Bank Ownership and Brown Lending:

Do State-Owned Banks Impede the Green Transition?

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Abstract

This paper examines how state ownership influences bank lending to carbon-intensive ("brown") sectors, leveraging the Paris Agreement as an exogenous policy shock. We find that state-owned banks allocate 15–27% more credit to brown sectors (intensive margin) and are significantly less likely to terminate relationships with brown firms (extensive margin) compared to private banks. These patterns are driven by three mechanisms specific to state-owned banks: weaker credit risk management, greater politicization, and alignment through common state ownership. Our results also highlight the environmental implications of state-controlled credit allocation, as firms relying more heavily on financing from state-owned banks exhibit higher greenhouse gas emissions.

Keywords: bank ownership, climate change, brown lending, state-own banks, brown-sector

1. Introduction

Transitioning to a low-carbon economy and achieving net-zero emissions globally requires annual financial flows for green investments ranging between $3 trillion and $6 trillion through 2050 (Global Financial Markets Association, 2020; Boston Consulting Group, 2020). Banks, as key intermediaries for these investments, are responsible for credibly channeling capital toward green activities and projects. At the same time, new climate-focused regulations are reshaping the financial landscape—requiring banks to gradually reduce their financing of carbon-intensive firms and completely phasing it out by 2050. (NZBA, 2021). This regulatory shift, combined with the market's growing sensitivity to climate risk, creates strong financial and reputational incentives for banks to adapt their lending portfolio (Bolton & Kacperczyk, 2021; Submitter et al., 2021).

During the green transition, different types of shareholders may have varying incentives to decarbonize their activities. For banks, a substantial body of research demonstrates that ownership structure plays a critical role in shaping lending decisions (Allen et al., 2017; Bertay et al., 2015; Brei & Schclarek, 2015; Sapienza, 2004). In particular, the lending behavior of state-owned banks (SOBs) can differ markedly from that of privately owned banks (POBs) due to distinct financial and non-financial objectives, governance structures, and risk management practices. These characteristics raise a question: do state-owned banks facilitate or hinder the shift to a low-carbon economy? Our paper aims to investigate how differences in bank ownership influence lending to carbon-intensive ("brown") versus green sectors, providing insights into the role of bank ownership in the low-carbon transition and the potential risks associated with the state-ownership-climate nexus.

The answer to our research question is not straightforward. On the one hand, private-owned banks are often subject to higher scrutiny from markets and regulators compared with state-owned banks (Borisova et al., 2012; Hau & Thum, 2009). This higher scrutiny may prompt private shareholders' interest in quicker, market-driven responses to climate regulations. Since shareholders of private banks prioritize financial returns, they may push management to limit (or withdraw) financing to carbon-intensive clients to avoid regulatory penalties, reputational damage, or financial losses. Consequently, for POB shareholders, climate alignment may be increasingly viewed as a pathway to mitigate risk and enhance long-term value, which can accelerate the shift toward green portfolios.

By contrast, state-owned banks operate under different shareholder incentives that often prioritize national economic stability, employment, and other political goals over financial returns (La Porta et al., 2002; Sapienza, 2004). While state ownership of banks may promise a greater alignment with government-led climate policies and green lending initiatives, SOB shareholders—typically government entities—also have mandates to secure the necessary national infrastructure, protect jobs and economic stability, particularly in sectors that used to be the engines of the national economy (Bacchiocchi et al., 2019; Bertay et al., 2015; Boubakri & Saffar, 2019; Cull & Xu, 2000; Micco & Panizza, 2006). These political and socioeconomic goals can lead SOBs to continue financing to carbon-intensive sectors, even when facing market or regulatory pressures to divest. Moreover, SOBs are characterized by counter-cyclical lending patterns and weaker credit risk management, often attributed to implicit state guarantees and limited expertise in credit risk assessment (Iannotta et al., 2007, 2013; Kornai, 1986; Sapienza, 2004). Consequently, such behavior may perpetuate financing of carbon-intensive firms, thereby undermining divestment efforts and heightening climate-related risks on state-banks' balance sheets.

To investigate how differences in bank ownership influence brown lending, we use Poland as a case study. Poland, the sixth-largest economy in the European Union and its third-largest greenhouse gas emitter (GHG), offers a unique setting to explore this question. With 40% of its banking sector assets held by SOBs, Poland provides a natural laboratory to examine the interaction between state ownership, lending practices, and climate risks. Our empirical investigation draws on a comprehensive dataset that integrates proprietary information about the entire population of Polish banks with granular bank-firm loan relationships from the National Bank of Poland's "large exposure" dataset, encompassing all loans exceeding 500,000 PLN (≈100,000 USD). This dataset is complemented by bank- and firm-level financial and non-financial information, including detailed ownership data, covering the period from 2013 to 2023.

We begin by examining the relationship between bank ownership and lending to carbon-intensive (brown) borrowers. To this extend, we classify firms as "brown" or "non-brown" based on the Climate Policy Relevant Sectors (CPRS) classification by Battiston et al. (2021), which identifies fossil fuels, utilities/electricity, and energy-intensive production as the three most transition-risk prone sectors. To disentangle the demand and supply effects of brown lending, we employ two complementary estimation approaches. First, we rely primarily on industry-time (ILS) fixed effects, as in Degryse et al. (2019) to control for industry-wide shocks

and seasonal variations, isolating changes in lending within industries over time. This approach is particularly useful for our sample in which firms with a single banking relationship dominate. Second, we use firm-time fixed effects following Khwaja & Mian (2008) to control for borrower demand by focusing on firms with multiple banking relationships. This allows us to compare lending decisions by SOBs and POBs to the same firm, thereby strengthening the identification of loan supply dynamics across ownership structures.

Our baseline results show that state-owned banks have greater exposure to polluting firms than privately-owned banks, reflecting higher transition risks potentially driven by policy mandates or risk-sharing motivations. The observed difference is economically meaningful, with SOBs lending approximately 13% to 27% more to firms in climate-policy-relevant sectors than POBs, depending on the model specification.

To provide a more causal interpretation, we employ a difference-in-differences (DiD) methodology, using the Paris Agreement as an exogenous policy shock. This approach enables us to analyze how bank ownership influences lending decisions to brown borrowers in response to a significant climate policy shift. Our results reveal that, on average, banks in our sample did not exhibit a statistically significant change in lending behavior following the Paris Agreement. However, when accounting for differences in bank ownership, we find diverging patterns in lending practices. Specifically, we notice that POBs reduced their lending to firms in carbon-intensive sectors, while SOBs increased such lending post-Paris Agreement. These findings align with the idea that, compared to the sluggish and less efficient SOBs, POBs may adapt more swiftly to regulatory and market incentives, driven by shareholder expectations and a focus on risk-return trade-offs.

Next, we explore the potential mechanisms behind state-owned banks' higher propensity to lend to carbon-intensive sectors compared with private banks. First, we test the “lower risk sensitivity” hypothesis that, due to lower credit risk screening capabilities or efforts, SOBs tend to finance riskier and less profitable firms, with potential losses can be absorbed by public funds (Kornai, 1986; Dong et al., 2014). Our results support this hypothesis, indicating that SOBs provide significantly more credit to financially constrained borrowers in brown sectors, particularly those with higher leverage and lower return on assets. This supports the notion that SOBs' lending to brown firms may stem from lenient credit standards and implicit state guarantees.

Second, we examine the impact of political influence on state-owned banks. Existing literature highlights that SOBs are often subject to political control, with their decision-making influenced by the priorities of government stakeholders (Carretta et al., 2012; Dinç, 2005; Sapienza, 2004b; Shleifer & Vishny, 1994; Wang et al., 2019; Zhou, 2023). This political influence can lead SOBs to act as instruments for achieving socio-economic and political objectives, which do not always align with economic efficiency. To examine this, we construct a bank politicization index, which measures the proportion of supervisory board members with political affiliations for banks in our sample. The index reveals that SOBs' supervisory boards are more politically connected than those of private banks, indicating stronger government control over their operations. Subsequently, we incorporate the politicization index into our empirical framework and show that politicization significantly increases SOB lending to brown firms. This evidence supports the hypothesis that hat politicized SOBs prioritize lending to carbon-intensive sectors, reflecting their use as tools for political objectives and potentially weaker governance leading to excessive risk-taking.

Third, a key hypothesis of politicized SOB lending is its potential focus on state-owned enterprises that align with the state's strategic and social objectives within their sectors (Cao et al., 2023). This behavior may be particularly pronounced in high-emitting sectors, such as fossil fuels, power, and utilities, which are deemed critical for national stability and economic development. In these sectors, the state also often aims to safeguard employment and promote infrastructure development. To test these dynamics, we analyze whether SOBs allocate a disproportionately higher share of lending to SOEs in brown sectors compared to POBs. Our findings confirm a strong link between SOBs and SOEs in these sectors, indicating that SOBs provide preferential treatment to climate-sensitive SOEs under common state ownership. This behavior likely reflects SOBs' broader mandate to support industries considered strategically important to the state, even when such practices may increase portfolio risk and conflict with broader climate objectives.

Our main findings relate to the volume of credit (the intensive margin) and equally interesting question is whether SOBs behave differently from POBs in terms lending connections with brown firms (the extensive margin). Specifically, we examine whether SOBs are more likely to establish new lending relationships (entry) or less likely to terminate existing ones (exit) with firms in climate-policy-relevant sectors (CPRS) after the Paris Agreement. Our findings reveal that SOBs are no more inclined than private banks to create new lending relationships with brown firms after the policy shock. However, SOBs are significantly less likely than

private banks to terminate existing relationships with brown firms. This suggests that SOBs maintain their lending to brown firms for a significantly longer period after the Paris Agreement which may again reflect the socio-political motives of SOB lending.

One concern about the sector-level approach to identifying brown firms is that state-controlled banks may be lending extensively to brown firms specifically to support their transition to a more environmentally sustainable economy, i.e., to support their greening initiatives, innovations, or projects. While our dataset lacks details on the explicit purpose of each loan, we approach this concern in two ways. To exclude such a mechanism, we start with investigating whether credit sourced from state-owned banks versus privately-owned banks differentially affects firms' greenhouse gas (GHG) emissions. We aggregate the data to the firm-year level and construct a measure representing the share of SOB credit in the total credit received by each firm. We obtained firm-level data on absolute Scope 1 and Scope 2 emissions from Trucost and matched it with our bank-firm dataset. To assess the differential impact of SOB versus POB credit, we interact the share of SOB borrowing with total bank lending to each firm. This approach enables us to evaluate how bank ownership influences the credit-to-emissions transmission mechanism. We find that the effect of bank lending on emissions intensifies as the share of SOB credit in total firm credit increases.

In the second approach, we examine, whether SOBs are more inclined to finance "brown" firms engaged in greening projects, as indicated by their volume of green patent applications and their receipt of green grants from EU funding sources. The underlying assumption is that firms actively pursuing green patents and grants are more likely to seek financing for transitioning to sustainable operations, rather than for activities that could raise their carbon emissions. We find no evidence that SOBs allocate more funding to firms transitioning toward climate-friendly practices. This result suggests that SOB lending to brown firms is not primarily driven by a focus on greening their operations.

Furthermore, we run additional analyses to exclude other potential explanations for our effects. First, SOBs' higher exposure to climate-sensitive borrowers might be offset by risk management strategies, such as charging higher interest rates or screening for default risk. Therefore, we examine the likelihood of loan defaults and effective interest rates as proxies for risk management. Our results document that SOB-financed brown loans are more likely to default, and SOBs do not charge higher interest rates to compensate for the elevated risk of lending to carbon-intensive firms. This supports the interpretation of weaker credit risk management practices at SOBs. Similarly, it might be the case that the unobserved

heterogeneity at the bank or borrower level may bias our results. Therefore, we incorporate stringent fixed-effects specifications, including bank-by-time, bank-by-sector, and lender-borrower pair fixed effects, alongside additional firm- and loan-level controls to test the robustness of our results. We document our results remain robust across all specifications, addressing concerns about unobserved factors driving the observed lending patterns.

Related literature. Our study contributes to several strands of the banking literature. First, it expands the literature on bank lending and climate risk by reestablishing the link and newly highlighting a heterogeneous effect stemming from bank ownership. Prior work shows that bank lending decisions increasingly reflect firms' climate risk profiles, recognizing the financial implications of climate change (Goss & Roberts, 2011).[1] The Paris Agreement marked a critical turning point, imposing regulatory and reputational pressures incentivizing banks to decarbonize their portfolios (Accetturo et al., 2022; Beyene et al., 2022; Degryse et al., 2023a; Ehlers et al., 2022; Martini et al., 2023; Reghezza et al., 2022). However, these efforts remain uneven across the banking sector, influenced by factors such as size, geographic focus, climate-related disclosures, and cross-border lending practices (Benincasa et al., 2022; Bruno & Lombini, 2023; Nguyen et al., 2023). At the same time, some banks continue substantial lending to carbon-intensive industries, reallocate loans to low-emission borrowers without fully divesting from high-carbon sectors, or engage in greenwashing practices by selectively reporting climate exposures (Giannetti et al., 2023; Martini et al., 2023; Mésonnier, 2019). Our study focuses on bank lending decisions concerning firms in brown sectors after the Paris Agreement, highlighting the heterogeneity effect driven by varied bank ownership.

Our study also expands the literature on the banking sector risks stemming from state ownership of banks. We expand the well-documented findings that SOBs tend to lend more to riskier and less efficient firms (Cao et al., 2023; Dinç, 2005; Ferri et al., 2014; Sapienza, 2004b), mainly as because of the weaker corporate governance standards (Kornai, 1980; Borisova et al., 2012b; La Porta et al., 2002) exaggerated by "soft budget constraints" and implicit state guarantees. Such a behavior could also allow these institutions to fund the strategic goals of government by realization of economic-socio goals. A few studies document the consequences of such behavior indicating a credit misallocation (Cong et al., 2019; Dinç, 2005; Fan et al., 2007; Jurzyk & Ruane, 2021; Sapienza, 2004b), overinvestment in sectors aligned with government priorities (Firth et al., 2008a), concentration of the bank credit (Geng

[1] Goss and Roberts were among the first to identify that firms with poor environmental performance face higher costs of capital due to perceived risks.

& Pan, 2024), and consequently higher bank losses, systemic risk, and bank defaults (Geng & Pan, 2024; Iannotta et al., 2013; Jurzyk & Ruane, 2021; Micco et al., 2007). Building on studies showing that SOBs prioritize lending to firms with weaker financial profiles we demonstrate that this pattern extends to climate-policy-relevant sectors, exacerbating not only financial but also transition risks in SOBs' portfolios. We also expand on the role of SOBs as instruments of state policy, often aligning credit allocation with national socio-economic priorities rather than market efficiency. While prior studies have shown that SOBs direct credit toward politically or economically strategic sectors to stabilize economies during periods of uncertainty (Micco & Panizza, 2006; Brei & Schclarek, 2013), our findings reveal that this focus on state-driven priorities not only distorts credit allocation but also increases banks' exposure to stranded assets—assets that lose economic value due to regulatory, market, or environmental shifts toward decarbonization.

Finally, our study also contributes to the literature on the political motivations underlying SOB lending. The academic literature documents that politicians on SOB boards often act as intermediaries, bridging the priorities of governments with banking decisions. The influence of political connections on lending practices by state-owned banks has been extensively documented across different streams of literature. One strand focuses on how political ties directly affect lending decisions, often leading to preferential treatment for state-owned enterprises (Fan et al., 2007; Sapienza, 2004). Another stream explores the motivations behind politically influenced lending, such as career incentives for local politicians. Wang et al. (2019) reveal that politically motivated lending disproportionately benefits politically sensitive sectors, such as infrastructure and heavy manufacturing, where employment and economic activity are crucial for political stability. Further research highlights how SOB lending aligns with broader political and electoral objectives (Bertay et al., 2015; Cull & Xu, 2003a, Koetter & Popov, 2021). Our study contributes to these streams of literature by integrating the role of political influence with the emerging challenges of climate policy. To the best of our knowledge, we are the first that demonstrate that politically connected SOBs disproportionately support firms in carbon-intensive firms mainly through their political ties in the board.

Our findings could be generalized or relevant for other regions with significant state banking presence, such as Central and Eastern Europe, Asia, and the Middle East, which collectively account for a substantial share of global greenhouse gas emissions. State-owned banks in these regions often finance state-owned enterprises that contribute significantly to emissions, posing a complex challenge for climate-aligned financial flows (IMF, 2017; OECD, 2024). Our work

provides insights into how state-owned banks can better support the green transition by recognizing transition risks in lending decisions, at least to the level observed in private banks. Key reforms could include improving governance, risk-screening capabilities, and accountability for poorly managed risks, as well as reducing political interference. Additionally, our findings contribute to discussions on how state-owned banks could take a leadership role in green lending, aligning their operations with the ambitions outlined in countries' nationally determined contributions (NDCs).

The remainder of the paper is structured as follows: Section 2 outlines the data and methodology, Section 3 presents the findings, Section 4 discusses the robustness tests, and Section 5 provides the conclusion.

2. Data and empirical setting

2.1. Databases

We rely on several proprietary administrative sources to build our dataset. We begin with granular administrative data on bank-firm level information from the National Bank of Poland's "large exposure" dataset (referred to as NB300). This dataset is similar to that derived from the large exposure regime introduced in the EU in 2014, which was designed to ensure that risks arising from large exposures are mitigated by limiting the maximum loss a bank could incur in the event of a sudden counterparty failure. However, the Polish large exposure reporting requirement came into force several years before the introduction of EU regulations and, in terms of scope, covers all individual bank loans above 500,000 PLN (≈ 100,000 USD) to firms, compared to the pan-European database for which the limit is set at €300 million or higher.[2] Specifically, the dataset includes credit risk exposures to firms, aggregated over the reporting period, and borrower-specific information including the firm's name, statistical identification number (REGON), location, and economic sector according to the NACE Rev. 2 classification.

We match this supervisory data with bank-level information for all banks operating in Poland from 2013:Q4 to 2023:Q4. Bank balance-sheet characteristics are collected from two administrative databases: COREP, which reports on banks' capital, and FINREP, which covers financial statements. Both are confidential supervisory databases, adhering to common

[2] According to Article 393 of the Capital Requirements Regulation (CCR), an exposure to a single client or connected group of clients is considered a large exposure when, before the application of credit risk mitigation measures and exemptions, it is equal or higher than 10% of an institution eligible capital or has a value equal or higher than €300 million.

reporting standards, and all European Union banks are mandated to provide accurate information.

We then merge the bank-firm dataset with non-financial information from the Central Statistical Office (GUS), which provides, among other details, granular, time-varying information on the types of ownership for non-financial entities in Poland according to the official GUS classification. The advantage of this data is that it covers the entire universe of companies in Poland and reflects changes in ownership structure.

The third data source are the firm-level data from a credit rating agency, Bisnode (see Müller et al., 2024) which contains information on balance sheet and income statement items, as well as firm-specific characteristics for both public and private companies. Although the data is updated annually, we align it with the quarterly frequency of our bank-firm level dataset.

2.2. Sample construction and descriptive statistics

The sample covers quarterly data from 2013:Q4 to 2023:Q4. After matching the different data sources, we obtain a final sample of 854,799 observations. In total, the matched estimation sample includes 39 banks, ranging from small institutions to large systemically important ones, representing the universe of commercial banks operating in Poland. This excludes small branches of foreign credit institutions and small, regionally focused cooperative banks, which accounted for 8% and 4% of total banking sector assets in Poland, respectively, by end-2023.

Our sample includes 41,438 firms, encompassing small and medium enterprises as well as large Polish corporations. On average, it represents about 70% of the total credit exposure to non-financial corporations (NFCs), as we exclude financial companies and retain only firms with a complete set of characteristics for the final estimation sample. To capture the richness of the data, we conduct our analysis at a quarterly frequency. Since the firm-level data is only available annually, we assign the most recent available information for each matched firm to each quarter.

2.1. Definition of variables

2.1.1. Dependent variable

Our baseline-outcome variable focuses on the intensive margin of bank lending to identify how banks adjust the scale of credit allocated to firms based on their exposure to climate risks. This allows us to understand the reallocations within banks' existing loan portfolios, revealing whether banks tighten or relax credit conditions for firms more vulnerable to transition risks.

Following the literature investigating the impact of climate-related financial risks on bank lending behavior using loan-level data (e.g., Degryse et al., 2019; Delis et al., 2024), we use the logarithm of bank lending at the bank-firm level as the dependent variable. In an extension of the paper, we also examine the extensive margin of bank lending, which enables us to assess whether banks change their propensity to initiate new lending relationships or terminate existing ones with climate-vulnerable firms, or expand/shrink the number of borrowers.

2.1.2. Main variables of interest

To measure banks' exposure to transition risk stemming from loans granted to non-financial companies, we need a metric that captures carbon-intensive firms. Identifying exposure to companies that may face transition risk is challenging due to limitations in data availability on direct and indirect emissions and transition plans—especially for private firms, which constitute the majority of our sample. Therefore, this paper follows the approach suggested by Battiston et al. (2021) and measures bank credit exposure to the so-called climate policy-relevant sectors (CPRS). This approach utilizes the NACE Rev. 2 statistical classification of economic activities in the European Union at the 4-digit level of granularity. It allows for the identification of sectors vulnerable to transition risk based on sectoral data concerning greenhouse gas (GHG) emissions, their role in the supply chain, and regulatory considerations.

[Figure 1]

Given that the exposure of the Polish banking sector to climate-sensitive sectors accounts for approximately half of the corporate loan portfolio (see Figure 1), and that the majority of exposures to CPRS relate to sectors characterized by relatively lower transition risk—such as construction and transportation—we focus on firms from sectors with the largest carbon footprint. Specifically, we create a "brown borrower" dummy variable to denote firms concentrated in mining, energy production, and energy-intensive industries. Collectively, firms in these sectors accounted for 14% of banks' corporate portfolios at the end of 2023 and were responsible for approximately 80% of direct GHG emissions in Poland.

To construct time-series data on bank ownership, we utilize supervisory bank-level data on ownership structures obtained from the National Bank of Poland. This data allows us to classify a bank as state-owned if the government directly or indirectly controls at least 20% of its capital. For all state-owned banks in our sample, the state holds the majority on the supervisory board and appoints the CEO--thereby exerting significant influence over the bank’s As of the end of 2023, state-owned banks accounted for 40% of the total assets in Poland's banking

sector. The remaining banks are classified as privately-owned banks, which are predominantly foreign-owned subsidiaries of large international groups (52%) and domestically-owned private banks (8%). This unique ownership structure of the Polish banking sector allows us to examine differences in lending policies toward the most polluting firms between SOBs and POBs.

2.1.3. Control variables

We include a wide range of control variables. At the bank level, these include bank size (*ASSETS*), measured by the logarithm of the bank's total assets, to control for market power; the ratio of non-performing loans to gross loans (*NPL*) to account for the credit quality of the loan portfolio; net income to total assets (*ROA*) and cost-to-income ratio (*CTI*) to measure profitability and management efficiency; deposits to total liabilities (*DEPOSITS*) and cash and cash equivalents to total assets *(LIQUIDITY*) to capture the bank's asset and funding liquidity position; and the CET1 capital ratio to risk-weighted assets to control for bank solvency.

At the firm level, we control for firm size using the natural logarithm of total assets (*lnassets*). To capture liquidity, we include the ratio of cash and cash equivalents to total assets (*cash*), as less liquid firms within industry clusters may seek larger loans. We account for leverage with the debt ratio (*leverage*), defined as the sum of current and non-current liabilities divided by total assets. Profitability is controlled using the ratio of earnings before interest and taxes to total assets (*roa*). To capture productivity and the capacity for credit substitution, we include the asset turnover ratio (*assets turnover*), calculated as revenues divided by total assets, and the logarithm of trade credit (*lntrade credit*). Finally, we include the tangibility ratio (*tangibility*), defined as tangible assets divided by total assets, to reflect the firm's asset structure and collateral availability.

The definitions and data sources of all variables used in this study are detailed in Appendix Table A1.

[Table A1]

2.2. Descriptive statistics

Table 1 presents summary statistics for the variables used in our analyses. The average loan volume (LOAN) is 7.1 million PLN (≈1.8 million USD), with a median of 1.9 million PLN (≈0.5 million USD), as shown in Panel A of Table 1. The average bank has total assets of 19.43 billion PLN (≈5 billion USD), calculated by exponentiating a mean of 14.44, with a standard deviation of 1.78, indicating variability in asset size across banks. The Tier 1 capital adequacy

ratio, a key measure of a bank's financial health, averages 15.98% across the sample. Along with other relatively robust financial stability ratios, this suggests that Polish banks, in general, maintain strong financial conditions over the analyzed period.

Next, we compare SOBs and POBs. Panel B illustrates that the exposure to climate-policy-relevant sectors (*CPRS*) is fairly consistent across both types of banks, with 14% of loan-level observations directed toward CPRS firms. Concerning other financial characteristics, SOBs are larger in asset size, better capitalized (*CET1R*), and more profitable (*ROA*). However, they exhibit lower credit quality in their non-financial loan portfolios (*NPL*) and have smaller liquid buffers (*LIQUIDITY*). Although the data highlights statistically significant differences in most financial ratios between the two groups, these are not substantial in economic terms, suggesting that POBs and SOBs share similar financial profiles and business models.

Table 1 also provides an overview of the firms in our sample, measured by their balance sheet characteristics. Panel A shows that the average firm's total assets (*assets*) amount to 143.86 million PLN (≈36.10 million USD). The average return on assets (*roa*), calculated as the ratio of net profits to total assets, is 5.62%. Additionally, the debt ratio (*leverage*) reflects relatively high indebtedness, averaging 63% with a standard deviation of 48.14. In Panel B, we highlight how characteristics vary between firms in the portfolios of POBs and SOBs. While we observe statistically significant differences across several metrics, these are not substantial in economic terms. Specifically, firms in SOBs' loan portfolios tend to be smaller and less profitable, though they exhibit a similar level of indebtedness, as measured by the debt-to-asset ratio.

[Table 1]

2.3. Empirical Setup

To investigate the influence of different ownership on banks' lending decisions to CPRS firms, we estimate the following baseline regression:

$$Lending(log)_{b,f,t} = \alpha_{f(ILS)} + \beta_1 SOB_{b,t} + \beta_2 CPRS_f + \beta_3 SOB_{i,t} \times CPRS_f + \beta_4 X_{b,t-1} + \beta_5 Z_{f,t} + \varepsilon_{b,f,t} \quad (1)$$

Lending(log) is the logarithm of the outstanding amount owed by debtor *f* to bank *b* at time *t*. α indicates either firm (*f*) or *ILS* fixed effects, which capture the heterogeneity in credit demand across firms. SOB is defined as a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable that equals one for firm *f* operating in climate-policy relevant sectors according to Battiston's

methodology (2019, 2022) based on the 4-digit NACE codes. We consider only companies operating in the most carbon-polluting sectors, including fossil fuels, utilities, and energy-intensive sectors. Our coefficient of interest lies in the interaction term (*SOB* × *CPRS*), which captures whether banks' lending behavior towards more polluting versus less polluting firms depends on bank ownership. In general, we expect the coefficient to be positive.

Following Degryse et al. (2019), we construct industry-time (*ILS*) fixed effects to control for variations arising from unobserved, time-varying factors specific to each industry, with industry clusters based on NACE section codes. This strategy allows us to capture effects for firms with a single banking relationship, which applies to approximately 80% of the firms in our sample. The regression specification compares how the loan portfolio (measured as the logarithm of credit exposure) of a single-bank firm within an industry cluster borrowing from a state-owned bank changes relative to another firm in the same industry cluster borrowing from a privately-owned bank in the same time period. Considering the substantial heterogeneity among firms within industries, we incorporate firm-level financial characteristics to account for each firm's financial conditions and credit demand.[3]

Our second complementary identification strategy employs firm-time fixed effects in Eq. (1), following the approach of Khwaja and Mian (2008). These fixed effects can be interpreted as absorbing firm credit demand. Identification of β_3 thus comes from comparing POB and a SOB lending to the same firms in a climate policy-relevant sector, relative to their lending to the same firms in non-climate policy-relevant sector. Incorporating firm-time fixed effects requires that a firm borrow from at least two banks, so this reduces the sample size and increases estimation uncertainty substantially. Therefore, we report results both without and with firm-time fixed effects.

A wide array of bank-level variables controls for bank-specific characteristics that may influence the decision to grant loans to brown borrowers. To mitigate concerns about reverse causality, each covariate is lagged by one quarter. We double-cluster standard errors at the bank and quarter-year levels to account for multiple bank-firm relationships per bank over time.

To ascertain whether state-owned banks reallocated their lending from less to more polluting firms compared with privately-owned banks following the Paris Agreement announcement, we

[3] Compared to Degryse et al. (2019), we do not include size and location fixed effects. Instead, we directly control for firm size, and in the context of a single-country study, location fixed effects may be overly granular, as there is likely limited meaningful variation between entities within the same district.

employ a loan-level triple Difference-in-Differences (DiD) regression model in the following form:

$$Lending(log)_{b,f,t} = \alpha_{f(ILS)} + \beta_1 SOB_{b,t} + \beta_2 CPRS_f + \beta_3 SOB_{i,t} \times CPRS_f + \beta_4 SOB_{i,t} \times CPRS_f \times PARIS_t + \beta_5 X_{b,t-1} + \beta_6 Z_{f,t} + \varepsilon_{b,f,t} \quad (2)$$

In comparison to Eq. (1), this specification includes a triple-interaction term (*SOB* × *CPRS* × *PARIS*), where *PARIS* is a dummy variable equal to 1 after the Paris Agreement announcement in December 2015, and 0 otherwise. The coefficient on the triple-interaction term (β_4) captures the change in lending by state-owned banks to climate-policy-relevant sectors from the pre-reform to the post-reform period, relative to the change in lending by privately-owned banks to firms in the same sectors over the same period.

In line with previous literature, we define the estimation window around the policy event to capture shifts in climate awareness and their impact on banks' lending behavior, specifically focusing on the three years before and after the signing of the Paris Agreement in 2015. This approach also helps mitigate confounding factors, such as the drop in production and emissions due to the COVID-19 pandemic and the spike in energy prices following the outbreak of the war in Ukraine in early 2022.

3. Empirical results

3.1. Baseline results

We first explore the association between bank ownership and lending to firms in climate-relevant policy sectors (CPRS), focusing on state ownership (SOBs) relative to private ownership of commercial banks (POBs).

[Table 2]

Table 2 presents the estimation results for Eq. (1) over the entire sample window 2013:Q3-2023:Q4. In Column (1), we begin with the most parsimonious version of the model, regressing corporate lending on a dummy variable for the most polluting, climate policy-relevant sectors, and an indicator for state-owned banks. The results show a negative and statistically significant coefficient for high-emission firms, suggesting that elevated climate policy risk is associated with a smaller bank lending portfolio. The insignificant coefficient for SOBs indicates no statistically significant difference in lending between SOBs and POBs.

In Columns (2) through (4), we introduce an interaction between SOB and CPRS, enabling us to compare the changes in lending to high-emission and low-emission sectors between SOBs

and POBs. We incrementally saturate the model with industry-time fixed effects (Column 2), bank controls (Column 3), and firm controls (Column 4). Industry-time fixed effects can be interpreted as proxying for industry-specific shifts in credit demand. Across all models, the interaction term between CPRS and SOB is positive and statistically significant, suggesting that lending by state-owned banks may be more strongly associated with risky climate policy-relevant sectors.The results are also significant in economic terms. Our preferred specification in Column (4) shows that, compared with POBs, state-owned banks allocate 27% more credit to firms in riskier climate policy-relevant sectors. This indicates that SOBs may expose themselves to transition risks—either deliberately (for strategic or social reasons) or due to lower awareness and sensitivity to climate risks. While this result highlights only a significant and sizable correlation, it suggests that state ownership of banks has been exercised in a way that may not reflect the state's increased commitments to mitigating the national contributions to climate change (through its NDCs).

Finally, in Column (5), we replace industry-time fixed effects with firm-time fixed effects. This setting allows us to absorb all firm-specific shocks and demand-side factors that could influence credit allocation by examining the loan supply extended to the same borrower within the same year-quarter from both SOBs and POBs. This approach leads to a more precise examination of the relationship between bank ownership and lending patterns to climate policy-relevant firms but comes at the cost of a significant reduction in sample size, as firm-time fixed effects require firms to have multiple lending relationships. Nevertheless, the results remain qualitatively and quantitatively consistent with our baseline model. Note that this specification also renders borrower-level control variables unidentified, as they are absorbed by the firm-time fixed effects, which capture all year-quarter borrower-specific characteristics.

3.2. Paris Agreement policy shock

We consider the 2015 Paris Agreement a plausibly exogenous shock that increased public pressure on environmental policies for major emitters. Signed by 194 parties in December 2015, the Agreement set an ambitious goal to limit the global temperature rise to well below 2°C above pre-industrial levels. This event heightened awareness of carbon-related risks and raised expectations of stricter regulatory frameworks. Although the conference was planned well in advance, the outcome remained uncertain even weeks before its conclusion (Seltzer et al., 2022). The scope of the Agreement—both in ambition and the number of signatories—surprised many observers. Thus, it can be viewed as an exogenous shock to firm (Bolton & Kacperczyk, 2021; Degryse et al., 2023b; Seltzer et al., 2022). We conjecture that this shifted

banks' perception of climate transition risks, thereby materially altering their lending policies toward green and brown firms. However, responses may differ across banks, particularly between SOBs and POBs, given their distinct objectives (Bacchiocchi et al., 2019; Cull & Xu, 2000, 2003b), credit standards (Barry et al., 2011; Cornett et al., 2010; Cull & Xu, 2000), and countercyclical behavior (Bertay et al., 2015; Brei & Schclarek, 2013; Capeleti et al., 2022; Panizza, 2023). To test this hypothesis, we employ a difference-in-differences (DiD) framework to evaluate how lending by SOBs versus POBs responded to the Paris Agreement as a policy shock.

[Table 3]

Table 3 displays the regression results, isolating the effects of the 2015 Paris Agreement on bank lending to climate policy-relevant firms, comparing SOBs and POBs. Column (1) reports the estimation results using industry-time fixed effects, while Column (2) presents results using firm-time fixed effects with a narrower sample of observations between 2013-2019 by leveraging multiple bank-firm relationships to control for firm-specific credit demand. The results in Column (1) indicate that the Paris Agreement does not exert a negative effect on lending to firms more exposed to transition risk. The increased regulatory pressure and heightened climate risk awareness associated with the Agreement do not prompt banks to adjust their lending policies toward climate-vulnerable firms. However, these aggregate results may mask significant heterogeneity between banks, particularly regarding ownership structure, which could influence how state-owned and private banks perceive and respond to climate-related risks and policy pressures. To examine this ownership heterogeneity, in Columns (2) and (3), we introduce a triple interaction term to capture differences in lending behaviors between state-owned and privately-owned banks following the Paris Agreement. In Column 2, the coefficient for $CPRS \times PARIS$ indicates a roughly −9.4% (i.e. $e^{(-0.099)} - 1$) decrease in lending to climate policy-relevant sectors at privately-owned banks between the pre-reform and post-reform period. Combining this estimate with the interaction term $CPRS \times SOB \times PARIS$ suggests that SOBs' lending to CPRS firms grows by a factor of 7.3% (i.e. $e^{(-0.099+0.169} - 1)$ over the same period. These significantly different growth rates underscore the pronounced impact of state ownership on the allocation of credit across brown and green firms.

Overall, these findings indicate that state-owned banks do not reduce lending to carbon-intensive firms following the Paris Agreement, relative to privately owned banks. Instead, they reallocate credit toward these climate-policy-relevant (brown) sectors, effectively substituting for the lending that privately owned banks have withdrawn. Our results provide novel evidence

on the importance of bank ownership structure in the loan supply to firms with varying climate risk profiles.

A key identifying assumption in our research design is the parallel trends assumption, i.e., that the trends (or changes) in the outcome variable across treated and control observations would be the same in the absence of treatment. We gauge its plausibility by examining pre-trends in the outcome variable across treatment and control observations. A significant difference in pre-trends would indicate a violation of the parallel trends assumption. We estimate a dynamic DiD (event-study) specification of the regression model. We use our baseline specification in Eq. (2) with industry-time fixed effects, replacing the Paris dummy with a full set of year-quarter dummies. Consistent with our static model, we employ a time window around the event, from 2013:Q4 to 2019:Q4.

[Figure 2]

The results, displayed in Figure 2, show that the pre-impact difference between state and private bank lending to brown (CPRS) activities before the Paris Agreement is not statistically different from zero. This finding supports the parallel trends assumption for our DiD estimation. Post-treatment dynamics reveal that the impact becomes consistently positive and statistically significant after approximately one year, around the time the Paris Agreement came into effect.

One might be also concerned that our main variables of interest are correlated with other unobserved firm- or bank-specific characteristics. To address this concern, Panel A of Table A2 in the Appendix shows that our findings remain robust under more stringent fixed-effects specifications. In Column (1), we include bank-by-time fixed effects, capturing any time-varying, bank-specific factors. Column (2) employs bank-by-sector fixed effects, controlling for a given bank's specialization in particular industries. In Column (3), we introduce lender-borrower pair fixed effects, allowing comparisons within the same lender-borrower relationship and thus further isolating the effect of a lender's ownership type on credit decisions. Recognizing that there may still be persistent differences between firms borrowing from so-called "brown" versus "non-brown" banks, Column (4) incorporates firm fixed effects to account for time-invariant, unobserved firm characteristics. Lastly, in Column (5), we add a set of loan-level variables, including the size of the loan relative to the bank's total assets, the number of banking relationships held by the firm, whether the bank has classified an exposure

as defaulted, and the length of the firm-bank relationship.[4] Across all four specifications in Panel A, the results remain robust.

[Table A2]

Panel B of Table A2 extends these robustness checks to the setting where the Paris Agreement serves as an exogenous policy shock, and the results again hold across the corresponding columns. Across all columns, the interaction term of interest remains statistically significant, with point estimates ranging approximately between 15% and 24%, suggesting that the effect is not only robust but also economically meaningful.

3.2. Mechanisms

This section delves deeper into the possible transmission mechanisms behind state-owned banks' tendency toward browner lending compared with private banks. Specifically, we test three hypotheses about why state-owned banks' lending may be more inclined toward brown firms. First, SOBs may be generally less sensitive to risk and therefore more likely to lend to climate-vulnerable firms, whether state-owned or privately owned. Second, through greater politicization, the state can direct SOBs to prioritize lending to carbon-intensive sectors critical to sustaining employment and to economic stability. Third, the lower political independence of SOBs implies their stronger connections to state-owned enterprises, which operate more prevalently in brown sectors than other firms and could receive more state-owned banks' credit.

3.2.1. Credit risk sensitivity of state-owned versus privately-owned banks

This subsection analyzes the role of borrower-specific factors, especially their return-risk profiles, as these are crucial in shaping creditors' lending decisions (Jiménez, 2014; Ongena et al., 2015), particularly to climate-vulnerable firms (Ivanov et al., 2023), and potentially influence lending practices between state-owned banks and private-owned banks. Traditional risk-shifting theory (Jensen & Meckling, 1976; Kandrac & Schlusche, 2021) suggest that banks may take on more risk to maximize returns, potentially increasing their exposure to vulnerable—including carbon-intensive—firms. This risk-shifting behavior may intensify in the context of greater principle-agent problems that SOBs embody (Shleifer & Vishny, 1994). Additionally, SOBs are known to have weaker credit screening processes, which leads to riskier lending practices (Abid et al., 2021; Dong et al., 2014; Iannotta et al., 2007; Samet et al., 2018). Moreover, SOB lending to climate-vulnerable firms may also reflect a 'gambling for

[4] Detailed definitions of all variables are provided in Table A1 in the Appendix.

resurrection' strategy (Ben-David et al., 2021; Freixas et al., 2004), as they are more likely to engage in riskier lending due to implicit state guarantees. In contrast, more conservative private banks may reduce lending to financially weak, climate-vulnerable firms, especially those likely to face repayment issues as climate-related risks intensify.

To examine how firms' financial vulnerabilities influence bank lending decisions, we focus on two key indicators—the leverage ratio and return on assets (ROA)—as determinants of default risk (Bennett et al., 2015; Bhagat et al., 2015). Following the literature, we define vulnerable borrowers as those with a debt-to-assets ratio above the 75th percentile and an ROA below the 25th percentile. Our empirical approach, using a triple interaction term, tests the differential lending behavior of SOBs and POBs toward financially vulnerable borrowers in carbon-intensive (risky CPRS) sectors, effectively assesses banks' risk-taking behavior through the lending channel.

[Table 4]

Table 4 reports the estimation results, which indicate that SOBs do indeed lend more to financially vulnerable firms in risky CPRS sectors. Column (1) shows that, not only do SOBs lend more to CPRS firms than POBs, but they also tend to lend disproportionately to firms with higher leverage and, therefore, higher financial vulnerability. Notably, these results are robust to controls for other firm characteristics. Columns (2) and (3) split the sample into pre- and post-Paris Agreement periods. The findings demonstrate that the observed effects are driven entirely by the post-Paris Agreement period. Column (4) further confirms analogous findings for ROA, showing that SOBs disproportionately lend to less profitable brown borrowers after the Paris Agreement. This raises financial stability concerns, as these borrowers face amplified climate change risks compounded by traditional firm-level vulnerabilities such as higher leverage and lower profitability. Once again, the results in Columns (5) and (6) show that these effects are only significant in the post-Paris period and not in the pre-Paris period, highlighting the evolving role of state-owned banks under heightened transition risk environments.

3.2.2. SOBs politicization

State-owned banks, if not properly shielded from political influence by proper corporate governance arrangements (OECD, 2024), could be misused by politicians for political gains. Politicians can misuse state-owned banks to advance their personal interests, such as reelection and personal profit, by directing funds to their supporters or those willing to pay the highest bribes, leading to resource misallocation and economic inefficiency (Shleifer and Vishny,

1994; Shleifer, 1998). Politicians are more likely to favor government bank ownership in environments where public accountability and judicial independence are low, as it allows them to extract benefits with fewer personal consequences (Perotti and Vorage, 2010). This misuse of SOBs undermines economic efficiency by allocating financial resources based on political rather than economic merit, stifling innovation, and hindering growth.

To assess the actual level of political influence on state-owned banks, we incorporate an index into our regressions that measures the politicization of supervisory boards across both SOBs and POBs. The politicization index is designed to measure the extent of political influence in the governance of banks through appointments to supervisory boards. To construct this index, we used data from two key sources: the National Court Register (*KRS*) and the National Electoral Commission (*PKW*). The first dataset, obtained from the *KRS*, provides comprehensive records of changes in supervisory boards for all registered companies in Poland, including banks. Specifically, it includes details of appointments and dismissals, as well as the names, surnames, and dates of birth of board members. Focusing on state-owned banks and privately-owned banks, we collected data on board composition between 2013:Q4 and 2023:Q4, enabling us to track the turnover of board members over time.

To identify political affiliations, we benchmarked the *KRS* dataset against the publicly available dataset from the *PKW* which contains information on all candidates in local and national elections in Poland from 1991 to 2023. This dataset includes candidates' names, dates of birth, and political affiliations, making it possible to match individuals from both datasets. By comparing the records, we identified board members who had previously run for political office or were otherwise affiliated with political parties. Using this matched data, we calculated the politicization index (*POLITIZATION*) as the proportion of board members in each bank and time period who were identified as former politicians or party loyalists. While Polish legislation prohibits current members of parliament or local government officials from being appointed to supervisory boards of state-owned enterprises, this index captures the indirect influence of political actors who are not currently in office but may still have close ties to the ruling party.

The average value of the politicization index between 2013 and 2023 is 0.07, with a standard deviation of 0.12, indicating that, on average, approximately 7% of board members (across SOBs and POBs) were former politicians or politically affiliated individuals. The data reveal a stark contrast between SOBs and POBs. The average value of the politicization index for SOBs is 0.19, compared with just 0.017 for POBs, indicating that political influence is overwhelmingly concentrated in state-owned institutions. For some banks, the index reaches a

maximum value of 0.5, meaning that half of the supervisory boards was composed of individuals with a political background. This suggests that SOBs are more likely to serve as tools for political agendas, with supervisory boards heavily influenced by government-aligned appointments. In contrast, POBs exhibit minimal evidence of political entanglement, reflecting their focus on profit-oriented governance and independence from political pressures.

We further incorporate the politicization index into our empirical framework by interacting this measure with the CPRS and SOB dummies (*SOB* × *CPRS* × *POLITIZATION*) to test the moderating effect of political influence on the relationship between state ownership, borrowers from high-emitting sectors, and SOBs' lending decisions. This interaction allows us to examine whether higher levels of politicization in state-owned banks amplify or mitigate their propensity to provide credit to firms in carbon-intensive ("brown") sectors.

[Table 5]

Table 5 presents the estimation results for the impact of politicization on the nexus between SOB lending and CPRS firms. Column (1) indicates that, on average, the politicization of bank boards does not have a statistically significant effect on overall lending. Column (2) reveals that the presence of former politicians on bank boards has a statistically significant positive effect on lending by SOBs compared to POBs, while Column (3) shows this effect is particularly pronounced in lending to carbon-intensive ("brown") firms. Finally, the results show that this effect is significant in both pre- (Column 4) and post-Paris Agreement periods (Column 5), supporting our hypothesis that politically connected banks are more likely to support high-emitting industries critical to the economy and employment, regardless of the intensity of transition risks.

3.2.3. SOBs lending relationship with state-owned enterprises

Previous literature indicates that SOBs lend more intensively to SOEs than POBs (Cull & Xu, 2000, 2003b). This reflects the often-cited strong nexus between state banks and state enterprises where state banks become one mechanism of the SOEs' soft budget constraint and financial support mechanism (Cao et al., 2023; Firth et al., 2008b; Wei & Wang, 1997). These findings might also extend to state-owned banks' lending to brown SOEs, driven by a variety of intertwined factors. For one, state-owned banks may have internal risk management practices that make lending to SOEs appear more favorable or less risky. Additionally, the political ties between SOEs and state-owned banks, often coupled with weaker governance practices, can reinforce this lending relationship. Furthermore, state-owned banks may be

mandated to support strategic SOEs that happen to operate in brown sectors, reflecting national priorities over purely financial considerations. Finally, external influences, such as economic shocks or shifts in policy, can exert additional pressure, steering lending practices toward these firms despite their environmental footprint.

To explore this hypothesis, we estimate whether SOBs lending is disproportionately directed toward brown SOEs compared to private bank lending. We estimate a triple difference model where we interact the double interaction term of SOB lending and CPRS vulnerable sectors with a SOE dummy ($SOB \times CPRS \times SOE$), which captures firms controlled directly or indirectly by the government.[5]

[Table 6]

Table 6 presents the results estimated using our baseline model, which includes industry-time fixed effects as well as bank and firm financial controls. First, in Column (1), we establish that state-owned banks not only lend more intensively to brown borrowers but also allocate a larger share of their lending to state-owned enterprises. These results align with the literature on state bank lending to SOEs and the lower sensitivity of state banks to risks (Cornett et al. 2010; Barry et al. 2011; Cao et al, 2023). Column (2) shows that the triple interaction term is positive and significant at a 10% level, supporting our hypothesis that SOBs tend to lend more to SOEs with a higher propensity to operate in brown sectors. In Columns (3) and (4), we split the sample into the pre- and post-Paris Agreement periods, respectively, to verify whether this effect changes over time. The results show that the effect is only significant in the post-Paris Agreement period, suggesting that as transition risks increase, state-owned banks step in to lend more to SOEs in carbon-intensive sectors, possibly due to reduced credit availability from private banks.

Overall, these findings suggest that state-owned banks tend to allocate credit more generously to SOEs than private banks do, and especially to SOEs in climate policy-relevant, "brown" sectors—firms that private banks might be more inclined to avoid.

3.3. Extensive margin

Our results thus far indicate that state-owned banks are more inclined to provide credit to carbon-intensive firms, particularly after the Paris Agreement. An important question that arises is whether SOBs influence the access of brown borrowers to credit, which we refer to as

[5] Note that in the model also include the double interaction terms note reported for brevity.

the extensive margin. To examine whether state-owned banks adjust their lending relationships on the extensive margin following the Paris Agreement more than private banks, we adopt two complementary empirical approaches.

First, we employ a fully saturated model similar to the one used in our analysis of the intensive margin and focus on bank entry and exit from lending relationships. We investigate whether SOBs are more likely to create new lending relationships (entry) or less likely to terminate existing relationships (exit) with companies in climate-policy-relevant sectors, particularly after the Paris Agreement. Following the methodology of Sastry (2024), we define entry as a dummy variable equal to one if bank b has a lending relationship with firm f in period t but did not have one prior to t. Conversely, exit is defined as a dummy variable equal to one if bank b does not have a lending relationship with firm f in period t but did have that relationship prior to t.

Given the construction of our dependent variables—where observations are only available when an active lending relationship exists—we cannot include lagged values of bank controls, as they would be undefined in periods without a relationship. To address this, we incorporate bank-time (year-quarter) fixed effects, which absorb all time-varying bank characteristics.

[Table 7]

Table 7 presents the estimation results on the impact of the Paris Agreement on banks' extensive margin decisions. Columns (1) to (3) of Table 7 display the results for the entry (new relationship) regressions. Column (1) indicates that banks, in general, do not increase the number of new credit relationships with brown borrowers after the Paris Agreement. These results are consistent with findings on the intensive margin, where no differential trend in the quantity or volume of brown credit is observed following the policy shock. In Columns (2) and (3), our estimates suggest that state-owned banks are no more likely than private banks to establish new lending relationships with brown firms post-Paris Agreement. The interaction terms between state bank ownership, climate-policy relevance, and post-Agreement period dummies are statistically insignificant across specifications with industry-time (Column 2) and firm-time fixed effects (Column 3).

The results in Column (4) do not provide evidence that banks overall are more likely to terminate existing relationships with carbon-sensitive borrowers after the Paris Agreement. However, these results conceal differences in banks' lending policies. The results in Columns (5) and (6) indicate that state-owned banks are significantly less likely to terminate existing

lending relationships with brown firms after the Paris Agreement compared with private banks. The coefficients on the interaction terms between state ownership, climate-policy relevance of borrowers, and the post-Paris Agreement period are negative and statistically significant. This implies that state-owned banks tend to maintain their lending to brown firms in the post-Agreement period—at least significantly longer than private banks.

The estimation results reflect the notion that state banks may be less sensitive to risks or less comprehensive in managing risks, or simply have additional objectives to commercial profitability—such as supporting employment and preserving jobs. The extensive margin results corroborate intensive margin results. Namely, after the Paris Agreement shock, SOBs are less likely to end relationships with brown firms and/or tend to increase lending to brown firms—presumably to accommodate any increase lending needs due to the parallel withdrawal of private banks from lending to brown firms on either extensive or intensive margin.

In our second approach, we examine whether there is evidence of a substitution effect in firms' credit relationships, shifting from private to state-owned banks after the Paris Agreement. To investigate this, we construct a time-varying, firm-level variable that captures the total number of a firm's credit relationships with banks, further broken down by bank ownership structure, as well as the share of a firm's credit relationships with state-owned banks relative to its total relationships with lenders at a given time. We then regress these variables on the interaction term $CPRS \times PARIS$ to assess the impact of the Paris Agreement. Our specification includes bank- and firm-level controls, along with time-industry fixed effects.

[Table 8]

The results are reported in Table 8. In Column (1) shows that the interaction term of CPRS lending and post-Paris Agreement period is statistically significant and negative, which implies that firms in climate policy-relevant sectors experience a reduction in the number of lending relationships, suggesting tighter credit access relative to non-CPRS firms after the Paris Agreement. Columns (2) and (3) show a statistically significant contraction in lending relationships with POBs for climate vulnerable firms, coupled with growing lending relationships with SOBs after the Paris Agreement. Finally, the share variable in Column (4) supports the notion that the share of lending relationships with SOBs increases significantly for brown firms relative to non-brown firms after the Paris Agreement. This is further reflected in Column (5), which shows an increase in the proportion of debt held with state-controlled banks relative to firms' total bank debt.

These results from a firm's perspective, corroborate our finding on the intensive and extensive margin of from bank-lending perspective. They show that brown firms saw their number of relationships with banks decline after the Paris Agreement policy shock, mainly because private bank withdrew from lending to firms in the brown sectors. SOBs compensated for this private bank withdrawal and their role in lending relationship with brown firms increased both on the intensive and extensive margin. Lower sensitivity to or incomplete management of risks, relationship lending to SOEs largely in brown sectors, and possible double-bottom-line objectives of protecting jobs could reflect the observed results.

3.4. The real environmental effects of SOB lending

We have demonstrated that state-owned banks provide more credit to firms in climate-policy relevant (brown) sectors than privately-owned banks. A potential limitation of our sector-level analysis is that SOBs might be reallocating financing to de-carbonizing firms within brown sectors. We cannot discard the possibility that brown borrowers who receive loans from SOBs may utilize them to reduce their emission levels.

This section explores the real environmental impact of lending by SOBs to non-financial firms—although we do not have direct data on loan purpose. Specifically, we examine if the credit sourced from state-owned versus privately-owned banks differentially affects firms' greenhouse gas emissions. To this end, we collapse the data to the firm-year level and construct a measure representing the share of SOB credit to total credit received by each firm. This share variable ranges between 0 and 100, where 0 indicates that the company is entirely financed by private banks, and 100 means it is fully financed by state-owned banks.

We further retrieve data on firms' absolute Scope 1 and Scope 2 emissions from Trucost, which we match with our bank-firm level dataset. The dependent variable is the logarithm of the sum of Scope 1 and Scope 2 emissions (*ghg*). Emissions data for most companies is available from 2018 onward. To examine the differential impact of credit from state-owned versus private banks, we interact the share of SOB borrowing with (log) total bank lending to each firm. This approach allows us to assess how the ownership structure of lending institutions influences the transmission from credit to emissions. Our firm-level regression includes the same firm-level control variables as in our baseline model, along with industry-year fixed effects to account for time-varying, industry-specific factors. We also include the logarithm of revenues as an important determinant of firms' carbon emissions. Standard errors are clustered at the firm level. The estimation results are reported in Table 9.

[Table 9]

In Column (1) of Table 9, we show the independent effects of total credit and the share of SOB credit on greenhouse gas emissions before moving to the interaction model. The coefficient on total credit is positive and highly significant, indicating that an increase in loan exposure is associated with an increase in firm emissions. This positive relationship may be driven by the scaling of business operations, where greater emissions are required to support expanded activities, which are funded by increased credit. Interestingly, the coefficient on the share of SOB credit is not statistically significant, suggesting no direct linear relationship between the share of SOB credit and emissions. This result could be expected because the share itself does not capture the size of the loan, and its economic impact.

In Column (2), we introduce an interaction term between firm's total loan obligation and the share of SOB lending in this total loan obligation to examine how the effect of total loan obligation on firm-level emissions varies with the share of SOB lending. The coefficient on this interaction term is positive and significant at the 1% level, suggesting that the impact of loan exposure on emissions becomes stronger as the share of SOB credit increases. To provide a more intuitive interpretation of this interaction, we conduct a margins analysis to examine how the marginal effect of loan exposure on emissions changes across different levels of SOB credit share. The results, visualized in Figure 3, show a clear upward trend in the marginal effect as the share of SOB credit increases from 0 to 100.

[Figure 3]

At the lower end, where firms receive all their credit from privately-owned banks, a 1% increase in loan exposure is associated with approximately a 2.36% increase in emissions. However, this effect intensifies as the share of SOB credit increases. At the upper end, where all credit is sourced from state-owned banks, the same 1% increase in loan exposure corresponds to about a 4.23% increase in emissions. The consistently positive and increasing marginal effect indicates that the impact of bank lending on firm emissions is more pronounced when a larger share of the credit comes from state-owned banks.

Column (3) further refines the analysis by introducing a triple interaction term that accounts for high-emitting firms, defined as those above the 75th percentile of emissions. This specification allows us to differentiate the effects of SOB lending on high emitters versus low emitters. The triple interaction term is positive and highly significant at the 1% level, indicating that the effect of SOB credit share on the relationship between loan exposure and emissions is

more pronounced for high-emitting firms. This suggests that SOBs are more likely to finance emission-intensive projects or expansions for firms that are already high emitters, potentially due to strategic industrial policies or differing risk assessments compared to private banks. These results have important implications for understanding the role of banking sector ownership in environmental outcomes. They suggest that policies aimed at reducing corporate emissions may need to consider not only the volume of credit but also its source.

4. Robustness checks

4.1. Replacing CPRS classification with firm-level emission data.

For our baseline model, we use a sectoral approach to identify brown borrowers, focusing on the three most polluting sectors and following the approach of Battiston et al. (2021). A key concern with the sectoral approach is that it does not account for the heterogeneity in firms' emissions within a sector. To validate our results, we retrieved emissions data from Trucost, which allows us to assign scope GHG emissions to over 14,000 borrowers in our sample. Most observations are from after 2018. Therefore, we cannot include the Paris Agreement policy shocks, and the results are not fully comparable. Additionally, it is worth noting that for many companies, Trucost relies on estimated emissions, which may not always accurately reflect the true carbon footprint of the firm. Nevertheless, this alternative approach helps shed light on the robustness of our baseline results.

[Table 10]

In Columns (1) and (2) of Table 10, we run our baseline specification from Eq. (1), where the dependent variable is logged credit, and the CPRS brown industry classification is replaced with Trucost GHG emissions data. In Column (1), we observe a positive association between GHG emissions and lending, potentially reflecting an expansion in economic activity that prompts banks to extend more finance. In Column (2), the results confirm that high-emitting firms receive more lending from state-owned banks, consistent with our baseline findings.

Given that we are particularly interested in high-emitting firms—those most responsible for environmental impact—we create a dummy variable, assigning a value of 1 for firms whose emissions are above the 75th percentile of the sample, and interact it with our main variable of interest. In Column (3), where we use industry-time fixed effects, we find that SOBs are especially likely to finance firms in the upper quartile of emissions, reinforcing our conclusion that SOBs are particularly involved in financing high emitters, with less concern for

environmental impact. In Column (4), we apply firm-time fixed effects to strengthen our identification strategy and find similar results.

4.2. Using EU-ETS data to assess the effect of SOB lending on firm-level emissions.

We established that credit from state-owned banks to brown borrowers is associated with higher emission intensity than credit from private banks. Given the size of our dataset and the fact that most of the firms are private, we cannot rule out that these results may be driven primarily by Trucost's estimated levels of Scope 1 and Scope 2 emissions, which could introduce model estimation risk and reflect broader industry trends.

To address these concerns, this section utilizes alternative carbon emission data from the European Union Emissions Trading System (EU ETS), which includes firm-level emissions reported in compliance with regulatory requirements. Using EU ETS data, we corroborate our earlier findings by verifying the empirical evidence that firms financed by SOBs underperform in greenhouse gas emissions compared to firms financed by private banks.

The EU ETS, one of the world's first and most comprehensive emissions trading systems, operates on a 'cap and trade' principle. A cap is set on total GHG emissions allowed for covered installations and aircraft operators, primarily within the most polluting sectors identified in the EU regulatory framework. This cap is reduced annually in alignment with the EU's climate targets, ensuring a gradual decrease in emissions over time. Emission allowances, with each allowance permitting the emission of one ton of CO_2-equivalent (CO_2eq), represent the cap.

The EU ETS provides information on verified Scope 1 emissions at the industrial facility level. To utilize this data at the company level, we aggregate it at the firm level. In Poland, 512 companies are required to participate in the EU ETS system. We matched these companies with our large exposure loan-level database using the local firm registration number, a common identifier across both databases. We find that 280 firms had at least one active relationship with at least one bank between 2013:Q4 and 2023:Q4.

[Table 11]

We follow the same empirical strategy as for the preceding Trucost estimation, collapsing the data at the firm level and using the full list of controls, along with industry-time fixed effects. The results are reported in Table 11. In Column (1), we examine the relationship between reported Scope 1 emissions and the (log) volume of bank financing. These results differ somewhat from those obtained with the Trucost sample, likely because EU ETS participants use bank financing to invest in green technologies to reduce emissions, thereby lowering their

participation costs in the system. EU ETS companies are also larger in size and may therefore be in a more favorable position to acquire funding for riskier environmentally sustainable projects compared to smaller, less established firms outside the system.

Column (2) of Table 11 confirms the earlier finding that firms receiving a greater share of their financing from state-owned banks tend to emit more greenhouse gases than similar firms financed by private banks. In Column (3), we test whether this effect is primarily associated with firms whose GHG emissions fall in the upper quartile. The triple interaction term is found to be insignificant, which does not support this claim. However, it is important to note that our estimations rely on the within-firm variation among firms participating in the EU ETS system, most of which are already associated with high emissions. In sum, our results corroborate our previous finding that SOBs tend to finance firms with higher greenhouse gas emissions compared to private banks.

4.3. Alternative channels

4.3.1. Does SOB credit facilitate the green transition of brown borrowers?

So far, we establish that SOBs are more likely to lend to high-emitting firms, with this pattern becoming even stronger after the Paris Agreement. We also observe that SOBs are less likely to exit relationships with companies in carbon-intensive sectors. Finally, our results indicate that credit from SOBs is more strongly associated with increases in firms' emissions compared to credit from private lenders. However, we cannot fully rule out the possibility that our findings are biased by state-owned banks' support for greening projects within brown (CPRS-prone) sectors. Lending to carbon-intensive firms does not necessarily create risks for banks; in fact, it can be socially and economically beneficial if bank financing supports green projects that help these firms transition to more sustainable operations.

One challenge we face is the lack of standardized metrics for assessing firms' environmental engagement across both public and private companies. While the EU's new Corporate Sustainability Reporting Directive (CSRD) aims to improve non-financial disclosures, it is still in the early stages of implementation. As a result, comprehensive and comparable environmental data—especially for smaller or private firms that dominate our sample—remains inconsistent. We also do not observe the purpose of the loans in our data, making it difficult to distinguish between loans used to finance greening versus brown projects.

To address this data gap, we examine a firm's revealed propensity to invest in green R&D, using green patents and green grants as proxies. Prior studies on firms' green innovation and

investments tend to focus on green patents and carbon abatement activities. Our identification strategy rests on the assumption that firms more active in green patent and green grant applications are generally more engaged in emission mitigation strategies and, at the same time, require more external (bank) financing for green R&D and deploying new green solutions. Thus, we use green patents (*patents*) and green grants (*grants*) as proxies for firms' green projects, which should also be correlated with their demand for green bank financing.

In our first approach, we combine bank-firm loan-level data with patent data, which allow us to differentiate between green and non-green firms. We use the Orbis Intellectual Property (IP) database to obtain information on the patenting activities of firms in our dataset. Similar to the EPO Worldwide Patent Statistical Database (PATSTAT), Orbis IP provides comprehensive global coverage of patents, including those from Poland. To identify green patents, we use the 'Y02' tag, developed by the OECD and EPO, which is widely recognized as a reliable marker for innovations contributing to climate change mitigation (Aghion et al., 2022). Following common practice in the innovation literature, we aggregate patents to the patent family level, which groups patents related to a single innovation, and assign them to the year of the earliest filing. Any patent family with a Y02 classification is considered a 'green' innovation.

Our results based on green patents are, however, limited to a small sample of firms engaged in developing environmentally friendly technologies. Furthermore, some green innovations and investments are not patentable, as firms may choose to keep them as trade secrets. Therefore, our second approach utilizes data on green grants from the Bisnote database, which compiles publicly available information on all projects in Poland funded by European Funds. This database covers over 45,000 companies, all of which have acquired funding for over 100,000 unique projects aligned with EU priorities. Each project in the database is detailed with identifiers, project titles, funding amounts, start and end dates, operational programs, and priority axes.

To identify green grants, we filter projects based on the thematic priority axes of European Funds. These axes represent strategic areas where funding is allocated to achieve policy objectives like environmental protection and sustainable development. Specifically, we focus on four of the twenty-eight priority axes that directly support environmental sustainability. Through this process, we identify 15,690 green grant projects allocated to 6,953 firms. Around 15% of the total grants from European Funds are directed toward green initiatives, reflecting the EU's strategic focus on sustainability. We then aggregate the number of green grants by firm and project start date, allowing us to observe how many green grants a firm receives in a

given period. Next, we match the green grant database with our bank-firm-level data using the firm's unique REGON identifier. This matching process enables us to link 5,002 firms, of which 647 received EU green funding aimed at fulfilling EU priorities. Since our primary database should capture the universe of EU-financed grants, we assign zero values to firms that we were unable to match.

[Table 12]

In Panel A of Table 12, we rerun our baseline model with a triple interaction term between a firm's brown sector affiliation, a loan from a SOB, and the presence of green patent applications (*SOB* × *CPRS* × *PATENT*). The estimation results in Column (1) suggest that firms with more green patent applications receive less bank funding overall—indicating that innovation may be better financed through internal equity (retained earnings) or external private equity and venture capital (PEVC) sources. Interestingly, firms in brown sectors with green patent applications appear to receive somewhat more bank financing than brown firms without green patent applications; however, this result is only significant at the 10 percent level. Importantly, the triple interaction term in Column (2) is insignificant, suggesting that our results are not strongly influenced by SOBs lending to firms actively pursuing greener initiatives.

In Panel B of Table 12, we present the estimation results for EU green grants. In Column (1), we find that firms with green grant projects do not receive more financing from banks, nor do firms in brown sectors with green grant projects. We note that the triple interaction term (*SOB* × *CPRS* × *GRANT*) is insignificant, regardless of whether we use industry-time (Column 2) or firm-time fixed effects (Column 3), alleviating concerns that SOBs may be lending to high emitters to support their transition to a greener economy. Taken together, the results above suggest it is unlikely that SOB lending to brown firms is primarily driven by support for greening projects.

4.3.2. Default rates and brown lending

In the mechanism section, we show that state-owned banks allocate more credit to climate-policy-relevant sectors, where borrowers tend to have higher leverage and lower returns on assets. This pattern suggests that state-owned banks may have a greater appetite for risk or weaker lending standards, aligning with previous evidence on public ownership and credit allocation (Barry et al., 2011; Cornett et al., 2010; Cull & Xu, 2000). An alternative explanation for these findings is that state-owned banks employ more rigorous screening and monitoring, allowing them to expand their market share among riskier borrowers without incurring

disproportionately higher credit losses. To test this alternative hypothesis, we replace the loan volume in Equation (1) with a dummy variable that takes the value of one if a bank classifies any loan to a given firm as defaulted. This approach enables us to assess whether loans from state-owned banks—particularly those directed to climate-policy-relevant borrowers—are indeed associated with greater credit risk realizations and financial costs of credit. The linear probability model results are presented in Table 13.

[Table 13]

In Column 1, we find that loans issued by state-owned banks display a higher likelihood of default than those issued by private-owned banks, and that credit extended to firms in climate-policy-relevant sectors also exhibits an elevated risk of default. In Column 2, the interaction term between state ownership and lending to climate-policy-relevant firms is statistically insignificant, suggesting that state-owned banks do not appear to manage climate-sensitive exposures any differently than they manage their non-climate portfolios. Finally, Column 3 indicates that the quality of loans to CPRS firms deteriorates more sharply at state-owned banks than private banks after the Paris Agreement, implying that increased credit provision to carbon-intensive borrowers—particularly those with weaker fundamentals—ultimately entails a heightened default probability. Overall, these patterns challenge the hypothesis that state-owned banks outperform private banks in managing climate-related credit risk.

4.3.3. Lending rates and brown premium

Another alternative hypothesis for our finding that state-owned banks (SOBs) extend a greater share of credit to climate-vulnerable borrowers is that SOBs make such allocations intentionally and get compensated by charging higher interest rates. In other words, SOBs may recognize the elevated transition risk in their loan portfolios and manage it by incorporating an additional risk premium for expected loss into the interest rates.

Since our dataset does not provide direct observations of interest rates at the loan level, we compute an effective interest rate following the approach outlined by Jensen and Johannsen (2017) and Cucić, Iyer, Kokas, Peydró, and Pica (2024). Specifically, we use annual firm balance sheet and income statement data to calculate the ratio of each firm's total interest payments to its liabilities. This measure serves as a proxy for the effective interest rate on a firm's loan (*eir*). Next, we aggregate our bank-firm level data to the firm level and construct a weighted average measure capturing the proportion of state-owned bank credit in a firm's

overall bank credit in a given year. We then regress the effective interest rate on the share of SOB credit, controlling for various firm-level characteristics and including firm and industry-time fixed effects. Table 14 reports the corresponding estimates.

[Table 14]

In Column 1, we find that lending by SOBs is, on average, more expensive for firms than credit provided by privately owned banks, consistent with the hypothesis that SOBs conduct greater risk-shifting than private banks—or compensate for their greater operational inefficiency. In Column 2, we interact the share of SOB credit with an indicator for firms operating in climate-policy-relevant sectors (*CPRS* × *share SOB*). This interaction term is statistically insignificant, suggesting that, relative to private-owned banks, SOBs do not impose an additional interest premium on CPRS borrowers compared with non-CPRS borrowers. In other words, while SOB credit is generally costlier, we don't find any evidence of an extra risk-based markup targeting brown borrowers and compensating for climate risk. Column 3 introduces a triple interaction to examine whether SOBs adjusted their pricing differently for CPRS borrowers following the Paris Agreement (i.e., a policy shock). The triple-interaction term is statistically insignificant, suggesting that SOBs did not adjust their pricing strategy for climate-related exposures relative to POBs after the Paris Agreement. Overall, SOBs do not appear to add a higher risk surcharge for lending to climate-sensitive borrowers following the green policy shock.

Although these effective interest rates are inferred measures rather than precise loan-specific rates—and thus should be interpreted with appropriate caution—our results do not support the conjecture that state-owned banks mitigate their higher climate-related risk exposures by charging correspondingly higher interest premiums.

5. Conclusion

This paper studied the role of bank ownership in bank lending allocation. It focused on the differential effect of state versus private ownership on lending allocation to brown versus non-brown firms. We found that, after the Paris Agreement, state-owned banks—banks directly or indirectly controlled by the government—increased lending to brown firms in risky climate-policy relevant sectors compared with private banks. This result survived a battery of robustness test. Delving deeper into the transmission mechanism behind the result revealed that state owned banks may lend to brown firms for at least two reasons. One, state-owned banks lend overall to financially riskier firms with higher leverage and lower return on assets—most likely because SOBs engage in greater risk-shifting and/or are less risk sensitive in their lending standards including to green transition risks. Two, state-owned banks are more politicized and

that enabled the state to direct their lending to strategically and socially important firms in sectors with greater transition risk. Also for this reason, state-owned banks lend more to state-owned enterprises that, have a higher propensity to operate in brown sectors. In an extension, we also highlight that firms receiving a greater share of loans from SOBs achieve lower reduction in GHG emissions and SOBs thus hinder the economic transition to net zero.

Our results have important policy implications for decisionmakers in countries with a similar context of state-owned banking, brown industries, and state ownership of firms. State-owned banks must be governed with appropriate degree of independence and greening of their lending should be one objective against which the performance of the banks is evaluated. Independent professional management responsible for good financial performance and also environmental impact would enable state banks to consider green transition risk in overall credit risk management—at least to the extend the private banks do so. Furthermore, the state bank ownership function can use performance contracts with the independent management of state-owned banks to lean forward on strategic leadership in green lending and crowd in also private capital and thus better reflect its commitment to achieving NDC goals.

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Figure 1: Banking sector credit exposures to climate policy relevant sectors

The figure below shows banks' credit exposure to climate policy-relevant sectors (*CPRS*), using data on large exposures and the statistical classification of economic activities applicable in the European Union (NACE Rev. 2). Climate policy-relevant sectors are defined according to the methodology presented by Battiston et al. (2017, 2021).

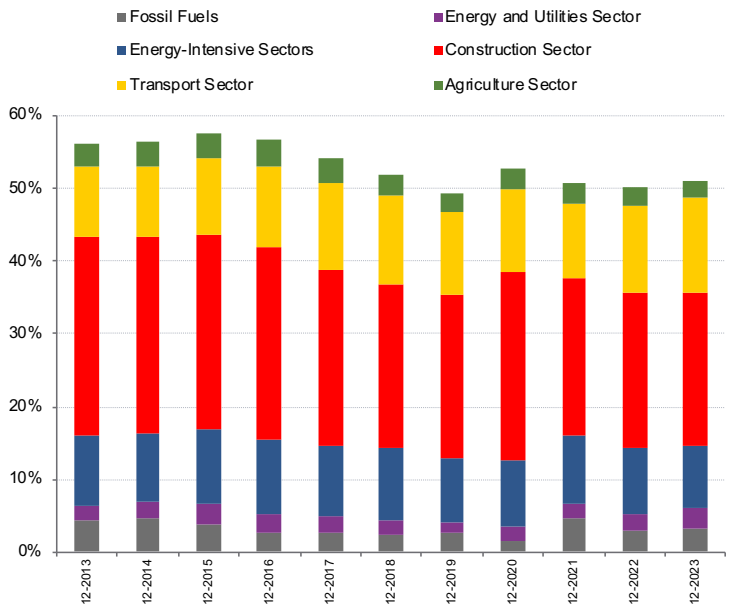

Figure 2: Dynamic treatment effect of the Paris Agreement

The figure displays the dynamic treatment effect of the Paris Agreement on the logarithm of credit, along with 95% confidence intervals. The point estimates represent the coefficient estimates from the dynamic DiD analysis, where relative year dummies are interacted with the CPRS dummy.

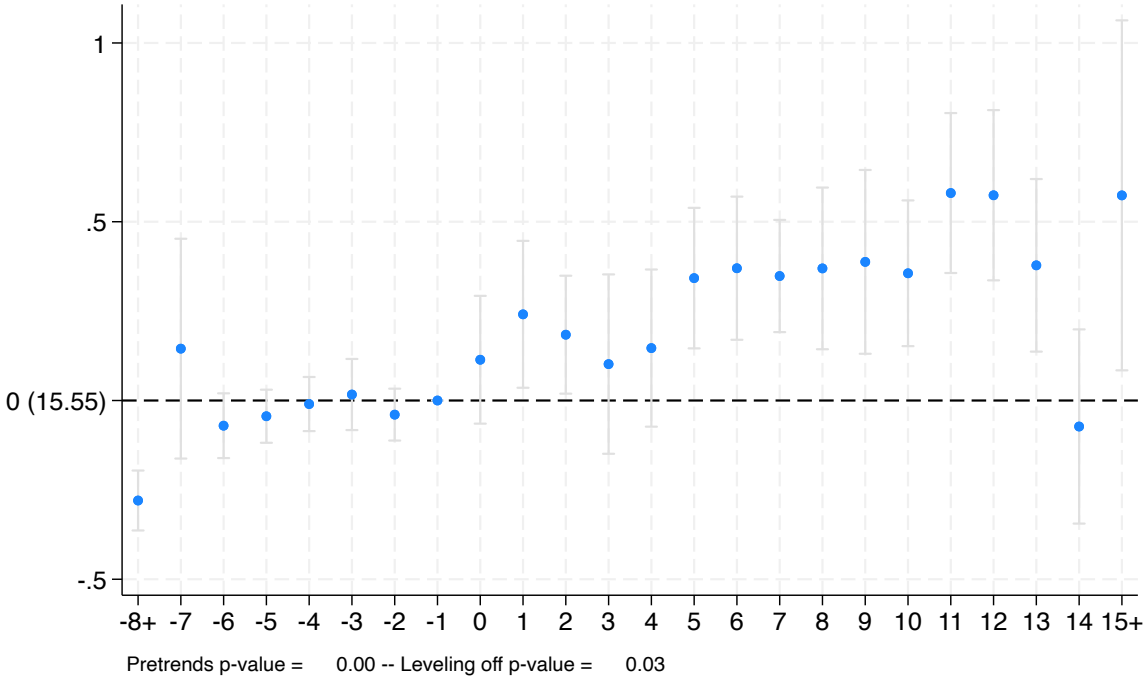

Figure 3: Marginal effects of SOBs' lending on GHGs

This figure illustrates the marginal effect of loan exposure on greenhouse gas (GHG) emissions as a function of the share of state-owned bank (SOB) credit.

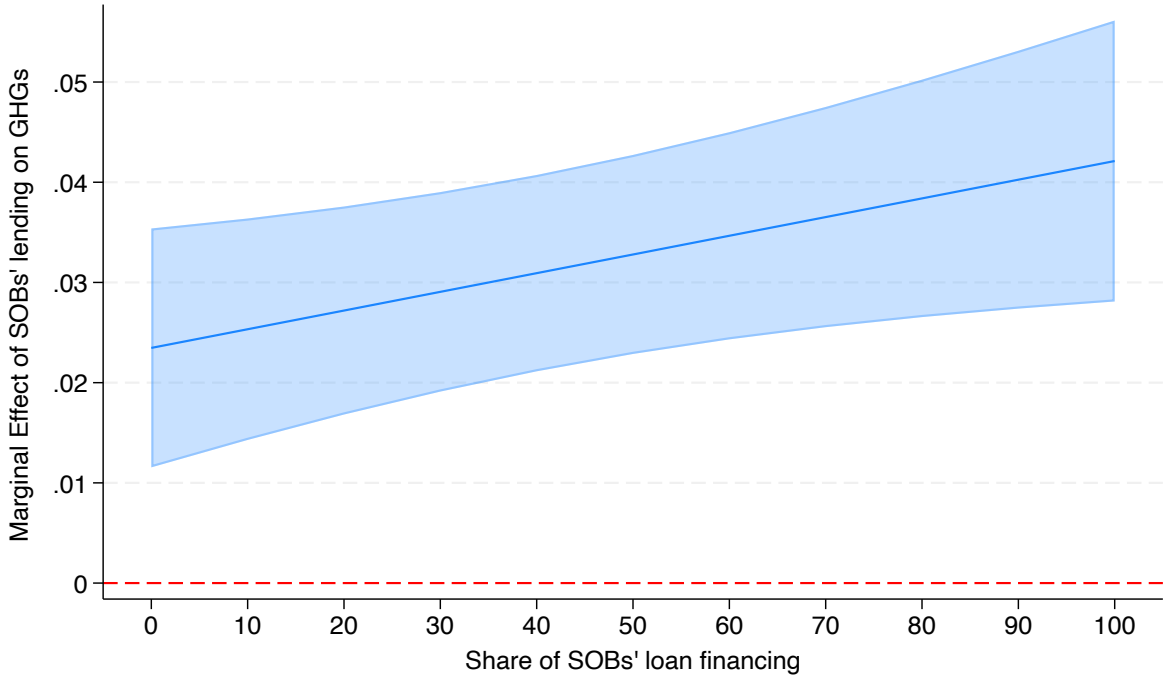

Table 1: Descriptive statistics

Panel A of the table presents summary statistics of the variables used in the main empirical specifications. Panel B shows the mean comparison test (t-test) between privately owned banks (POBs) and state-owned banks (SOBs). These descriptive statistics are based on an estimation sample comprising 39 unique banks and 41,438 companies over the period 2013:Q4–2023:Q4. Definitions of the variables and their sources are provided in Appendix Table A1.

Panel A: Summary statistics

	N	Mean	SD	p25	Median	p75
LOAN	854,779	14.44	1.78	13.59	14.45	15.46
CPRS	854,779	0.14	0.35	0.00	00.0	00.0
ASSETS	854,779	23.69	0.24	23.71	23.71	23.71
ROA	854,779	0.76	0.64	0.38	0.90	1.18
NPL	854,779	7.20	4.41	4.30	6.12	8.22
CET1R	854,779	15.98	4.13	13.30	15.83	17.90
CTI	854,779	56.55	12.47	48.91	53.16	62.01
DEPOSITS	854,779	67.48	17.25	65.37	71.73	77.47
LIQUIDITY	854,779	20.49	6.62	16.19	19.64	23.91
lnassets	854,779	19.02	1.23	18.13	19.07	20.10
debt ratio	854,779	63.33	48.14	43.11	60.39	76.05
roa	854,779	5.62	15.08	0.95	4.26	9.98
cash	854,779	6.58	9.66	0.88	2.90	8.16
asset turnover	854,779	182.73	162.6	78.31	150.07	239.85
tangibility	854,779	36.09	27.28	12.26	31.98	55.51
lntrade credit	854.779	1,680.34	175.7	1,585.34	1,703.68	1,817.52

Panel B: Difference-in-means test

	POBs	SOBs	Difference
LOAN	14.44	14.46	-0.02***
CPRS	0.14	0.14	0.00***
ASSETS	23.68	23.71	-0.03***
ROA	0.74	0.81	-0.07***
NPL	6.74	8.36	-1.62***
CET1R	15.37	17.50	-2.13***
CTI	58.00	52.95	5.05***
DEPOSITS	67.63	67.10	0.54***
LIQUIDITY	21.30	18.47	2.82***
lnassets	19.04	18.96	0.09***
leverage	63.49	62.92	0.57***
roa	5.89	4.96	0.93***
cash	6.39	7.04	-0.65***
asset_turnover	188.77	167.74	21.03***
tangibility	34.47	40.11	-5.64***
lntrade_credit	1691.16	1653.50	37.66***

Table 2: The nexus between SOB and CPRS

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable represents the logarithm of total loan volume to non-financial corporations at the bank-firm level. SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. All regressions include control variables and various sets of fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Loan	(2) Loan	(3) Loan	(4) Loan	(5) Loan
CPRS	-0.098**	-0.161***	-0.170***	-0.177***	
	(0.044)	(0.036)	(0.035)	(0.034)	
SOB	-0.056	-0.089	-0.045	-0.029	-0.004
	(0.092)	(0.088)	(0.050)	(0.078)	(0.039)
CPRS × SOB		0.237**	0.262***	0.269***	0.217***
		(0.098)	(0.090)	(0.078)	(0.071)
ASSETS			-0.355***	-0.216**	-0.168**
			(0.098)	(0.083)	(0.066)
ROA			-0.100	-0.086	0.023
			(0.072)	(0.081)	(0.033)
NPL			-0.012**	-0.003	-0.011**
			(0.006)	(0.007)	(0.004)
CET1R			0.010	0.003	0.006
			(0.007)	(0.007)	(0.005)
CTI			-0.003	-0.004	0.000
			(0.003)	(0.003)	(0.001)
DEPOSITS			-0.005***	-0.000	-0.004***
			(0.002)	(0.002)	(0.001)
LIQUIDITY			0.008*	0.004	0.004*
			(0.004)	(0.005)	(0.002)
lnassets				0.667***	0.000
				(0.025)	(0.000)
leverage				0.007***	0.000
				(0.001)	
roa				-0.001***	
				(0.000)	
cash				-0.023***	
				(0.003)	
assets turnover				-0.000	
				(0.000)	
tangibility				0.004***	
				(0.000)	
lntrade credit				-0.001***	
				(0.000)	

Observations	965,379	965,379	854,779	854,779	325,568
Banks	41	41	39	39	39
Firms	43,407	43,407	41,438	41,438	11,314
Adj. R-squared	0.030	0.031	0.040	0.223	0.326
Industry × time FE	Yes	Yes	Yes	Yes	No
Firm × time FE	No	No	No	No	Yes

Table 3: The effects of Paris Agreement on the nexus between SOB and CPRS

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable represents the logarithm of total loan volume to non-financial corporations at the bank-firm level. SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. PARIS is a dummy variable equal to 1 after the Paris Agreement announcement in December 2015, and 0 otherwise. All regressions include control variables and various sets of fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Loan	(2) Loan	(3) Loan
CPRS	-0.056***	-0.083***	
	(0.019)	(0.020)	
SOB		0.157***	0.222***
		(0.054)	(0.041)
PARIS	0.000	0.000	
	(0.000)	(0.000)	
CPRS × SOB		0.159***	0.011
		(0.051)	(0.098)
CPRS × PARIS	-0.033	-0.099***	
	(0.035)	(0.022)	
SOB × PARIS		-0.165*	-0.193***
		(0.082)	(0.050)
CPRS × SOB × PARIS		0.169**	0.268***
		(0.076)	(0.068)
Observations	549,294	549,294	215,922
Banks	38	38	38
Firms	34,776	34,776	9,274
Adj. R-squared	0.245	0.246	0.324
Bank controls	Yes	Yes	Yes
Firm controls	Yes	Yes	No
Industry × time FE	Yes	Yes	No

Table 6: Mechanism: The nexus between SOB, CPRS and SOE

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable represents the logarithm of total loan volume to non-financial corporations at the bank-firm level. SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. SOE is a dummy variable equal to 1 for firms directly or indirectly controlled by the government, and 0 otherwise. Columns (1) and (2) present results for the full sample. Columns (3) and (4) show results for pre- and post-Paris Agreement periods, respectively. All regressions include control variables and industry-time fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	Loan	Loan	Loan	Loan
CPRS	-0.176***	-0.174***	-0.080***	-0.178***
	(0.035)	(0.036)	(0.023)	(0.039)
SOB	-0.033	-0.032	0.168**	-0.011
	(0.077)	(0.077)	(0.066)	(0.057)
SOE	-0.437***	-0.394***	-0.449**	-0.402***
	(0.100)	(0.103)	(0.137)	(0.126)
CPRS × SOB	0.264***	0.256***	0.148**	0.309***
	(0.074)	(0.074)	(0.049)	(0.054)
SOB × SOE	0.608**	0.494	0.664**	0.521*
	(0.297)	(0.296)	(0.229)	(0.264)
CPRS × SOE	0.096	-0.142	-0.384	-0.015
	(0.191)	(0.299)	(0.579)	(0.348)
CPRS × SOB × SOE		0.555*	0.345	0.756*
		(0.321)	(0.618)	(0.401)
Observations	854,779	854,779	177,691	371,603
Banks	39	39	38	33
Firms	41,438	41,438	22,838	29,955
Adj. R-squared	0.224	0.224	0.257	0.242
Bank controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Industry × time FE	Yes	Yes	Yes	Yes

Table 5: Mechanism: The impact of politization on the nexus between SOBs and CPRS.

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable represents the logarithm of total loan volume to non-financial corporations at the bank-firm level. SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. POLITICIZATION is a measure that quantifies the level of political influence in SOBs by calculating the proportion of party loyalists/politicians on SOB boards. Columns (1) and (4) show full sample results. Columns (1) and (2) present results for the full sample. Columns (3) and (4) show results for pre- and post-Paris Agreement periods, respectively. All regressions include control variables and industry-time fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Loan	(2) Loan	(3) Loan	(4) Loan	(5) Loan
CPRS	-0.105**	-0.105**	-0.153***	-0.044	-0.154***
	(0.047)	(0.047)	(0.044)	(0.034)	(0.050)
SOB	0.048	-0.062	-0.073	0.150***	-0.082
	(0.074)	(0.122)	(0.112)	(0.043)	(0.135)
POLITIZATION	-0.226	-1.978**	-1.793**	-1.277***	-2.163***
	(0.220)	(0.806)	(0.824)	(0.345)	(0.665)
CPRS × SOB			0.102	0.083**	0.160
			(0.100)	(0.028)	(0.109)
SOB × POLITIZATION		2.174**	1.874**	0.891	2.382**
		(0.896)	(0.906)	(0.497)	(0.832)
CPRS × POLITIZATION			-1.197***	-1.358***	-1.306
			(0.414)	(0.218)	(0.772)
CPRS × SOB × POLITIZATION			1.930***	2.074***	2.084**
			(0.521)	(0.358)	(0.912)
Observations	854,779	854,779	854,779	177,691	371,603
Banks	39	39	39	38	33
Firms	41,438	41,438	41,438	22,838	29,955
Adj. R-squared	0.223	0.224	0.225	0.258	0.244
Bank controls	No	No	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Industry × time FE	Yes	Yes	Yes	Yes	Yes

Table 6: Mechanism: Financial constraints and risk-shifting channel

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable represents the logarithm of total loan volume to non-financial corporations at the bank-firm level. SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. Leverage is defined as the ratio of total liabilities to total assets, while roa is calculated as earnings before interest and taxes divided by total assets. Columns (1) and (4) show full sample results. Columns (2)-(3) and (5)-(6) present pre- and post-Paris Agreement periods, respectively. All regressions include control variables and industry-time fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Loan	(2) Loan	(3) Loan	(4) Loan	(5) Loan	(6) Loan
CPRS	-0.208***	-0.178***	-0.193***	-0.169***		
	(0.010)	(0.019)	(0.014)	(0.007)		
SOB	-0.104***	0.150***	-0.070***	-0.013***		
	(0.007)	(0.017)	(0.010)	(0.005)		
CPRS × SOB	0.180***	0.139***	0.241***	0.277***		
	(0.019)	(0.049)	(0.026)	(0.012)		
CPRS × leverage	0.001***	0.002***	0.000			
	(0.000)	(0.000)	(0.000)			
SOB × leverage	0.001***	0.000**	0.001***			
	(0.000)	(0.000)	(0.000)			
CPRS × SOB × leverage	0.002***	0.000	0.001***			
	(0.000)	(0.001)	(0.000)			
CPRS × roa				-0.001***	-0.004***	0.001**
				(0.000)	(0.001)	(0.001)
SOB × roa				-0.003***	0.000	-0.002***
				(0.000)	(0.001)	(0.000)
CPRS × SOB × roa				-0.002**	0.001	-0.006***
				(0.001)	(0.002)	(0.001)
Observations	854,779	177,691	371,603	854,779	177,691	371,603
Banks	39	38	33	39	38	33
Firms	41,438	22,838	29,955	41,438	22,838	29,955
Adj. R-squared	0.224	0.256	0.242	0.224	0.256	0.242
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry × time FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Extensive margin: new and terminated lending relationships of SOBs

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variables are defined as follows: Entry is a dummy variable equal to 1 if a bank establishes a lending relationship with a firm in a given period but did not have one in the prior period. Conversely, Exit is defined as a dummy variable equal to 1 if a bank does not have a lending relationship with a firm in a given period but had one in the prior period. SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. PARIS is a dummy variable equal to 1 after the Paris Agreement announcement in December 2015, and 0 otherwise. All regressions include control variables and various sets of fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Entry	(2) Entry	(3) Entry	(4) Exit	(5) Exit	(6) Exit
CPRS	-0.001	-0.002		0.000	-0.002	
	(0.003)	(0.003)		(0.003)	(0.002)	
SOB		0.000			0.000	
		(0.000)			(0.000)	
CPRS × SOB		0.011**	0.014*		0.012**	0.008
		(0.004)	(0.007)		(0.005)	(0.007)
CPRS × PARIS	0.001	0.003	0.000	0.003*	0.007***	0.000
	(0.003)	(0.003)	(0.000)	(0.002)	(0.002)	(0.000)
CPRS × SOB × PARIS		-0.012	-0.014		-0.018***	-0.016*
		(0.008)	(0.010)		(0.006)	(0.009)
Observations	632,709	632,709	260,204	632,709	632,709	260,204
Banks	38	38	38	38	38	38
Firms	36,527	36,527	10,763	36,527	36,527	10,763
Adj. R-squared	0.280	0.280	0.449	0.112	0.112	0.350
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry × time FE	Yes	Yes	No	Yes	Yes	No
Bank × time FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm × time FE	No	No	Yes	No	No	Yes

Table 8: Extensive margin: number of relationships with SOBs and POBs

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variables are time-varying, firm-level measures that capture: the total number of a firm's credit relationships with banks (Column 1); the breakdown of these relationships by bank ownership structure (Columns 2 and 3); the share of a firm's credit relationships with state-owned banks (SOBs) relative to its total relationships with lenders at a given time (Column 4); and the proportion of debt held with state-controlled banks relative to the firm's total bank debt (Column 5). SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. PARIS is a dummy variable equal to 1 after the Paris Agreement announcement in December 2015, and 0 otherwise. All regressions include control variables and various sets of fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) No. of relationships	(2) No. of relationships with SOBs	(3) No. of relationships with POBs	(4) Share of SOBs' relationships	(5) Share of SOBs' relationships
CPRS	0.078***	0.036**	0.042*	1.290	1.215
	(0.023)	(0.016)	(0.023)	(0.997)	(1.032)
CPRS × PARIS	-0.075***	0.021*	-0.096***	1.852**	2.566***
	(0.019)	(0.012)	(0.011)	(0.752)	(0.860)
Observations	549,294	549,294	549,294	549,294	549,294
Banks	38	38	38	38	38
Firms	34,776	34,776	34,776	34,776	34,776
Adj. R-squared	0.245	0.215	0.276	0.276	0.261
Bank controls	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Industry × time FE	Yes	Yes	Yes	Yes	Yes

Table 9: The environmental impact of SOB lending on greenhouse gas emissions (GHG)

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable is the logarithm of the sum of Scope 1 and Scope 2 emissions (ghg). Share SOB is a time-varying firm-level measure representing the share of credit received from state-owned banks (SOBs) relative to the total credit received by each firm. ghg_75 is a dummy variable equal to 1 for firms whose emissions are above the 75th percentile of the sample. Lnloan represents the logarithm of total bank lending to each firm. The regression includes the same firm-level control variables as in our baseline model, along with industry-year fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors are clustered at the firm level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)
	ghg	ghg	ghg
share SOB	-0.000	-0.003**	0.002**
	(0.000)	(0.001)	(0.001)
lnloan	0.031***	0.023***	0.023***
	(0.005)	(0.006)	(0.003)
share SOB × lnloan		0.000**	-0.000**
		(0.000)	(0.000)
ghg_75			2.421***
			(0.165)
ghg_75 × lnloan			-0.020*
			(0.011)
ghg_75 × share SOB			-0.012***
			(0.003)
ghg_75 × lnloan × share SOB			0.001***
			(0.000)
lnassets	0.402***	0.402***	0.140***
	(0.026)	(0.026)	(0.019)
leverage	-0.003***	-0.003***	-0.002***
	(0.000)	(0.000)	(0.000)
roa	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)
cash	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
assets turnover	0.002***	0.002***	0.001***
	(0.000)	(0.000)	(0.000)
tangibility	0.001*	0.001*	0.000
	(0.000)	(0.000)	(0.000)
lntrade credit	0.001***	0.001***	0.000***
	(0.000)	(0.000)	(0.000)
lnrevenues	0.006***	0.006***	0.006***
	(0.000)	(0.000)	(0.000)
Observations	95,536	95,536	95,536
Firms	15,074	15,074	15,074

Adj. R-squared	0.642	0.642	0.795
Firm controls	Yes	Yes	Yes
Industry × time FE	Yes	Yes	Yes

Table 10: The nexus between SOB and brown borrowers

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable represents the logarithm of total loan volume to non-financial corporations at the bank-firm level. SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). GHG is the logarithm of the sum of Scope 1 and Scope 2 emissions. GHG_75 is a dummy variable equal to 1 for firms whose emissions are above the 75th percentile of the sample. All regressions include control variables and various sets of fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Loan	(2) Loan	(3) Loan	(4) Loan
ghg	0.119***	0.097***		
	(0.029)	(0.028)		
SOB	-0.166	-0.594***		
	(0.136)	(0.169)		
SOB × ghg		0.070**		
		(0.034)		
ghg_75 × ghg			0.023**	
			(0.009)	
SOB × ghg_75			-2.507***	-0.925**
			(0.195)	(0.426)
SOB × ghg_75 × ghg_1_2			0.308***	0.108*
			(0.021)	(0.054)
Observations	120,089	120,089	120,089	52,132
Banks	29	29	29	27
Firms	14,545	14,545	14,545	4,144
Adj. R-squared	0.198	0.199	0.198	0.331
Bank controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	No
Industry × time FE	Yes	Yes	Yes	No
Firm × time FE	No	No	No	Yes

Table 11: The environmental impact of SOB lending on EU-ETS firms' GHGs

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable is the logarithm of the sum of Scope 1 emissions for EU ETS firms. Share SOB is a time-varying firm-level measure representing the share of credit received from state-owned banks relative to the total credit received by each firm. ghg_75 is a dummy variable equal to 1 for firms whose emissions are above the 75th percentile of the sample. Lnloan represents the logarithm of total bank lending to each firm. The regression includes the same firm-level control variables as in our baseline model, along with industry-year fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors are clustered at the firm level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) GHG	(2) GHG	(3) GHG
share SOB	0.001	-0.008*	-0.008**
	(0.001)	(0.004)	(0.003)
lnloan	-0.061***	-0.082***	-0.055***
	(0.021)	(0.027)	(0.019)
share SOB × lnloan		0.001**	0.001**
		(0.000)	(0.000)
ghg_75			3.188***
			(0.987)
ghg_75 × lnloan			-0.006
			(0.059)
ghg_75 × share SOB			-0.005
			(0.013)
ghg_75 × lnloan × share SOB			-0.000
			(0.001)
Observations	5,902	5,902	5,902
Firms	280	280	280
Adj. R-squared	0.284	0.287	0.575
Firm controls	Yes	Yes	Yes
Industry × time FE	Yes	Yes	Yes

Table 12: The role of green grants and green patents

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable represents the logarithm of total loan volume to non-financial corporations at the bank-firm level. SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. Patents refers to the number of green patent applications filed by a company. Grants refers to the number of green grants received by a company. All regressions include control variables and various sets of fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Loan	(2) Loan	(3) Loan
Panel A: Green patents			
CPRS	-0.105**	-0.177***	
	(0.048)	(0.034)	
SOB		-0.0288	-0.00319
		(0.078)	(0.039)
CPRS × SOB		0.269***	0.219***
		(0.079)	(0.071)
patents	-0.180**	-0.193***	0
	(0.068)	(0.070)	(0.000)
CPRS × patents	0.193*	0.221*	0
	(0.113)	(0.121)	(0.000)
SOB × patents		0.199	-0.396
		(0.393)	(0.406)
CPRS × SOB × patents		-0.286	-0.266
		(0.482)	(0.473)
Panel B: Green grants			
CPRS	-0.104**	-0.176***	0.000
	(0.048)	(0.035)	(.)
SOB		-0.029	-0.004
		(0.078)	(0.039)
CPRS × SOB		0.268***	0.216***
		(0.078)	(0.070)
grants	0.038	0.016	0.000
	(0.088)	(0.147)	(0.000)
CPRS × grants	-0.309	-0.387	0.000
	(0.267)	(0.337)	(0.000)
SOB × grants		0.053	0.154
		(0.196)	(0.198)
CPRS × SOB × grants		0.321	0.443
		(0.504)	(0.558)
Observations	854,779	854,779	325,568

Banks	39	39	39
Firms	41,438	41,438	11,314
Bank controls	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes
Industry × time FE	Yes	Yes	No

Table 13: Default rates and brown lending

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable represents the defaulted exposure, indicated by a dummy variable that takes the value of 1 if any bank-firm-level exposure is categorized in the default category and 0 otherwise (performing loans). SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. PARIS is a dummy variable equal to 1 after the Paris Agreement announcement in December 2015, and 0 otherwise. All regressions include control variables and various sets of fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Default	(2) Default	(3) Default
CPRS	0.010***	0.008***	0.010***
	(0.003)	(0.003)	(0.003)
SOB	0.022***	0.021***	0.045***
	(0.006)	(0.006)	(0.007)
PARIS			0.000
			(0.000)
CPRS × SOB		0.007	-0.012
		(0.006)	(0.007)
CPRS × PARIS			-0.004
			(0.003)
SOB × PARIS			-0.030***
			(0.009)
CPRS × SOB × PARIS			0.028**
			(0.013)
Observations	854,779	854,779	549,294
Banks	39	39	38
Firms	41,438	41,438	34,776
Adj. R-squared	0.183	0.183	0.187
Bank controls	Yes	Yes	Yes
Firm controls	Yes	Yes	No
Industry × time FE	Yes	Yes	No

Table 14: Lending rates and brown lending

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable is the effective interest rate (eir), calculated as the ratio of a firm's total interest payments to its total liabilities, aggregated at the firm level. Share SOB is a time-varying firm-level measure representing the share of credit received from state-owned banks relative to the total credit received by each firm. PARIS is a dummy variable equal to 1 after the Paris Agreement announcement in December 2015, and 0 otherwise. The regression includes the same firm-level control variables as in our baseline model, along with industry-year fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors are clustered at the firm level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) eir	(2) eir	(3) eir
CPRS	0.051	0.058	
	(0.918)	(0.916)	
share SOB	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
CPRS × share SOB		-0.000	-0.000
		(0.000)	(0.001)
CPRS × PARIS			-0.069**
			(0.028)
share SOB × PARIS			-0.000*
			(0.000)
CPRS × share SOB × PARIS			0.000
			(0.001)
Observations	703,156	703,156	457,042
Firms	39,922	39,922	33,585
Adj. R-squared	0.670	0.670	0.716
Firm controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Industry × time FE	Yes	Yes	Yes

Table A1: Variables

This table reports the definitions and sources of the variables employed in the study.

Variable	Description of Variables	Source
LOAN	Logarithm of bank lending at the bank-firm level	NB300
CPRS	Dummy variable equal to 1 if the firm operates in a climate policy-relevant sector, 0 otherwise	NB300
SOB	Dummy variable equal to 1 if the bank is state-controlled, 0 otherwise	FINREP
SOE	Dummy variable equal to 1 if the firm is a state-owned enterprise, 0 otherwise	GUS
ASSETS	Logarithm of the bank's total assets	FINREP
ROA	Net income to total assets	FINREP
NPL	Ratio of non-performing loans to gross loans	FINREP
CET1R	CET1 capital ratio to risk-weighted assets	FINREP
CTI	Cost-to-income ratio	FINREP
DEPOSITS	Ratio of deposits to total liabilities	FINREP
LIQUIDITY	Ratio of cash and cash equivalents to total assets	FINREP
POLITIZATION	Ratio of party politicians to total board members in SOBs	KRS
lnassets	Natural logarithm of total assets	BISNODE
leverage	Ratio of total liabilities to total assets	BISNODE
roa	Earnings before interest and taxes to total assets	BISNODE
cash	Ratio of cash and cash equivalents to total assets	BISNODE
asset turnover	Ratio of revenues to total assets	BISNODE
tangibility	Tangible assets to total assets ratio	BISNODE
lntrade credit	Logarithm of trade credit	BISNODE
emissions	Logarithm of the sum of Scope 1 and Scope 2 GHGs	TRUCOST
patents	Number of green patent applications filed by a company	ORBIS
grants	Number of green grants received by a company	BISNODE
eir	Ratio of interest expense to total assets	BISNODE

Table A2: Unobserved heterogeneity

This table presents the OLS regression results using data from 2013:Q4 to 2023:Q4. The dependent variable represents the logarithm of total loan volume to non-financial corporations at the bank-firm level. SOB is a dummy variable equal to 1 if the loan is provided by a state-controlled bank and 0 if provided by a privately-owned bank (POB). CPRS is a dummy variable equal to 1 for firms operating in climate-policy-relevant sectors. PARIS is a dummy variable equal to 1 after the Paris Agreement announcement in December 2015, and 0 otherwise. All regressions include control variables and various sets of fixed effects. Detailed definitions of the variables are provided in Appendix 1. Standard errors, clustered at the bank-time level, are reported in parentheses. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1) Loan	(2) Loan	(3) Loan	(4) Loan	(5) Loan
			Panel A: Baseline		
CPRS	-0.173***	-0.183***	-0.561	-0.561	-0.558
	(0.035)	(0.033)	(0.450)	(0.461)	(0.466)
CPRS × SOB	0.259***	0.268***	0.141***	0.141***	0.137***
	(0.074)	(0.049)	(0.018)	(0.018)	(0.018)
Observations	854,746	854,735	848,647	848,647	848,647
Banks	38	38	37	37	37
Firms	41,438	41,435	38,926	38,926	38,926
Adj. R-squared	0.234	0.244	0.666	0.648	0.649
			Panel B: Paris Agreement		
CPRS	-0.083***	-0.074***			
	(0.021)	(0.021)			
CPRS × SOB	0.175***	0.086**	0.085***	0.085***	0.086***
	(0.059)	(0.039)	(0.011)	(0.011)	(0.012)
CPRS × PARIS	-0.097***	-0.118***	-0.108***	-0.108***	-0.106***
	(0.020)	(0.023)	(0.022)	(0.022)	(0.022)
CPRS × SOB × PARIS	0.148*	0.238***	0.199***	0.199***	0.192***
	(0.083)	(0.028)	(0.027)	(0.028)	(0.030)
Observations	549,279	549,265	543,776	543,776	543,776
Banks	37	37	36	36	36
Firms	34,776	34,772	32,422	32,422	32,422
Adj. R-squared	0.255	0.268	0.747	0.747	0.747
Bank controls	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Industry × time FE	Yes	Yes	Yes	Yes	Yes
Bank × time FE	Yes	No	No	No	No
Bank × industry FE	Yes	Yes	No	No	No
Bank × firm FE	Yes	Yes	Yes	No	No
Firm FE	Yes	Yes	Yes	Yes	No