brown penalizing factor on banks' sustainable lending activities. Their model predicts that a green supporting factor has the potential to increase sustainability in banks' lending activities, while a brown penalizing factor might have an adverse effect. Gouriéroux (2022) propose a methodology to calculate capital requirements for climate-related long-run risks. Alessi et al. (2022) assess different macro-prudential instruments to address climate risk and propose a temporary extra capital buffer for those risks, until the economy and banks' balance sheets become greener, D'Orazio and Popoyan (2019) and Hidalgo-Oñate et al. (2023) review different macroprudential instruments to reduce climate risk and foster green investment, and D'Orazio (2021) proposes several approaches to better align macroprudential COVID recovery policies with climate goals.

Contributions dealing with sustainable finance or climate finance that are closely related to our paper focus on questions around how to best incentivize the financing of initially mentioned investments into setting up a sustainable economy. The EU has clearly communicated the political intention and to strengthen the role of the financial sector in order to act as an enabler to guide the low-carbon transition (EU, 2021). The academic literature that explores different transmission mechanisms of sustainable finance is growing rapidly. Ghisetti et al. (2015), Noally and Smeets (2016) and Egli et al. (2022) describe the role of financing constraints for directed technical change from fossil fuels to renewable energy technology innovation. Mazzucato (2013, 2018) describes the impact of the type of finance—public vs. private—provided. Furthermore, Campiglio (2016) assess the role of banking and monetary policy in financing the transition to a low-carbon economy, and Papoutsi et al. (2022) present an assessment of the impact of quantitative easing on sustainable developments in the economy. Also, public-private approaches are often seen as a vehicle to close investment gaps, as well as to allocate risks in a more efficient manner (cf. e.g., OECD, 2017; 2020). In this context, inter alia OECD (2019) investigates the role of alternative financing vehicles in sustainable finance, including, for instance, public-private partnerships. Monk and Perkins (2020) assess drivers for the emergence and diffusion of green bonds. However, from an academic perspective, the role of finance in contributing effectively and efficiently to the transitioning to a low-carbon economy has so far been considerably underestimated (Mercure et al., 2019; De Haas and Popov, 2022).

Our original contribution is, hence, twofold: Firstly, we contribute to the literature dealing with banking regulation and supervision by shedding some light on the impact of CRST on banks' risk exposure. Secondly, we contribute to the literature dealing with climate finance by analyzing CRSTs as one potential driver for sustainable finance and reductions in carbon emissions.

3 Theoretical Framework

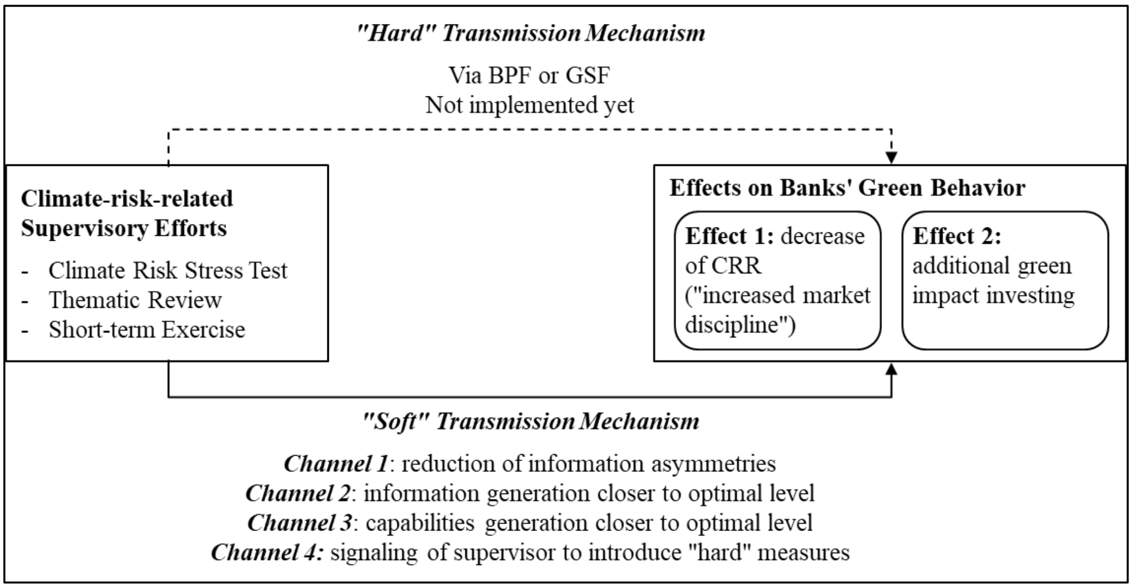
3.1 Background: the ECB's Climate-risk-related Supervision

The ECB has initiated its efforts to supervise climate risk in 2020 with the communication of its 'Guide on Climate-Related and Environmental Risks: Supervisory expectations relating to risk management and disclosure' (ECB, 2020a). In that guide, the ECB specifies its expectations to the SIs relating to (i) business model and strategy, (ii) governance and risk appetite, (iii) risk management; and (iv) disclosure in a climate risk context. The goal is to enhance the banking industry's awareness of and preparedness for managing climate-related and environmental risks. SIs have been "expected to consider the extent to which their current management and disclosure practices for climate-related and environmental risks are sound, effective, and comprehensive in the light of the expectations set out in the guide". Where needed, SIs have been "expected to promptly start enhancing their practices" and have been asked by the ECB's 'Joint Supervisory Teams' to "inform the ECB of any existing divergences in their practices from the supervisory expectations and of arrangements aimed at progressively addressing these expectations" until 2021 (ECB, 2020a, p.8). All expectations will be gradually implemented until 2024. The efforts do not apply for LSIs, which are supervised by the national competent authorities.

Following the publication of the guide, the ECB has performed three concrete supervisory exercises in 2022 to assess and enhance SIs' level of preparedness for properly managing climate risk: a 'Climate Risk Stress Test' (CRST), a 'Thematic Review' and a 'Short-Term Exercise'. The CRST has been carried out in 2022 for the first time as a component of the stress testing in the context of the Supervisory Review and Evaluation Process (see Article 100 of the Capital Requirements Directive CRD IV, ECB, 2022b). The CRST is "seen as a joint learning exercise with pioneering characteristics aimed at enhancing both banks' and supervisors' capacity to assess climate risk", and aims at generating transparency regarding and improving the availability of climate-related information and capabilities (ECB, 2021a; 2022b). This goes in line with the established opinion that one key effect of stress testing is to create information, thereby reducing information asymmetries. Particularly, the CRST generates information with regard to climate risk exposure and management, as well as unmanaged climate risk. Furthermore, the relevance of climate risk to the different SIs is determined by means of a 'Risk Tolerance Framework' (ECB 2023b). The CRST is complemented by the Thematic Review exercise, which puts the magnifying glass on SIs' climate risk management capabilities and practices, such as the inclusion of climate risk in the SIs' strategy as well as their cascading down into the operative functions (ECB, 2022a). The Short-Term Exercise as the third component of the climate risk supervisory efforts aims at establishing a view on the general disclosure of climate risk information by SIs, i.e., about the coverage of the SI's climate risk reporting (ECB, 2023c). To verify SIs' self-reported results, Joint Supervisory Teams may perform on-site inspections. The climate risk supervisory exercises are intended to be continued and improved throughout the coming years and will be complemented by further exercises such as climate risk reporting as an enhanced Pillar 3 component of the Basel III reporting requirements, which the EU has already embedded within the forthcoming CRR3 regulation (Oliver Wyman, 2023) and further stress testing exercises contributing to the EU's fit-for-55 strategy (ECB, 2023d) under the aegis of the European Banking Authority. While the 2022 exercises had a pilot and informative character, going forward, the according supervision will be further developed and refined (Gouriéroux, 2022; RI, 2022).

3.2 Effects of Climate-risk-related Supervisory Efforts

Climate-risk-related supervision might affect banks' green behavior—i.e., the reduction of climate-risk-related and climate finance—through two transmission mechanisms: (i) a 'soft transmission mechanism', based on additional information, capabilities and signaling effects; and (ii) a 'hard transmission mechanism' based on induced changes in the cost of bank lending, e.g., through a green supporting factor or a brown penalizing factor. In this paper we focus on the soft transmission mechanism, also because, so far, no green supporting factor or brown penalizing factor resulting from the banks' climate risk assessment have been imposed. This might change in the future and could also intensify the regulatory and supervisory impact; however, political resistance may hamper its implementation (Oliver Wyman, 2023). This setup, i.e., the prevalence of the soft transmission mechanism and absence of the hard transmission mechanism, allows us to analyze the effects that supervisory exercises might have on climate-related information gathering and improvement of skills in isolation, without being distorted by overlapping effects of the hard transmission mechanism. We propose four distinct channels through which the soft transmission mechanism might operate: channel 1 induces a reduction of information asymmetries between banks and their business counterparts, channel 2 a generation of additional information regarding climate risk, channel 3 an increase in climate-risk-related capabilities, and channel 4 a signaling of the supervisory authorities' intention to banks to potentially introduce hard measures in the future.



Note: BPF = brown penalizing factor, CRR = Climate-related risk, GSF = green supporting factor.

Figure 1: Effects of Climate-risk-related Supervisory Efforts on Banks' Green Behavior

As introduced in Section 2, especially the investigation of channel 1 is widely rooted in the context of non-climate-related supervisory activities such as regular Supervisory Review and Evaluation Process and stress testing. However, the fundamental reasoning is transferrable to climate-related supervisory efforts and can be used as a basis for the explanation of soft effects within the climate risk context. The key argument for the introduction of stress testing and the disclosure of its results in the aftermath of the financial crises in 2008/9 is to foster an increase in market discipline via a reduction of information asymmetries (Bernanke, 2013; Ellahie, 2013; Gorton and Ordonez, 2014, Fuchs et al., 2023). An increased disclosure provides market participants with better insights into the risk exposure of banks, yielding more adequately reflected market prices. This might cause a more efficient resource allocation—e.g., less investment into high-risk activities—and could consequently also hamper excessive risk taking of banks (Goldstein and Sapra, 2013). Petrella and Resti (2016) underpin this point by stating that especially the disclosure of historical data is valuable for market participants, especially in the case of skepticism towards forward-looking data (*zoom hypothesis*) and newly generated information such as Common Equity Tier 1 (CET1) capital ratios have a significant explanatory power regarding the future development of banks (*stress hypothesis*) (Ferretti et al., 2023). However, these positive effects are controversially discussed in the literature. Petrella and Resti (2016) argue that the market might disregard the information generated during supervisory exercises (*irrelevance hypothesis*). Furthermore, four levers can potentially induce even negative—i.e., welfare-reducing—effects of disclosing supervisory results: The Hirshleifer effect states that greater disclosure might reduce risk sharing opportunities for economic agents, which experience idiosyncratic shocks (Hirshleifer, 1971); if self-reporting and disclosure are involved, bank managers have a strong incentive to respond myopically trying to inflate the perception of short-term performance at the expense of long-term efficiency—a typical climate risk form is ‘greenwashing’ (Gigler et al., 2014); market participants might react strategically to disclosure; and private information generation might be crowded out (Goldstein and Sapra, 2013). Despite these potential adverse effects, evidence has shown that supervisory action generally has a disciplining effect on markets, especially if an ideal level of disclosure is required (Goldstein and Leitner, 2018).

Within the context of climate-risk-related supervisory efforts, not only the disclosure of additional information and a resulting reduction of information asymmetries is relevant, but also the generation of additional climate risk information itself, even if they remain undisclosed (channel 2). The cost of information generation and distorted incentives for banks to generate such information—for instance, myopic bank managers, who highly discount the long-term benefits of increased climate risk information availability, as well as the public goods nature of such information—might lead to their under-provision (Sharma et al., 2021). Hence, the gathering of additional climate risk information incentivized by regulatory and supervisory efforts might have a welfare-increasing impact.

An analogous reasoning applies to the build-up of climate-risk-related capabilities of banks, such as recruitment or training of employees with skills to generate, interpret and operationalize climate-risk-related information (channel 3) (Hansen, 2022). Indeed, qualitative *ex post* assessments of the ECB's 2022 CRST have revealed that the exercise has led to increases in capabilities (Oliver Wyman, 2023).

Lastly, the introduction of climate-risk-related supervisory efforts might have a signaling effect on banks with respect to the future introduction of hard measures such as brown penalizing factors and green supporting factors (channel 4). If banks are able to anticipate such forthcoming measures—which is one of the intentions of the ECB's climate risk supervisory efforts that communicates explicitly their potential future introduction—they might prepare *ex ante* for this possibility by adjusting their behavior accordingly (see Oliver Wyman, 2023).

4 Empirical Strategy

4.1 Difference-in-difference Design

In this section we set up a modeling framework to explore empirically the transmission of climate-risk-related supervisory efforts via the soft transmission mechanism. We use a DiD approach, where we estimate empirical models for four different dependent variables, see Table

1. Those variables are proxies for measuring the two potential effects of climate risk supervision, i.e., a decrease of climate risk (effect 1) and an increase in climate finance (effect 2). As a proxy for climate risk, we use Bloomberg's Environmental Score (E-Score) for FI. As a proxy for climate finance, we use (2.1) banks' green bond issuance; (2.2) banks' ESG-AUM; and (2.3) 'green credit' to reflect the impact on green lending decisions.

Table 1: Dependent Variables as Proxies for Banks' Green Behavior

Effect 1: Decrease of Climate Risk	Effect 2: Green Impact Investing
1 Bloomberg E Score (Disclosure Score adjusted)	2.1 Green bonds issuance
	2.2 ESG-AUM
	2.3 Green credit

A detailed description of the proxies follows in Section 5. For each of the four dependent variables introduced above, the DiD regression equation takes the form

$$Y_{ibt} = \beta_{0,i} + \beta_{1,i} treat_{ibt} + \beta_{i,2} post_{ibt} + \beta_3 treat_{ibt} \times post_{ibt} + X_{ibt}\gamma_i^T + a_{ibt} + \varepsilon_{ibt} , \quad (1)$$

where $Y_{ib}, i \in (1,4)$ represents the four different dependent variables, which serve as proxies for green bank behavior, $treat_{ibt}$ a dummy variable indicating the treatment of the treatment group with the climate risk supervisory efforts, $post_{ibt}$ a dummy variable describing the introduction time of the climate risk supervisory efforts, X_{ibt} the matrix of the control variables, a_{ibt} fixed effects, and ε_{ibt} the error term.

We choose the SIs as the treatment group and the LSIs as the control group[7]. As described in Section 3, SIs are subject to climate-risk-related supervisory efforts; their selection is made based on the banks' systemic relevance and does not involve any self-selection, so that this treatment group remains unaffected by any potential self-selection bias. We choose the LSIs as a control group for three main reasons: firstly, and most importantly, LSIs do not face climate-

[7] For the ECB's list of supervised entities, classified into SIs and LSIs, see https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.listofsupervisedentities202304.en.pdf (accessed 08/2023). For regression 2.3 with green credit as the dependent variable, for reasons of data availability, we only include German SIs and LSIs in the sample.

risk-related supervisory efforts induced by the ECB, i.e., they do not undergo the treatment[8]. Secondly, LSIs—like the SIs—are headquartered in the euro area. Thus, many external factors such as macroeconomic, political, regulatory, legal, and societal conditions potentially impacting banks' green behavior apply similarly or equally for both the SIs and the LSIs. Factors that do not impact the two groups equally, such as specific banking regulations, can be relatively easily accounted for by means of the inclusion of adequate control variables or bank-level fixed effects[9] (see below). Thirdly, data for the two groups of banks are generally available from the same data sources, which reduces any potential shortcomings with regard to data comparability[10].

We treat the SIs with the introduction of climate risk supervision as an exogenous shock from the year 2020 onwards. As described in Section 3, in 2020, the ECB Guide on Climate-Related and Environmental Risks has been published, announcing the supervisory effort starting with data collection and the SIs' self-assessment, and the CRST, Thematic Review and Short-Term Exercise publication in 2022 (see above). Hence, introducing the treatment in 2020, we account for announcement effects. We lag the treatment variable by one year to estimate the effect of the treatment in previous periods on the current period and, thus, test for potential delays in the observed effects.

[8] The Netherlands are the only economy, which has introduced CRST for all banks, insurers, and pension funds independently of their system significance. We have, thus, excluded all banks from the Netherlands from our sample. Furthermore, we have excluded all banks from Croatia, which has joined the euro area only in 2022, i.e., during the considered time period.

[9] The total sizes of the treatment and the control group in terms of total assets are approx. $3.48*10^{13}$ EUR (SIs) and $3.54*10^{12}$ EUR (LSIs) for the regression to the green bonds. For the remainder of the regressions, size ratios are comparable.

[10] As an alternative control group to the LSIs and in the case of data availability (here for green bonds issuance), we have tested non-euro-area banks, which are headquartered in the EU (EU-non-euro-area banks), i.e., banks from Bulgaria, the Czech Republic, Denmark, Hungary, Poland, Romania, and Sweden. The DiD analyses for which the corresponding data was available as well, revealed similar results to those obtained with the LSIs as the control group.

Within the DiD regressions, we include controls reflecting macroeconomic conditions, the policy and regulatory environment, as well as banks' specificities. To determine the exact control variables, we refer to a body of literature analyzing determinants of green banking behavior, such as the issuance of new sustainable financial instruments. Within this body of literature, the major share of contributions analyzes determinants for green bonds issuance, while analyses of determinants for other green bank behavior such as increasing ESG-AUM or green lending remain subject to future research. Acknowledging this lacuna, and for the benefit of increasing comparability, we choose similar control variables across the four DiD regressions. Firstly, we control for the development of the macroeconomic variables year-over-year (YY) GDP growth and YY inflation (Campiglio, 2016) (both from Refinitiv Eikon). Furthermore, banks' environmental reputation has been identified as a driver of green bonds issuance (e.g., Dossa and Kaeufer, 2014; Serafeim 2014; Basu et al. 2022; Christensen et al. 2022, Dutordoir et al., 2023, Gianetti, 2023); therefore, we control for banks facing environmental controversies (Refinitiv Eikon), which measure banks' involvement in environmentally harmful incidents having the potential to impose reputational risk to the banks and to induce stakeholder pressure. Furthermore, since the regulatory environment has been identified as another key driver for GB issuance (Dan and Tiron-Tudorm, 2021), we control for the introduction of the Sustainable Finance Disclosure Regulation (SFDR) in 2021, as it does not equally affect all banks within our sample, but only banks, which, *inter alia*, exceed a size threshold of 500 employees. Furthermore, since issuer characteristics have been identified as another driver for GB issuance (Bancel and Glavas, 2020), we include bank-level fixed effects[11], such as banks' business model and headquarter (HQ) location. Further drivers for GB issuance are the development of the GB market, the development of premia for GB ('greenium') (Hinsche, 2021), and other environmental regulations. A milestone in the development of the

[11] While we include bank-level fixed effects in the main regressions, we also account for country-level fixed effects in the robustness checks, see Section 6.

GB market has been the publication of the GB principles (ICMA, 2021). However, these voluntary process guidelines equally apply to all banks within our sample. The same holds true as well for the development of the greenium as well as other environmental regulations on the EU level. We refrain from controlling for carbon prices due to potential endogeneity issues arising from causalities, which have been demonstrated to run from the GB index to CO_2 futures' returns (Marín-Rodriguez et al., 2022). Due to the potential impact of carbon prices on GB issuance (Laeven and Popov, 2022), the inclusion of this control remains subject to future research. Note, however, that for all regressions apart from the regression to the share of GB to all issued bonds, we have included a control variable for annual EU-ETS carbon prices (World Bank), since for the according dependent variables, the above-described causalities have not yet been demonstrated. Lastly, for the regression on green credit only, we control for debtor sector, debtor type, debtor size and debtor risk rating, since the analysis of green lending is debtor specific. We, furthermore, account for time, bank-level, and country-level fixed effects (e.g., Ioannou and Serafeim, 2012, 2017; Baldini et al. 2018). Using Stata's *reghdfe* ordinary least squares (OLS) method allows for the inclusion of fixed effects by means of 'absorbing', and for multi-level clustering (Correia, 2016).

4.2 Parallel Trends

Critical to the validity of our findings is the exogeneity of changes in banks' green behavior. Therefore, we have to make sure that the differences in the trends we capture have not preceded the announcement of the ECB's climate-risk-related supervision in 2020, i.e., that the SIs were not already before the shock starting to behave greener than the LSIs, and we are not simply picking a continuation of longer-term trends (see, e.g., Angrist and Pischke, 2008).

For testing the 'parallel trends assumption', we perform two alternative tests:

Firstly, we follow the normalized difference approach by Imbens and Wooldridge (2009) to examine trends in banks' green behavior preceding the shock in 2020. According to this test, there must not be a divergence of the dependent variables (climate risk, GB, ESG-AUM and green lending) prior to the treatment. To test this, we calculate the normalized differences as averages by treatment status scaled by the square root of the sum of the variances. This approach has an advantage over the t-test, as it is a scale-free measure of differences in distributions independent of the sample size (Imbens and Wooldridge, 2009). An absolute normalized difference smaller than 0.25 indicates that there is no significant difference in the evolution of characteristics between treated and control groups (Mueller et al., 2023). Tables A.6, A.8, A.10 and A.12 in the Appendix report the normalized differences between the treatment and control groups during the pre-treatment period. For all climate risk and sustainable finance proxies (Bloomberg E-Score, GB issuance, ESG-AUM, and green lending), the normalized differences of the dependent variables (0.21; 0.21; 0.06; 0.02) remain well below the 0.25 rule of thumb. The same holds for the normalized differences of the majority of the controls. Only the normalized difference of the share of banks' lending to sector K[12] (financial and insurance activities) exceeds the threshold with 0.40. This, however, does not invalidate our empirical strategy, since the lending to financial and insurance activities is more reflective of general sector trends, and not our main dependent variables.

Secondly, we perform additional tests and consider the pre-treatment period before the introduction of the ECB's climate-risk-related supervisory efforts, i.e., the time period from 2015 to 2020. We split the time period into the years 2015 to 2016 (first period I) and 2017 to 2019 (second period I), as well as into the years 2015 to 2017 (first period II) and 2018 to 2019 (second period II). We then estimate the following models for the different periods:

$$Y_{ibt} = \beta_{i0} + \beta_{i1} treat_{ibt} + \beta_{i2} post_{ibt}^{n} + \beta_{i3} treat_{ibt} \times post_{ibt}^{n} + X_{ibt}\gamma_i^T + a_{ibt} + \varepsilon_{ibt} \, , \qquad (2)$$

[12] According to the Nomenclature of Economic Activities NACE (https://nacev2.com/en/activity/financial-and-insurance-activities).

with $n \in (2016, 2017)$. The results in Tables A.7, A.9. A.11 and A.13 demonstrate no significant trend change in the pre-treatment period (here exemplarily displayed for the first and second period I).

5 Data

In this section, we provide a description of the core data underlying the four DiD analyses introduced in Section 4. An exhaustive list of all data points and their sources can be found in Table A.1 in the Appendix. Regarding data quality, it is important to be aware of three aspects: Firstly, especially the availability of reported environmental data is rather incomplete, both for banks and debtors[13]. Secondly, many ratings, amongst which the Refinitiv Eikon environmental rating and the Bloomberg E-Score, are based on the rated entities' self-reported data; consequently, potential greenwashing issues cannot be ruled out[14]. Thirdly, a lack of standardization both in the environmental reporting of the entities as well as in rating methodologies across different rating agencies prevents meaningful cross-entity comparisons. The fragmented data availability has consequences for the comparability of the four regressions. It is important to note that DiD 1 to 2.2 are based on the same sub-sets of the original data set sourced from Refinitiv Eikon, while DiD 2.3 is based on a different data set extracted from the ECB Corep data base. Since the underlying set of SIs and LSIs is the same for all four DiDs, all data sets do still have a large overlap.

Tables A.2 to A.5 show the descriptive statistics of the main variables. The final samples for the four analyses consist of 680 (climate risk), 16,124 (GB issuance), 999 (ESG-AUM) and 22,320 (green lending) observations between the years 2015 and 2022 (climate risk), 2010 and

[13] For SIs, data coverage is 79% for GB, 41% for ESG-AUM, and 34% for the Bloomberg E-Score and Disclosure Score. For LSIs, data coverage is 32% for GB, 2% for ESG-AUM and 1% for the Bloomberg E-Score and Disclosure Score. For the debtors, coverage is 10% amongst the non-private-person debtors.

[14] For larger entities, reported environmental data are audited, however, entities for which this applies represent a minor share of all rated entities.

2023 (green bonds), 2015 and 2023 (ESG-AUM), and 2014 and 2022 (green lending). Sustainable finance activities are generally low, with, e.g., the average share of green to all bonds issued by banks in the observed period from 2010 to 2023 being approx. 0.2%, the average share of banks' green lending from 2014 to 2022 being approx. 1%.

5.1 Data 1: Climate Risk (Disclosure-adjusted)

In order to test for the decrease in climate risk we use the Bloomberg E-Score for the FI. The score measures banks' environmental risk exposure and management along the dimensions ESG integration, exclusions, financed emissions, industry exposure, sustainable lending & underwriting, engagement, market initiatives, and portfolio climate transition risk on a scale from 0 (high environmental risk exposure and/or bad management) to 10 (low environmental risk exposure and/or good management). It, thus, serves as a proxy for banks' exposure to unmanaged environmental risk. Furthermore, for each bank's E-Score, Bloomberg provides a disclosure score, which measures the share of the available to the queried data points from which the E-Score is aggregated on a percentage scale. Since taking the E-Score as a stand-alone proxy for the banks' environmental risk exposure implicitly assumes full and constant disclosure, we multiply the E-Score and the according Disclosure Score on the bank level, hence accounting for the fact that disclosure is incomplete and time-varying.

5.2 Data 2.1: Green Bonds Issuance

To the end of determining the impact of climate risk supervisory efforts on banks' green impact investment and finance, we, firstly, investigate the impact on the issuance of green bonds, which have emerged in 2007 as a new sustainable financial instrument whose "proceeds will be exclusively applied towards new and existing green projects" (ICMA, 2014). Like for any standard fixed-income product, investors who purchase a green bond from the bond issuer—e.g., a bank—receive an agreed interest rate, as well as their original investment once the bond reaches maturity (Monk and Perkins, 2020). GB have been used to finance (and refinance) a range of green projects such as renewable energy, energy efficiency, green buildings, and low-carbon transportation (Ng and Tao, 2016). Hence, banks' GB issuance (Refinitiv Eikon, issued amount in EUR) can be used as a proxy for banks' green impact investment. We normalize banks' GB issuance to banks' total bonds issuance to correct for any effects due to fluctuations in the total bonds' issuance (Tolliver et al., 2019). Hence, our proxy is expressed on a percentage scale. Furthermore, it is important to note that GB can also contribute to the reduction in banks' climate risk exposure.

5.3 Data 2.2: ESG-AUM

As a second proxy to test the impact of the climate risk supervisory efforts on climate finance, we test the impact on banks' ESG-AUM. The data is retrieved from Refinitiv Eikon in EUR. The classification of AUM as ESG-AUM is based on the self-reporting of the banks according to a set of uniform criteria. For instance, Socially Responsible Investment (SRI) and ethical funds can be considered, as well as investments in environmental assets such as renewable energy assets. Hence, compared to GB, ESG-AUM are more broadly defined, and reflect, besides banks' green investment, also their social investment. Therefore, we expect to see a lower impact of climate risk supervisory efforts compared to the effects on GB. As it is the case for GB, ESG-AUM can contribute to the reduction of banks' climate risk exposure.

5.4 Data 2.3: Green Lending

The third proxy for testing the impact of the climate-risk-related supervisory efforts on the impact of climate finance is a variable that measures banks' green lending activities. In order to obtain a measure of its relative importance, we use the share of green lending to total lending of banks as a percentage scale. The ECB's Corep database contains annual data of SI's and LSI's lending activities including debtor information and the credit size. We classify the debtors according to their Refinitiv Eikon environmental rating on a continuous scale from 0 to 1, with 0 being a non-sustainable debtor with an environmental rating of D-, and 1 being a highly sustainable debtor with an environmental rating of A+. Unclassified debtors are treated as non-sustainable.

6 Results

We find statistically significant impacts of climate-risk-related supervisory efforts on both disclosure-adjusted climate risk exposure and climate finance (green bonds, ESG-AUM, green lending). In the following, we present the results of the four different DiD analyses.

When interpreting the results, note that there is a threat of identification due to the fact that SIs are generally larger banks, which are active on a global scale, while LSIs are smaller banks with a more local focus in their business: it is possible that SIs changed their environmental behavior after 2020 throughout the world, for reasons unrelated to supervisory actions, but, e.g., due to enhanced global scrutiny of public institutions, in the wake of the US's renewed commitment to climate action under President Biden. To test for this formally, ideally, the regressions are run on pseudo samples of banks of a comparable size and global scope from outside of the euro area. For data availability reasons, this test is only possible for green bonds issuance. Here, we run the test with SIs as the treatment group and banks of a comparable size, whose headquarters are located in the EU but outside the Eurozone (i.e., Bulgaria, the Czech Republic, Denmark, Hungary, Poland, Romania, and Sweden) as a control group, revealing similar results (see Table A.16 in the Appendix). Going forward, we recommend to also perform this test for the other dependent variables.

6.1 Results 1: Climate Risk (Disclosure-adjusted)

The DiD analysis for the impact of climate-risk-related supervisory efforts on the environmental risk exposure of banks provides evidence that banks reduce their climate risk exposure significantly, i.e., there is a positive impact on their disclosure-adjusted E-score. This result is robust with regards to the inclusion and exclusion of the control variables, see Table 2. Furthermore, the dynamic analysis reveals some significant lead effects of the climate risk supervision, see Table A.14 in Appendix A.3. Amongst the control variables, YY GDP growth, YY inflation, and carbon prices have a significant positive impact on banks' environmental risk. To limit potential endogeneity issues of the control variables, we regress the product of the Bloomberg E-Score and the Disclosure Score to the control variables and find no significant impact, both in the contemporary and the lagged regression.

Table 2: Env. Risk x Disclosure—Sequential Regressions w/o Non-eurozone Banks

VARIABLES	(1) env_risk_disc	(2) env_risk_disc	(3) env_risk_disc	(4) env_risk_disc	(5) env_risk_disc	(6) env_risk_disc	(7) env_risk_disc	(8) env_risk_disc
after	0.161***	0.162***	0.183***	0.137***	0.0782	0.0826		0.0939
	(0.0482)	(0.0484)	(0.0509)	(0.0486)	(0.0479)	(0.0591)		(0.0600)
o.after							-	
treatment								0.0646*
								(0.0365)
o.treatment	-	-	-	-	-	-	-	
treat_after	0.371***	0.369***	0.369***	0.369***	0.368***	0.380***	0.381***	0.414***
	(0.115)	(0.114)	(0.114)	(0.114)	(0.114)	(0.105)	(0.105)	(0.108)
env_controv		-0.174	-0.163	-0.157	-0.177	-0.176	-0.169	0.398***
		(0.128)	(0.117)	(0.117)	(0.117)	(0.119)	(0.122)	(0.141)
gdp_growth_yy			1.883***	1.297***	1.106***	1.225**		1.520**
			(0.426)	(0.364)	(0.363)	(0.579)		(0.659)
o.gdp_growth_yy							-	
inflation_yy				1.406***	0.505	0.534*		0.789**
				(0.341)	(0.307)	(0.299)		(0.352)
o.inflation_yy							-	
log_CO2_price					0.0558***	0.0562***		0.0494***
					(0.0148)	(0.0150)		(0.0143)
o.log_CO2_price							-	
sfdr						-0.0243	-0.0257	-0.0794
						(0.0923)	(0.0928)	(0.106)
Constant	0.0678***	0.0747***	0.0370	0.0346	-0.0798	-0.0833	0.137***	-0.128***
	(0.0201)	(0.0198)	(0.0255)	(0.0258)	(0.0503)	(0.0535)	(0.0225)	(0.0338)
Observations	680	680	680	680	680	680	680	680
R-squared	0.622	0.623	0.637	0.640	0.643	0.643	0.644	0.251

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
Env_risk_disc on a scale from 0 (bad) to 10 (good), disclosure-adjusted.
Results based on stata's reghdfe OLS estimation method; fixed effects treated by means of 'absorbing' (Correia, 2016). Columns (1) to (6) report results considering bank fixed effects. Column (7) reports results considering bank and time fixed effects. Column (8) reports results without consideration of any fixed effects.

6.2 Results 2.1: Green Bonds Issuance

The DiD regression of climate risk supervisory efforts on green bonds issuance also reveals a positive significant impact, see Table 4. This result is robust with regards to the inclusion and exclusion of the control variables. In this analysis, only the introduction of the SFDR has a small significant impact on GB issuance. The dynamic analysis reveals that the lagged effects slightly exceed the non-lagged effects in terms of their intensity, which points to a delayed reaction of banks to the treatment, see Table A.15 in Appendix A.3. To reduce the likelihood of the occurrence of potential endogeneity issues (a necessary, but not sufficient condition), we perform a regression of the share of green bonds to the control variables and find no significant impact.

6.3 Results 2.2: ESG-AUM

The DiD analysis of climate risk supervisory efforts on banks' ESG-AUM also reveals a positive significant impact, see Table 4. Compared to DiD 2.1, we observe effects of an even smaller magnitude. This result is intuitive, as ESG-AUM include also social and governance AUM besides environmental AUM, on which it is reasonable to assume that climate risk supervisory efforts have a limited impact. This result is robust with regard to the sequential inclusion of the control variables. In this analysis, only the YY inflation has a small but significant impact on ESG-AUM. The dynamic analysis reveals that lagged effects are slightly more pronounced, again pointing to an adjustment period of banks' behavior, see Table A.17 in Appendix A.3. To reduce the likelihood of the occurrence of potential endogeneity issues (a necessary, but not sufficient condition), we perform a regression of the ESG-AUM to the control variables and find no significant impact.

6.4 Results 2.3: Green Lending

The DiD analysis of climate risk supervisory efforts on banks' green lending also reveals a strong positive and significant impact, see Table 5. Also, this result is robust with regard to the inclusion and exclusion of the control variables. In this analysis, we do not observe any significant impact of the macroeconomic and bank-specific controls. Amongst the debtor-specific controls, we observe significant effects of both debtor sizes and debtor sectors. Regarding debtor size, the analysis reveals a significant negative impact of debtors being of a very small and of a medium size. The negative effect of debtors of a very small size reflects that many of these debtors, such as private individuals or very small companies, often lack a sustainability rating and are, thus, classified as non-sustainable. The negative effect of debtors of a medium size reflects a combination of many medium-sized companies being unrated and having a non-sustainable score. Following this argumentation, we could also expect the control for small debtors having a significant negative impact. The absence of this result might be rooted in the fact that many project companies (e.g., special purpose vehicles) of renewable energy projects, such as solar and wind parks, are classified as small companies, which generally have very good environmental ratings. Regarding the sectors, we observe a significant negative impact of debtors stemming from the sectors agriculture, forestry, and fishing, mining, and quarrying, and construction. A negative impact of human health services and arts, entertainment and recreation can potentially be rooted in the fact that most of the debtors from these sectors do not have a sustainability rating, and are, thus, classified as non-sustainable. For the sectors transport and storage, financial and insurance activities as well as for public administration and defense, we observe a significant positive impact. This points to a generally positive environmental performance of those sectors, which is reasonable especially for public administration, having ambitious climate policy goals and taking an intended model role in environmental protection topics. This holds true as well for the financial and insurance activities sector, which has a high visibility regarding environmental protection topics, and thus an increased need to disclose environmental information and perform well in the according ratings. Beyond these observations to be explained in terms of content, however, also data availability and comparability might partially cause these results. Especially for the sector transport and storage, good performance within environmental ratings is often rooted in the sector-wide comprehensive setting of ambitious climate targets, which, in turn, is partially caused by the high visibility of this sector. The set climate policy targets contribute positively to the rating, even though no positive environmental contribution has materialized, and it also remains unclear if the targets will actually be reached. Furthermore, for the sector financial institutions and insurance, data-related distortions of the results might be caused by the fact that the majority of environmental ratings—amongst which the Refinitiv Eikon rating, used in our analysis—mainly accounts for the financial institutions' and insurances' own environmental performance in a narrower sense, only marginally taking into account their portfolios' environmental performance. Therefore, the leverage effect attributed to the financial sector is only very poorly reflected in the data. It remains subject to future research to scrutinize the exact relations and impact. The dynamic analysis reveals that lagged effects are slightly more intense, again pointing to an adjustment period of banks' behavior, see Table A.18 in Appendix A.3. To reduce the likelihood of the occurrence of potential endogeneity issues (a necessary, but not sufficient condition), we perform a regression of the issuance share of green lending to the control variables and find no significant impact.

Table 3: Green Bonds—Sequential Regressions w/o Non-eurozone Banks

VARIABLES	(1) GB_to_all_bonds	(2) GB_to_all_bonds	(3) GB_to_all_bonds	(4) GB_to_all_bonds	(5) GB_to_all_bonds	(6) GB_to_ALL	(7) GB_to_ALL
after	0.000193	0.000181	0.000322**	-0.000360	-0.000940		-0.000862
	(0.000122)	(0.000128)	(0.000142)	(0.000554)	(0.000687)		(0.000648)
o.after						-	
treatment							0.00106
							(0.000891)
o.treatment	-	-	-	-	-	-	
treat_after	0.0572***	0.0571***	0.0571***	0.0571***	0.0540***	0.0540***	0.0545***
	(0.0111)	(0.0111)	(0.0111)	(0.0111)	(0.0106)	(0.0106)	(0.0107)
env_controv		0.0126	0.0127	0.0128	0.0125	0.0125	0.0246
		(0.0415)	(0.0414)	(0.0414)	(0.0414)	(0.0414)	(0.0221)
gdp_growth_YY			0.0285**	0.0208*	0.0125		0.0139
			(0.0115)	(0.0109)	(0.00896)		(0.00939)
o.gdp_growth_YY						-	
inflation_YY				0.0232	0.0175		0.0185
				(0.0185)	(0.0174)		(0.0176)
o.inflation_YY						-	
SFDR					0.00502**	0.00506**	0.00422**
					(0.00212)	(0.00210)	(0.00173)
Constant	0.000174	0.000141	-0.000257	-0.000463	-0.000270	-7.87e-06	-0.000417*
	(0.000247)	(0.000267)	(0.000359)	(0.000460)	(0.000403)	(0.000312)	(0.000216)
Observations	16,142	16,142	16,142	16,142	16,142	16,142	16,142
R-squared	0.222	0.222	0.223	0.223	0.224	0.224	0.115

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
GB_to_all_bonds on a percentage scale.
Results based on stata's reghdfe OLS estimation method; fixed effects treated by means of 'absorbing' (Correia, 2016).
Columns (1) to (5) report results considering bank fixed effects. Column (6) reports results considering bank and time fixed effects.
Column (7) reports results without consideration of any fixed effects.

Table 4: ESG-AUM—Sequential Regressions w/o Non-eurozone Banks

VARIABLES	(1) ESG_AUM_Abs_s	(2) ESG_AUM_Abs_s	(3) ESG_AUM_Abs_s	(4) ESG_AUM_Abs_s	(5) ESG_AUM_Abs_s	(6) ESG_AUM_Abs_s	(7) ESG_AUM_Abs_s
after	0.000133	0.000103	0.000545	-0.00215*	-0.00364		-0.00335*
	(0.000133)	(0.000148)	(0.000353)	(0.00123)	(0.00227)		(0.00200)
o.after						-	
treatment							0.000473
							(0.00105)
o.treatment	-	-	-	-	-	-	
treat_after	0.0205**	0.0205**	0.0205**	0.0205**	0.0158**	0.0169**	0.0168**
	(0.00960)	(0.00966)	(0.00967)	(0.00967)	(0.00746)	(0.00788)	(0.00797)
env_controv		0.00488	0.00485	0.00504	0.00504	0.00438	0.0115
		(0.00972)	(0.00999)	(0.00990)	(0.0101)	(0.0101)	(0.00827)
gdp_growth_YY			0.0409	0.00976	-0.0273		-0.0186
			(0.0279)	(0.0144)	(0.0200)		(0.0148)
o.gdp_growth_YY						-	
inflation_YY				0.0746*	0.0567**		0.0619*
				(0.0408)	(0.0284)		(0.0313)
o.inflation_YY						-	
SFDR					0.00848	0.00645	0.00640
					(0.00620)	(0.00460)	(0.00471)
Constant	0.000505	0.000329	-0.000479	-0.000604	0.000305	-0.000168	-0.000347*
	(0.00177)	(0.00170)	(0.00219)	(0.00225)	(0.00173)	(0.00203)	(0.000196)
Observations	999	999	999	999	999	999	999
R-squared	0.311	0.311	0.313	0.314	0.316	0.318	0.061

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
ESG_AUM_Abs_s in EUR.
Results based on stata's reghdfe OLS estimation method; fixed effects treated by means of 'absorbing' (Correia, 2016).
Columns (1) to (5) report results considering bank fixed effects. Column (6) reports results considering bank and time fixed effects.
Column (7) reports results without consideration of any fixed effects.

Table 5: Green Credit—Sequential Regressions w/o Non-eurozone Banks

VARIABLES	(1) debt_env_rel	(2) debt_env_rel	(3) debt_env_rel	(4) debt_env_rel	(5) debt_env_rel	(6) debt_env_rel	(7) debt_env_rel	(8) debt_env_rel	(9) debt_env_rel
after	-12.16***	-12.16***	-12.16***	-12.00***	-8.505***	-1.860	-0.737		-1.183
	(1.859)	(1.859)	(1.859)	(1.831)	(2.799)	(2.431)	(2.842)		(2.719)
o.after								-	
treatment									-7.525
									(6.000)
o.treatment	-	-	-	-	-	-	-	-	
treat_after	19.41**	19.41**	19.41**	19.41**	19.41**	19.42**	16.93**	17.83**	18.67**
	(8.027)	(8.027)	(8.028)	(8.028)	(8.028)	(8.028)	(8.346)	(8.814)	(8.572)
o.sfdr		-	-	-	-	-	-	-	-
env_controv			1.425	1.741	1.761	2.016	0.176	5.132*	-5.265
			(1.400)	(1.545)	(1.548)	(1.616)	(2.755)	(2.664)	(3.556)
gdp_growth_YY				16.29	61.23***	96.75***	93.61***		101.7***
				(14.07)	(14.71)	(22.82)	(29.93)		(28.39)
o.gdp_growth_YY								-	
inflation_YY					-107.2**	96.63	136.6		142.8
					(46.27)	(161.7)	(147.2)		(164.6)
o.inflation_YY								-	
CO2_price						-0.299	-0.316		-0.344
						(0.198)	(0.199)		(0.213)
o.CO2_price								-	
dbtr_sect_A							-46.19***	-22.89**	7.471
							(8.847)	(10.75)	(8.296)
dbtr_sect_B							-148.3**	-152.6**	-106.6
							(65.25)	(70.46)	(108.5)
dbtr_sect_C							225.3	226.1	202.4
							(200.6)	(207.7)	(179.2)
dbtr_sect_D							-7.645	-8.307	3.085
							(9.481)	(11.80)	(5.922)

dbtr_sect_E	-0.844	8.076	-7.067
	(9.046)	(9.310)	(6.241)
dbtr_sect_F	-15.51***	-4.683	0.266
	(4.804)	(5.761)	(3.815)
dbtr_sect_G	-12.90***	0.577	-6.722*
	(4.748)	(7.564)	(3.860)
dbtr_sect_H	42.81	49.48*	31.05
	(28.45)	(27.98)	(34.13)
dbtr_sect_I	-19.18*	-6.120	1.890
	(10.92)	(13.01)	(5.733)
dbtr_sect_J	-1.220	5.045	-27.73
	(15.67)	(12.30)	(31.88)
dbtr_sect_K	25.88***	21.77***	17.13***
	(5.038)	(2.833)	(2.114)
dbtr_sect_L	-12.05***	-0.621	-5.748*
	(3.347)	(4.649)	(2.963)
dbtr_sect_M	-17.96***	-2.499	-4.657
	(5.104)	(6.864)	(5.830)
dbtr_sect_N	-11.59	-13.14	-8.949
	(7.762)	(19.84)	(13.31)
dbtr_sect_O	9.451***	1.077	-2.946
	(3.242)	(2.915)	(2.621)
dbtr_sect_P	-24.61	-102.6***	-54.29***
	(33.71)	(34.31)	(19.09)
dbtr_sect_Q	-37.08**	-40.24***	-15.51**
	(15.50)	(15.36)	(7.780)
dbtr_sect_R	-41.00**	-55.54***	-10.20*
	(19.43)	(21.36)	(5.299)
dbtr_sect_S	-36.09	-27.89	-23.80
	(24.62)	(26.24)	(14.55)
dbtr_sect_T	-17.18	1.043	17.99
	(32.97)	(34.22)	(13.37)
debt_vsmall_rel		-18.60*	4.113
		(10.92)	(9.338)
debt_small_rel		-19.04	-27.88**
		(12.02)	(11.80)
debt_medium_rel		-22.91**	-26.44**
		(9.158)	(11.85)
debt_large_rel		7.389	-3.230

								(33.44)	(25.30)
o.debt_vlarge_rel								-	-
Constant	12.04***	12.04***	12.04***	11.73***	11.84***	12.66***	0.416	-0.629	6.529***
	(0.657)	(0.657)	(0.656)	(0.727)	(0.743)	(1.153)	(2.037)	(2.141)	(2.233)
Observations	22,320	22,320	22,320	22,320	22,320	22,320	22,320	22,320	22,320
R-squared	0.184	0.184	0.184	0.184	0.184	0.184	0.199	0.203	0.016

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
Debt_env_rel on a percentage scale.
Results based on stata's reghdfe OLS estimation method; fixed effects treated by means of 'absorbing' (Correia, 2016).
Columns (1) to (7) reports result considering bank fixed effects. Column (8) reports results considering bank and time fixed effects.
Column (9) reports results without consideration of any fixed effects.

7 Discussion and Policy Implications

Banking Supervision plays a key-role in fostering an adequate reflection of climate risk in banks' overall risk identification, assessment, and management strategies (see, e.g., Hansen, 2022). Wrong quantitative assessments or even disregarding climate risk might over time increase systemic risks to the financial sector and, hence, jeopardize financial stability. From a political economy point of view there is a discussion whether supervisory authorities could and should foster the guidance towards carbon-neutral transition of economies by steering capital into sustainability-increasing investments. While the mandate given to central banks and supervisory authorities is less clear—especially as there is a potential trade-off between the mandate of guaranteeing financial stability and financing a green transition (e.g., Skinner, 2021), the ECB has positioned itself generally as a promoter of green banking supervision (UN, 2017; Lagarde, 2021). The concrete implications of this positioning, however, are not yet fully defined. Other competent authorities, such as Federal Reserve's Waller, take a more hesitant position, pointing out that "Climate change does not pose such 'significantly unique or material' financial stability risks that the Federal Reserve should treat it separately in its supervision of the financial system" (Reuters, 2023).

In this paper, we have shown that climate-risk-related supervisory efforts have a statistically significant impact on banks' climate risk reduction and climate finance. This indicates that banks, once additional and better information is generated and becomes available due to the climate-risk-related supervisory efforts, capabilities are enhanced, and as soon as they expect the introduction of future climate-risk-related capital requirements, start focusing on the reduction of their climate risk exposure, and also increase their green capital allocation. It is important to note that demonstrating the statistically significant impact does not allow us to derive any normative statement regarding whether the effort of the SIs suffices the requirements defined within the 'ECB Guide on Climate-Related and Environmental Risks'.

Further important observations concern data availability. Firstly, we have shown that regarding the impact on climate risk reduction, the neglection of the disclosure levels leads to an over-estimation of the positive impact of the climate-risk-related supervisory efforts. This is especially important to note, since such an overestimation can lead supervisory authorities to take insufficient action. As described in Section 5, data coverage, data quality (mainly due to self-reporting in combination with limited auditing currently only for big companies and resulting greenwashing) a lack of standardization, and, hence, comparability, as well as insufficient data granularity (e.g., no distinct measurement of the climate risk impact, exposure, management, and unmanaged risk) are the main issues, which have to be tackled to improve this situation. While these data-related shortcomings represent a limiting factor to the measurability of the impact of climate-risk-related supervisory efforts on banks' green behavior, we have also seen that—as intended—the climate risk supervisory efforts themselves have a significant positive impact on the climate-risk-related information disclosure of the banks.

From these findings, we can derive three key recommendations for policy makers, regulators, and supervisory authorities: Firstly, since the climate-risk-related supervisory efforts show a positive impact on both climate risk reduction and green impact investing, supervisory authorities should continue the exercise. This is especially the case due to the positive effect on banks' risk reduction, which is at the core of the mandate of supervisory authorities. Secondly, while continuing the efforts, it is important to also announce the continuation early on, since we have seen that already the expectation of the climate-risk-related supervisory efforts leads to positive effects. Thirdly, policy makers, regulators and supervisory authorities should focus on an improvement of climate-risk-related data availability, data quality, and a standardization of indicators. On the one hand, this will significantly improve insights regarding the effectiveness and efficiency of the introduction of policies, regulations, and supervisory efforts, as well as their continuous improvement. On the other hand, given the results of the above analyses, we can assume that further increasing information availability will also have further positive impacts on both the reduction of banks' climate risk and an increase in green impact investing.

Building on our findings in this paper, we will further investigate both empirical and policy issues. From an empirical perspective, we have been able to demonstrate that our results are remarkably robust with regard to different choices of control variables and different types of fixed effects. Nevertheless, we will further investigate potential endogeneity issues, for example for the price of CO_2 certificates. This variable plays clearly a role in explaining the green dependent variables in our models. At the same time, carbon prices should be also demand-driven. From a policy perspective, we will investigate whether there are significant discrepancies between agencies' evaluations of banks' greening activities on the one hand (e.g., the environmental risk exposure and management proxy used in this paper) and the assessments by supervisory authorities (e.g., via Supervisory Review and Evaluation Process score) on the other hand. Furthermore, the analyses could be extended to non-EU economies. Regarding this, firstly, the treatment group could be changed to non-EU banks facing comparable supervisory efforts. Secondly, an additional comparison of the present treatment group of euro area SIs with similarly large banks from other non-EU economies, such as banks from the US or China, would potentially reveal interesting insights, even though we have already controlled for bank size fixed effects. The most interesting future research, however, will be possible, as soon as data quality has improved, and it will be worthwhile to re-run the analysis and compare those results with the present ones.

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Appendix

A.1 Data and Descriptive Statistics

A.1.1 Variables Overview

Table A.1: Variables Overview

Variable Name	Variable	Unit	Description	Database
Banks' unmanaged environmental risk	Env_risk	Scale 0 to 10	Bloomberg E-Score, scale 0 (lowest) to 10 (highest), annual, 2015-2022	Bloomberg
Banks' disclosure of unmanaged environmental risk	Env_disc	%	Bloomberg E-Score Disclosure Score, percentage of available data points, annual, 2015-2022	Bloomberg
Banks' disclosed unmanaged environmental risk	Env_risk_disc	n.a.	Product of Bloomberg E-Score and Disclosure Score	Calculated
Banks' total bonds issuance	All_bonds	EUR	Banks' (SI, LSI, EU-non-euro-area) total bonds issuance, annual, 2010 - 2023	Refinitiv Eikon
Banks' green bonds issuance	Green_bonds	EUR	Banks' (SI, LSI, EU-non-euro-area) green bonds issuance, annual, 2010 - 2023	Refinitiv Eikon
Share of green bonds to all bonds	GB_to_all	%	Share of banks' green bonds to total bonds issuance, annual, 2010 -2023	Calculated
ESG-AUM	ESG_AUM_Abs	EUR	Banks' (SI, LSI, EU-non- euro-area) total ESG-AUM, annual, 2015-2023	Refinitiv Eikon
ESG-AUM scaled	ESG_AUM_Abs_s	EUR * 10^9	Banks' (SI, LSI, EU-non- euro-area) total ESG-AUM, annual, 2015-2023, scaled	Refinitiv Eikon
Total credit (lending)	All_debt	EUR	Banks' (SI, LSI) total credit (lending), annual, 2014-2022	ECB Corep
Green credit (lending)	Debt_env	EUR	Banks' (SI, LSI) green credit (lending), annual, 2014-2022, based on environmental rating of debtors	Calculated based on ECB Corep and Refinitiv Eikon
Share of green to total credit (lending)	Debt_env_rel	%	Share of green to total credit (lending), annual, 2014-2022, based on environmental rating of debtors	Calculated
GDP growth YY	Gdp_growth_yy	%	YY GDP growth, 2010-2023, euro area and EU-non- euro-area countries	Refinitiv Eikon
Inflation YY	Inflation_yy	%	YY inflation, 2010-2023, euro area and EU-non-euro-area countries	Refinitiv Eikon
CO2 prices EU ETS	CO2_price	EUR/ tCO2e	Carbon prices in EU ETS, annual, 2010-2023	World Bank

Introduction of SFDR	SFDR	dummy	Dummy variable for the introduction of the SFDR for banks w/ >500 employees in the EU in 2021	Determined based on Refinitiv Eikon
Banks’ HQ country	HQ_country	n.a.	Banks’ HQ country	ECB Corep
Banks’ total assets	Log_ta	n.a.	Banks’ (SI, LSI, EU-non- euro-area) total assets as proxy for bank size, average, ln, 2010 -2023,	ECB Corep; Banks’ financial reports
Banks’ environmental controversies	Env_controv	dummy	Dummy variable for banks facing environmental controversies, annual, 2010-2023	Refinitiv Eikon
Banks’ lending to very small debtors	debt_vsmall_rel	%	Share of banks’ lending to very small debtors to total lending, annual, 2015-2022	Calculated based on S&P Capital IQ
Banks’ lending to small debtors	debt_small_rel	%	Share of banks’ lending to small debtors to total lending, annual, 2015-2022	Calculated based on S&P Capital IQ
Banks’ lending to medium-sized debtors	debt_medium_rel	%	Share of banks’ lending to medium-sized debtors to total lending, annual, 2015-2022	Calculated based on S&P Capital IQ
Banks’ lending to large debtors	debt_large_rel	%	Share of banks’ lending to large debtors to total lending, annual, 2015-2022	Calculated based on S&P Capital IQ
Banks’ lending to very large debtors	debt_vlarge_rel	%	Share of banks’ lending to very large debtors to total lending, annual, 2015-2022	Calculated based on S&P Capital IQ
Banks’ lending to sector A	dbtr_sect_A	%	Share of banks’ lending to debtors from sector A (agriculture, forestry, and fishing) to total lending, annual, 2015-2022	ECB Corep
Banks’ lending to sector B	dbtr_sect_B	%	Share of banks’ lending to debtors from sector B (mining and quarrying) to total lending, annual, 2015-2022	ECB Corep
Banks’ lending to sector C	dbtr_sect_C	%	Share of banks’ lending to debtors from sector C (manufacturing) to total lending, annual, 2015-2022	ECB Corep
Banks’ lending to sector D	dbtr_sect_D	%	Share of banks’ lending to debtors from sector D (electricity, gas, steam and air conditioning supply) to total lending, annual, 2015-2022	ECB Corep
Banks’ lending to sector E	dbtr_sect_E	%	Share of banks’ lending to debtors from sector E (water supply) to total lending, annual, 2015-2022	ECB Corep
Banks’ lending to sector F	dbtr_sect_F	%	Share of banks’ lending to debtors from sector F (construction) to total lending, annual, 2015-2022	ECB Corep
Banks’ lending to sector G	dbtr_sect_G	%	Share of banks’ lending to debtors from sector G (wholesale and retail trade) to total lending, annual, 2015-2022	ECB Corep

Banks' lending to sector H	dbtr_sect_H	%	Share of banks' lending to debtors from sector H (transport and storage) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector I	dbtr_sect_I	%	Share of banks' lending to debtors from sector I (accommodation and food service activities) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector J	dbtr_sect_J	%	Share of banks' lending to debtors from sector J (information and communication) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector K	dbtr_sect_K	%	Share of banks' lending to debtors from sector K (financial and insurance activities) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector L	dbtr_sect_L	%	Share of banks' lending to debtors from sector L (real estate activities) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector M	dbtr_sect_M	%	Share of banks' lending to debtors from sector M (professional, scientific, and technical activities) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector N	dbtr_sect_N	%	Share of banks' lending to debtors from sector N (administrative and support service activities) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector O	dbtr_sect_O	%	Share of banks' lending to debtors from sector O (public administration and defence, compulsory social security) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector P	dbtr_sect_P	%	Share of banks' lending to debtors from sector P (education) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector Q	dbtr_sect_Q	%	Share of banks' lending to debtors from sector Q (human health services and social work activities) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector R	dbtr_sect_R	%	Share of banks' lending to debtors from sector R (arts, entertainment, and recreation) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector S	dbtr_sect_S	%	Share of banks' lending to debtors from sector S (other services) to total lending, annual, 2015-2022	ECB Corep
Banks' lending to sector T	dbtr_sect_T	%	Share of banks' lending to debtors from sector T (activities of households as employers) to total lending, annual, 2015-2022	ECB Corep

A.1.2 Descriptive Statistics 1: Climate Risk (Disclosure-adjusted)

Table A.2: Environmental Risk x Disclosure—Summary Statistics

VARIABLES	Observations (matched)	Mean	Std. Dev	P25	Median	P75
env_risk_disc	680 (304*; 376**)	0.19 (0.32*; 0.09**)	0.48 (0.61*; 0.30**)	0.00 (0.00*/**)	0.00 (0.02*; 0.00**)	0.10 (0.03*; 0.00**)
env_risk_disc (2015-2019)	425 (190*; 376**)	0.07 (0.12*; 0.03**)	0.18 (0.24*; 0.10**)	0.00 (0.00*/**)	0.00 (0.01*; 0.00**)	0.01 (0.13*; 0.00**)
env_controv	680 (304*; 376**)	0.04 (0.07*; 0.02**)	0.20 (0.26*; 0.13**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
CO2_price	680 (304*; 376**)	26.18 (26.18*/**)	26.35 (26.35*/**)	7.33 (7.33*/**)	17.45 (17.45*/**)	30.82 (30.82*/**)
gdp_growth_YY	680 (304*; 376**)	0.02 (0.02*/**)	0.03 (0.03*/**)	0.02 (0.02*/**)	0.02 (0.02*/**)	0.03 (0.03*/**)
inflation_YY	680 (304*; 376**)	0.02 (0.02*/**)	0.03 (0.03*/**)	0.00 (0.00*/**)	0.01 (0.01*/**)	0.02 (0.02*/**)
SFDR	680 (304*; 376**)	0.15 (0.25*; 0.07**)	0.36 (0.43*; 0.25**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)

This table reports descriptive statistics for the variables used in the main empirical analysis for banks' disclosure-adjusted climate risk. The baseline sample consists of 680 env_risk_disc observations between 2015 and 2022 (except env_risk_disc (2015-2019)). Separate values for SIs and LSIs are indicated as (SI-Value*; LSI-Value**). See Table A.1 for detailed variable definitions incl. units.
Rounded values shown.

A.1.3 Descriptive Statistics 2.1: Green Bonds Issuance

Table A.3: GB Issuance—Summary Statistics

VARIABLES	Observations (matched)	Mean	Std. Dev	P25	Median	P75
GB_to_all	16,142 (1,264*; 14,896**)	0.001 (0.018*; 0.000**)	0.03 (0.09*; 0.00**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
GB_to_all (2010-2019)	11,530 (890*; 10,640**)	0.000 (0.002*; 0.000**)	0.00 (0.01*; 0.00**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
env_controv	16,142 (1,264*; 14,896**)	0.003 (0.032*; 0.001**)	0.05 (0.18*; 0.02**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
gdp_growth_YY	16,142 (1,264*; 14,896**)	0.013 (0.013*/**)	0.02 (0.02*/**)	0.01 (0.01*/**)	0.02 (0.02*/**)	0.02 (0.02*/**)
inflation_YY	16,142 (1,264*; 14,896**)	0.021 (0.021*/**)	0.02 (0.02*/**)	0.00 (0.00*/**)	0.02 (0.02*/**)	0.03 (0.03*/**)
SFDR	16,142 (1,264*; 14,896**)	0.053 (0.241*; 0.040**)	0.22 (0.41*; 0.20**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)

This table reports descriptive statistics for the variables used in the main empirical analysis for banks' green bonds issuance. The baseline sample consists of 16,142 GB_to_all observations between 2010 and 2023 (except GB_to_all (2010-2019)). Separate values for SIs and LSIs are indicated as (SI-Value*; LSI-Value**). See Table A.1 for detailed variable definitions incl. units. Rounded values shown.

A.1.4 Descriptive Statistics 2.2: ESG-AUM

Table A.4: ESG-AUM—Summary Statistics

VARIABLES	Observations	Mean	Std. Dev	P25	Median	P75
ESG_AUM_Abs_s	999 (414*; 585**)	0.43 (1.04*; 0.01**)	3.62 (5.56*; 0.14**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
ESG_AUM_Abs_s (2015-2019)	555 (230*; 325**)	0.05 (0.12*; 0.00**)	1.19 (1.85*; 0.00**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
env_controv	999 (414*; 585**)	0.04 (0.08*; 0.01**)	0.20 (0.28*; 0.11**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
gdp_growth_YY	999 (414*; 585**)	0.01 (0.01*/**)	0.03 (0.03*/**)	0.02 (0.02*/**)	0.02 (0.02*/**)	0.03 (0.03*/**)
inflation_YY	999 (414*; 585**)	0.02 (0.02*/**)	0.03 (0.03*/**)	0.00 (0.00*/**)	0.02 (0.02*/**)	0.03 (0.03*/**)
SFDR	999 (414*; 585**)	0.19 (0.33*; 0.09**)	0.39 (0.47*; 0.28**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (1.00*; 0.00**)

This table reports descriptive statistics for the variables used in the main empirical analysis for banks' ESG-AUM. The baseline sample consists of 999 ESG_AUM_Abs_s observations between 2015 to 2023 (except ESG_AUM_Abs_s (2015-2019)). Separate values for SIs and LSIs are indicated as (SI-Value*; LSI-Value**). See Table A.1 for detailed variable definitions incl. units. Rounded values shown.

A.1.5 Descriptive Statistics 2.3: Green Lending

Table A.5: Green Lending—Summary Statistics

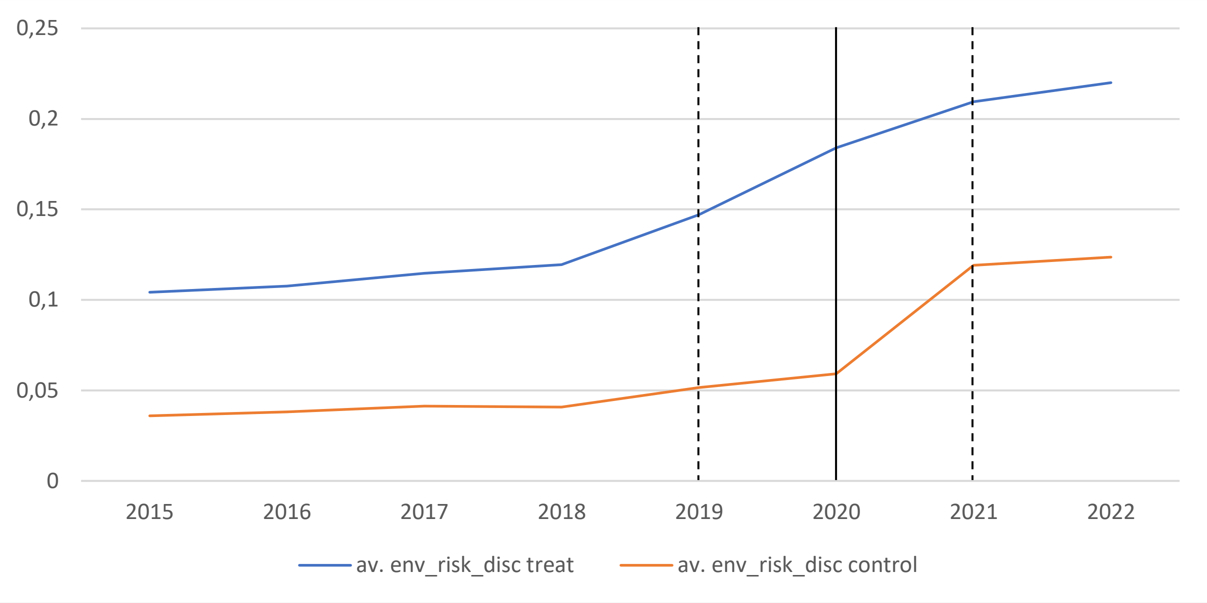
VARIABLES	Observations (matched)	Mean	Std. Dev	P25	Median	P75
debt_env_rel	22,320 (3,366*; 18,954**)	0.01 (0.01*/**)	0.14 (0.20*; 0.12**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
debt_env_rel (2014-2019)	14,880 (2,244*; 12,636**)	0.01 (0.01*/**)	0.16 (0.20*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
env_controv	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.03 (0.07*; 0.02**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_A	22,320 (3,366*; 18,954**)	0.01 (0.00*; 0.01**)	0.06 (0.00*; 0.07**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_B	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_C	22,320 (3,366*; 18,954**)	0.01 (0.02*; 0.01**)	0.08 (0.11*; 0.07**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_D	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.03 (0.02*; 0.03**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_E	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.03 (0.00*; 0.03**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_F	22,320 (3,366*; 18,954**)	0.01 (0.00*; 0.01**)	0.06 (0.00*; 0.06**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_G	22,320 (3,366*; 18,954**)	0.01 (0.01*/**)	0.07 (0.08*; 0.06**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_H	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.03 (0.05*; 0.02**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)

dbtr_sect_I	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.03 (0.00*; 0.03**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_J	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.02 (0.03*; 0.02**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_K	22,320 (3,366*; 18,954**)	0.40 (0.28*; 0.40**)	0.43 (0.41*; 0.43**)	0.00 (0.00*/**)	0.10 (0.00*; 0.22**)	0.88 (0.60*; 0.90**)
dbtr_sect_L	22,320 (3,366*; 18,954**)	0.02 (0.00*; 0.02**)	0.10 (0.03*; 0.11**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_M	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.05 (0.02*; 0.05**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_N	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.04 (0.03*; 0.04**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_O	22,320 (3,366*; 18,954**)	0.06 (0.08*; 0.06**)	0.18 (0.23*; 0.17**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_P	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.01 (0.01*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_Q	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.02 (0.01*; 0.03**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_R	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.02 (0.00*; 0.02**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_S	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.02 (0.00*; 0.02**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
dbtr_sect_T	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.03 (0.00*; 0.03**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
debt_vsmall_rel	22,320 (3,366*; 18,954**)	0.06 (0.02*; 0.06**)	0.18 (0.07*; 0.19**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
debt_small_rel	22,320 (3,366*; 18,954**)	0.01 (0.01*/**)	0.07 (0.11*; 0.07**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
debt_medium_rel	22,320 (3,366*; 18,954**)	0.03 (0.02*; 0.03**)	0.13 (0.21*; 0.14**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
debt_large_rel	22,320 (3,366*; 18,954**)	0.04 (0.07*; 0.03**)	0.15 (0.21*; 0.14**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
debt_vlarge_rel	22,320 (3,366*; 18,954**)	0.04 (0.07*; 0.03**)	0.15 (0.07*; 0.14**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)
gdp_growth_yy	22,320 (3,366*; 18,954**)	0.02 (0.02*/**)	0.03 (0.03*/**)	0.02 (0.02*/**)	0.02 (0.00*/**)	0.03 (0.03*/**)
inflation_yy	22,320 (3,366*; 18,954**)	0.02 (0.02*/**)	0.02 (0.03*/**)	0.00 (0.00*/**)	0.01 (0.01*/**)	0.02 (0.02*/**)
sfdr	22,320 (3,366*; 18,954**)	0.00 (0.00*/**)	0.37 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)	0.00 (0.00*/**)

This table reports descriptive statistics for the variables used in the main empirical analysis for banks' green lending. The baseline sample consists of 22,320 debt_env_rel observations between 2014 and 2022 (except debt_env_rel (2014-2019)). Separate values for SIs and LSIs are indicated as (SI-Value*; LSI-Value**). See Table A.1 for detailed variable definitions incl. units.
Rounded values shown.

A.2 Parallel Trends

A.2.1 Parallel Trends 1: Climate Risk (Disclosure-adjusted)



Pre-treatment period until 2019 (Start of lead effects).

Figure A.1: Environmental Risk x Disclosure—Treated vs. Control

Table A.6: Environmental Risk x Disclosure—Parallel Trends Normalized Differences

	Treated		Control		Norm. Diff.
VARIABLES	Mean	Std. Dev.	Mean	Std. Dev.	
env_risk_disc	0.32	0.61	0.09	0.30	0.21
env_controv	0.07	0.26	0.02	0.13	0.09
CO2_price	26.81	26.37	26.81	26.37	0.00
gdp_growth_YY	0.02	0.03	0.02	0.03	0.00
inflation_YY	0.01	0.01	0.01	0.01	0.00
sfdr	0.25	0.43	0.07	0.25	0.22

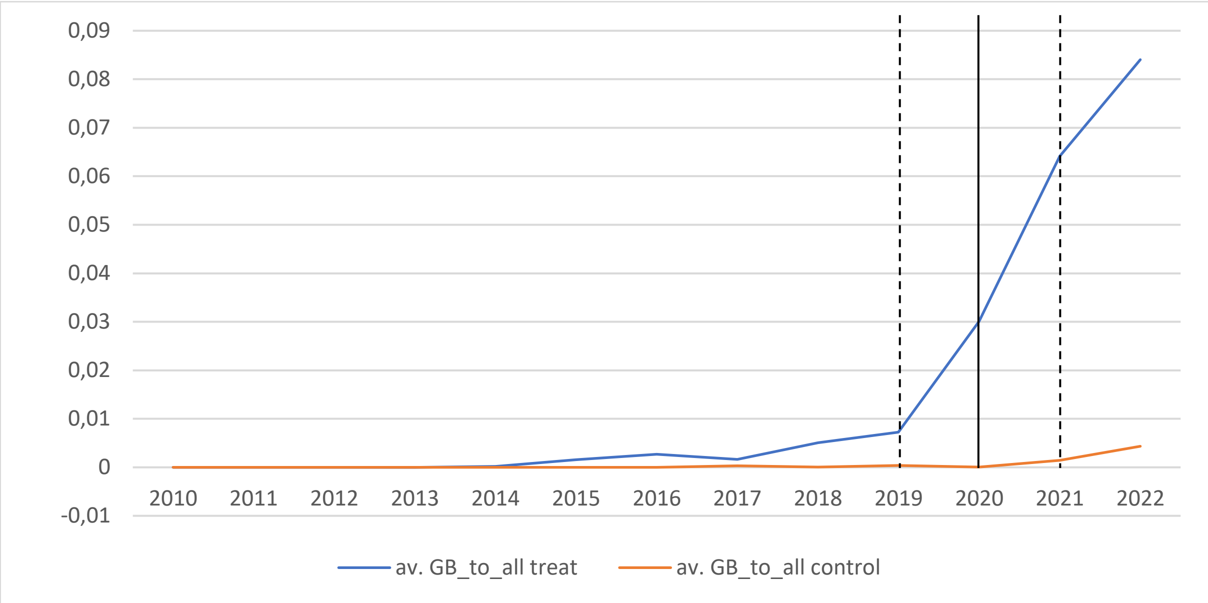
This table reports statistics of relevant co-variates over the pre-shock period (2015 to 2019) dividing the sample between treated (SIs) and control group (LSIs). The last column reports normalized differences between treatment and control groups (differences in averages by treatment status, scaled by the square root of the sum of the variances). An absolute difference smaller than 0.25 indicates that there is no significant difference between the groups. See Table A.1 for detailed variable definitions incl. units.
Rounded values shown.

Table A.7: Environmental Risk x Disclosure—Parallel Trends Pre-treatment Period

VARIABLES	(1) env_risk_disc Parallel Trends
afterPT	0.0384
	(3.451)
o.treatment	-
treat_afterPT	0.0402
	(0.0258)
env_controv	-0.0653
	(0.0646)
gdp_growth_yy	-2.486
	(60.33)
inflation_yy	-1.519
	(230.2)
o.log_CO2_price	-
o.sfdr	-
Constant	0.0913
	(1.671)
Observations	340
R-squared	0.768

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

A.2.2 Parallel Trends 2.1: Green Bonds Issuance



Pre-treatment period until 2019 (Start of lead effects).
Figure A.2: GB Issuance—Treated vs. Control

Table A.8: GB Issuance—Parallel Trends Normalized Differences

	Treated		Control		Norm. Diff.
VARIABLES	Mean	Std. Dev.	Mean	Std. Dev.	
GB_to_all	0.01	0.01	3.44	0.01	0.21
env_controv	0.03	0.17	0.00	0.02	0.25
gdp_growth_yy	0.02	0.00	0.02	0.00	0.00
inflation_yy	0.01	0.01	0.01	0.01	0.00
sfdr	0.00	0.00	0.00	0.00	n.a.

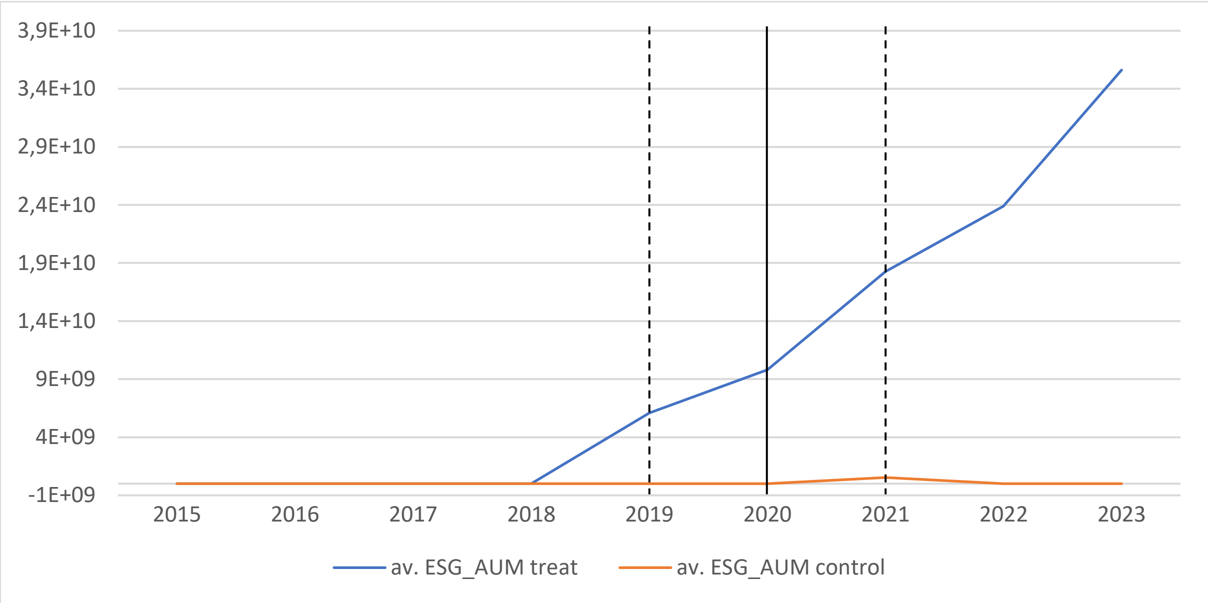
This table reports statistics of relevant co-variates over the pre-shock period (2010 to 2023) dividing the sample between treated (SIs) and control group (LSIs). The last column reports normalized differences between treatment and control groups (differences in averages by treatment status, scaled by the square root of the sum of the variances). An absolute difference smaller than 0.25 indicates that there is no significant difference between the groups. See Table A.1 for detailed variable definitions incl. units.
Rounded values shown.

Table A.9: GB Issuance—Parallel Trends Pre-treatment Period

VARIABLES	(1) GB_to_all Parallel Trends
afterPT2	0.000130
	(0.000145)
o.treatment	-
treat_afterPT2	0.00171
	(0.00109)
env_controv	0.000855**
	(0.000341)
gdp_growth_yy	0.00260
	(0.00230)
inflation_yy	0.000381
	(0.00404)
o.sfdr	-
Constant	-1.14e-05
	(0.000111)
Observations	9,224
R-squared	0.148

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

A.2.3 Parallel Trends 2.2: ESG-AUM



Pre-treatment period until 2019 (Start of lead effects).
Figure A.3: ESG-AUM—Treated vs. Control

Table A.10: ESG-AUM—Parallel Trends Normalized Differences

	Treated		Control		Norm. Diff.
VARIABLES	Mean	Std. Dev.	Mean	Std. Dev.	
ESG_AUM_Abs_s	0.12	1.84	0.00	0.00	0.06
env_controv	0.06	0.26	0.02	0.15	0.24
gdp_growth_yy	0.02	0.003	0.02	0.003	0.00
inflation_yy	0.01	0.007	0.01	0.007	0.00
sfdr	0.00	0.00	0.00	0.00	n.a.

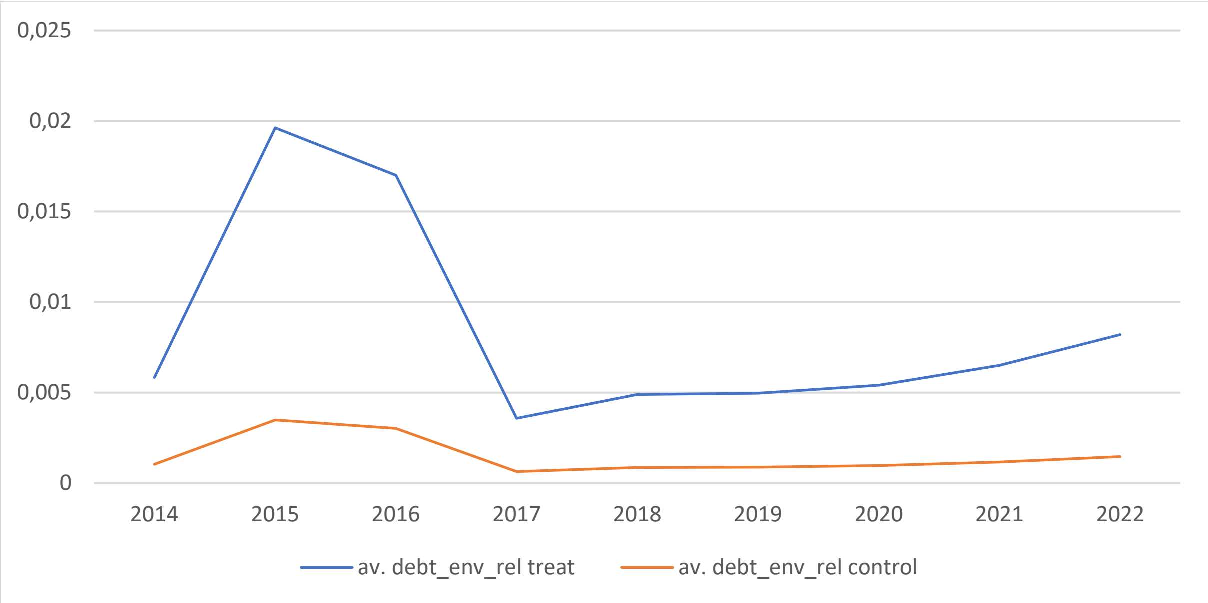
This table reports statistics of relevant co-variates over the pre-shock period (2015 to 2023) dividing the sample between treated (SIs) and control group (LSIs). The last column reports normalized differences between treatment and control groups (differences in averages by treatment status, scaled by the square root of the sum of the variances). An absolute difference smaller than 0.25 indicates that there is no significant difference between the groups. See Table A.1 for detailed variable definitions incl. units.
Rounded values shown.

Table A.11: ESG-AUM—Parallel Trends

VARIABLES	(1) ESG_AUM_Abs_s Parallel Trends
afterPT	0.00579
	(0.00390)
treatment	-0.000687
	(0.00159)
treat_afterPT	0.00169
	(0.00204)
env_controv	0.0138***
	(0.00269)
gdp_growth_yy	-0.0904
	(0.147)
inflation_yy	-0.437
	(0.288)
o.sfdr	-
Constant	0.00248
	(0.00294)
Observations	555
R-squared	0.057

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

A.2.3 Parallel Trends 2.3: Green Lending



Pre-treatment period until 2019 (Start of lead effects).

Figure A.4: Green Lending—Treated vs. Control

Table A.12: Green Lending—Parallel Trends Normalized Differences

	Treated		Control		Norm. Diff.
VARIABLES	Mean	Std. Dev.	Mean	Std. Dev.	
debt_env_rel	0.01	0.04	0.01	0.02	0.02
env_controv	0.01	0.07	0.00	0.02	0.09
dbtr_sect_A	0.00	0.00	0.01	0.07	0.20
dbtr_sect_B	0.00	0.00	0.00	0.00	0.03
dbtr_sect_C	0.02	0.12	0.01	0.07	0.17
dbtr_sect_D	0.00	0.02	0.00	0.03	0.03
dbtr_sect_E	0.00	0.00	0.00	0.03	0.09
dbtr_sect_F	0.00	0.00	0.01	0.06	0.15
dbtr_sect_G	0.01	0.08	0.01	0.07	0.02
dbtr_sect_H	0.00	0.05	0.00	0.02	0.09
dbtr_sect_I	0.00	0.00	0.00	0.03	0.08
dbtr_sect_J	0.00	0.03	0.00	0.01	0.10
dbtr_sect_K	0.26	0.39	0.42	0.42	0.40
dbtr_sect_L	0.00	0.02	0.02	0.10	0.25
dbtr_sect_M	0.00	0.01	0.00	0.05	0.10

dbtr_sect_N	0.00	0.04	0.00	0.04	0.01
dbtr_sect_O	0.09	0.24	0.07	0.18	0.10
dbtr_sect_P	0.00	0.01	0.00	0.01	0.04
dbtr_sect_Q	0.00	0.01	0.00	0.02	0.05
dbtr_sect_R	0.00	0.00	0.00	0.02	0.07
dbtr_sect_S	0.00	0.00	0.00	0.02	0.07
dbtr_sect_T	0.00	0.00	0.00	0.03	0.10
debt_vsmall_rel	0.02	0.11	0.06	0.18	0.28
debt_small_rel	0.01	0.08	0.01	0.07	0.01
debt_medium_rel	0.02	0.10	0.04	0.14	0.18
debt_large_rel	0.07	0.21	0.04	0.14	0.16
debt_vlarge_rel	0.07	0.21	0.04	0.14	0.16
gdp_growth_yy	0.02	0.003	0.02	0.003	0.00
inflation_yy	0.01	0.007	0.01	0.007	0.00
sfdr	0.00	0.00	0.00	0.00	n.a.

This table reports statistics of relevant co-variates over the pre-shock period (2014 to 2022) dividing the sample between treated (SIs) and control group (LSIs). The last column reports normalized differences between treatment and control groups (differences in averages by treatment status, scaled by the square root of the sum of the variances). An absolute difference smaller than 0.25 indicates that there is no significant difference between the groups. See Table A.1 for detailed variable definitions incl. units.
Rounded values shown.

Table A.13: Green Lending—Parallel Trends

VARIABLES	(1) debt_env_rel Parallel Trends
afterPT	5.652
	(3.532)
o.treatment	-
treat_afterPT	9.708
	(7.004)
o.sfdr	-
env_controv	5.643
	(57.90)
gdp_growth_yy	1,119***
	(325.7)
inflation_yy	-1,630***
	(261.3)
dbtr_sect_A	-30.28
	(30.55)
dbtr_sect_B	-197.1
	(449.6)
dbtr_sect_C	324.7***
	(20.44)
dbtr_sect_D	-18.80
	(49.41)
dbtr_sect_E	6.365
	(51.18)
dbtr_sect_F	-6.671
	(30.61)
dbtr_sect_G	-2.660
	(24.08)
dbtr_sect_H	79.67
	(61.00)
dbtr_sect_I	-12.79
	(61.05)
dbtr_sect_J	-0.561
	(79.37)
dbtr_sect_K	24.25***
	(4.027)
dbtr_sect_L	-2.115
	(17.70)
dbtr_sect_M	-9.244
	(32.18)
dbtr_sect_N	-4.483
	(40.25)
dbtr_sect_O	3.477
	(8.804)
dbtr_sect_P	-128.9
	(212.0)
dbtr_sect_Q	-38.49
	(69.15)
dbtr_sect_R	-49.22
	(90.79)
dbtr_sect_S	-54.85
	(107.8)
dbtr_sect_T	-35.35
	(59.63)
debt_vsmall_rel	-30.12***
	(11.31)

debt_small_rel	-26.36
	(21.11)
debt_medium_rel	-26.69**
	(11.20)
debt_large_rel	0.462
	(11.10)
o.debt_vlarge_rel	-
Constant	-8.891
	(6.100)
Observations	14,880
R-squared	0.308

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

A.3 Results: Robustness Checks

A.3.1 Results 1: Climate Risk (Disclosure-adjusted)

Table A.14: Environmental Risk x Disclosure—Baseline Regression

VARIABLES	(1) env_risk_disc Contemporaneous	(2) env_risk_disc 1 Year Lead	(3) env_risk_disc 1 Year Lagged
after	0.0826		
	(0.0591)		
o.treatment	-	-	-
treat_after	0.380***		
	(0.105)		
env_controv	-0.176	-0.0569	-0.303*
	(0.119)	(0.0754)	(0.159)
gdp_growth_yy	1.225**	-0.687	-1.812***
	(0.579)	(0.495)	(0.479)
inflation_yy	0.534*	3.454***	-0.297
	(0.299)	(1.182)	(0.357)
log_CO2_price	0.0562***	0.0276***	0.0474***
	(0.0150)	(0.0105)	(0.0141)
sfdr	-0.0243	0.225***	-0.110
	(0.0923)	(0.0750)	(0.0993)
F.after		0.0154	
		(0.0343)	
F.treat_after		0.230***	
		(0.0807)	
L.after			0.242***
			(0.0800)
L.treat_after			0.414***
			(0.120)
Constant	-0.0833	-0.0214	0.0156
	(0.0535)	(0.0343)	(0.0418)
Observations	680	595	595
R-squared	0.643	0.598	0.673

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
Env_risk on a scale from 0 (bad) to 10 (good).
Results based on stata's reghdfe OLS estimation method; fixed effects treated by means of 'absorbing' (Correia, 2016).

A.3.2 Results 2.1: Green Bonds Issuance

Table A.15: GB Issuance—Baseline Regression

VARIABLES	(1) GB_to_all Contemporaneous	(2) GB_to_all 2 Years Lead	(3) GB_to_all 1 Year Lead	(4) GB_to_all 1 Year Lagged
after	-0.000940			
	(0.000687)			
o.treatment	-	-	-	-
treat_after	0.0540***			
	(0.0106)			
env_controv	0.0125	-0.00650	0.00127	0.0179
	(0.0414)	(0.0203)	(0.0272)	(0.0467)
gdp_growth_YY	0.0125	-0.00886	-0.00507	-0.0176*
	(0.00896)	(0.00671)	(0.00760)	(0.0105)
inflation_YY	0.0175	-0.00656*	0.0220	0.00562
	(0.0174)	(0.00361)	(0.0153)	(0.0205)
SFDR	0.00502**	0.0155***	0.0124***	0.000434
	(0.00212)	(0.00466)	(0.00346)	(0.000571)
F2.after		-0.000708***		
		(0.000209)		
F2.treat_after		0.0227***		
		(0.00544)		
F.after			-0.00150***	
			(0.000491)	
F.treat_after			0.0400***	
			(0.00828)	
L.after				0.000387
				(0.000953)
L.treat_after				0.0634***
				(0.0133)
Constant	-0.000270	0.000315**	-0.000104	0.000391
	(0.000403)	(0.000133)	(0.000312)	(0.000440)
Observations	16,142	13,836	14,989	14,989
R-squared	0.224	0.169	0.199	0.234

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
GB_to_all on a percentage scale.
Results based on stata's reghdfe OLS estimation method; fixed effects treated by means of 'absorbing' (Correia, 2016).

Table A.16: GB Issuance—Sequential Regressions EU-non-eurozone Banks as Control Group

VARIABLES	(1) GB_to_all	(2) GB_to_all	(3) GB_to_all	(4) GB_to_all	(5) GB_to_all	(6) GB_to_all
after	0.0366***	0.0364***	0.0346**	0.0138	0.00464	
	(0.0132)	(0.0132)	(0.0133)	(0.0107)	(0.0121)	
o.after						-
treatment					0.00147	
					(0.00123)	
o.treatment	-	-	-	-		-
treat_after	0.0208	0.0209	0.0235	0.0349**	0.0278**	0.0179
	(0.0172)	(0.0173)	(0.0175)	(0.0165)	(0.0165)	(0.0171)
env_controv		0.00620	0.00799	0.00981	0.0213	0.0104
		(0.0398)	(0.0393)	(0.0392)	(0.0218)	(0.0384)
gdp_growth_YY			0.164**	0.102	0.00231	-0.0832*
			(0.0680)	(0.0645)	(0.0625)	(0.0443)
inflation_YY				0.328**	0.241*	-0.0521
				(0.138)	(0.136)	(0.211)
Constant	0.00148	0.00134	-0.00181	-0.00560	-0.00356	0.0156
	(0.00244)	(0.00256)	(0.00331)	(0.00427)	(0.00249)	(0.0140)
Observations	1,960	1,960	1,960	1,960	1,960	1,960
R-squared	0.170	0.170	0.173	0.180	0.077	0.191

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
GB_to_all on a percentage scale.
Results based on stata's reghdfe OLS estimation method; fixed effects treated by means of 'absorbing' (Correia, 2016). Columns (1) to (4) report results considering bank fixed effects. Column (5) reports results considering bank and time fixed effects. Column (6) reports results without consideration of any fixed effects.

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A.3.3 Results 2.2: ESG-AUM

Table A.17: ESG-AUM—Baseline Regression

VARIABLES	(1) ESG_AUM_Abs_s Contemporaneous	(2) ESG_AUM_Abs_s 1 Year Lead	(3) ESG_AUM_Abs_s 1 Year Lagged
after	-0.00364		
	(0.00227)		
o.treatment	-	-	-
treat_after	0.0158**		
	(0.00746)		
env_controv	0.00504	0.00988	0.00559
	(0.0101)	(0.0116)	(0.0109)
gdp_growth_YY	-0.0273	-0.0160	-0.0613**
	(0.0200)	(0.0266)	(0.0283)
inflation_YY	0.0567**	0.0355*	0.0203
	(0.0284)	(0.0184)	(0.0161)
SFDR	0.00848	0.00815	-0.000280
	(0.00620)	(0.00607)	(0.000280)
F2.after			
F2.treat_after			
F.after		-0.00187	
		(0.00137)	
F.treat_after		0.0112**	
		(0.00444)	
L.after			0.00104
			(0.00113)
L.treat_after			0.0228*
			(0.0115)
Constant	0.000305	-0.000355	0.00113
	(0.00173)	(0.00143)	(0.00174)
Observations	999	888	888
R-squared	0.316	0.319	0.350

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
ESG_AUM in EUR.
Results based on stata's reghdfe OLS estimation method; fixed effects treated by means of 'absorbing' (Correia, 2016).

A.3.4 Results 2.3: Green Credit

Table A.18: Green Lending—Baseline Regression

VARIABLES	(1) debt_env_rel Contemporaneous	(2) debt_env_rel 1 Year Lead	(3) debt_env_rel 1 Year Lagged
after	-0.724		
	(2.867)		
o.treatment	-	-	-
treat_after	17.49**		
	(8.844)		
o.sfdr	-	-	-
env_controv	0.0475	-0.261	0.0235
	(2.873)	(2.318)	(4.313)
gdp_growth_YY	96.50***	150.0***	49.95***
	(30.57)	(41.88)	(13.97)
inflation_YY	153.7	-1,201***	237.5
	(156.2)	(361.1)	(150.4)
CO2_price	-0.338	0.411***	-0.521**
	(0.209)	(0.119)	(0.210)
dbtr_sect_A	-32.76***	-30.16**	-39.51***
	(12.15)	(14.01)	(13.61)
dbtr_sect_B	-126.2**	-159.8**	-137.0**
	(59.16)	(71.52)	(63.58)
dbtr_sect_C	231.4	263.7	249.1
	(207.0)	(239.3)	(226.2)
dbtr_sect_D	-3.990	-13.29	-2.226
	(11.76)	(12.61)	(17.71)
dbtr_sect_E	2.613	1.975	11.69
	(9.457)	(10.99)	(11.18)
dbtr_sect_F	-9.599	-4.716	-10.17
	(6.254)	(6.512)	(7.431)
dbtr_sect_G	-1.950	1.078	2.374
	(8.116)	(9.136)	(10.58)
dbtr_sect_H	62.05**	59.46**	72.90***
	(28.46)	(30.02)	(28.06)
dbtr_sect_I	-10.89	-5.652	-11.32
	(13.80)	(14.84)	(17.01)
dbtr_sect_J	11.39	9.617	10.83
	(12.46)	(13.18)	(11.79)
dbtr_sect_K	27.81***	23.26***	32.84***
	(3.296)	(2.670)	(3.670)
dbtr_sect_L	-4.913	0.639	-6.872
	(5.356)	(5.679)	(6.700)
dbtr_sect_M	-8.818	-5.021	-7.381
	(7.780)	(7.630)	(10.21)
dbtr_sect_N	-7.705	-18.32	-4.249
	(19.20)	(24.34)	(22.91)
dbtr_sect_O	9.568***	2.736	11.43***
	(3.160)	(3.180)	(3.804)
dbtr_sect_P	-32.79	-72.59**	-35.73
	(33.81)	(35.32)	(38.48)
dbtr_sect_Q	-27.13*	-47.70**	-34.79*
	(15.01)	(19.61)	(20.25)
dbtr_sect_R	-37.19*	-52.11**	-39.61*
	(19.62)	(22.71)	(22.81)
dbtr_sect_S	-23.66	-20.64	-13.16

	(24.01)	(28.72)	(25.83)
dbtr_sect_T	-6.045	8.832	-8.096
	(36.00)	(32.41)	(45.48)
debt_vsmall_rel	-17.40	-20.59	-20.61
	(11.19)	(13.62)	(13.66)
debt_small_rel	-22.70*	-20.47*	-28.17*
	(11.83)	(10.79)	(15.71)
debt_medium_rel	-32.75***	-28.66***	-35.55***
	(8.317)	(6.190)	(12.80)
debt_large_rel	1.937	7.550	3.560
	(32.74)	(37.67)	(41.79)
o.debt_vlarge_rel	-	-	-
F.after		-14.54***	
		(2.719)	
F.treat_after		12.67*	
		(7.687)	
L.after			6.495
			(4.329)
L.treat_after			17.33
			(10.95)
Constant	1.356	8.216***	2.636
	(2.356)	(2.317)	(2.625)
Observations	22,320	19,840	19,840
R-squared	0.200	0.234	0.224

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

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