Firm Emissions and Credit Allocation*

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Abstract

Many banks, especially in the EU, are reducing their exposure to firms that are large emitters of greenhouse gases. For the green transition, it is key to know whether this reduction means fewer loans to the entire high-emitting industry or whether it is a shift to greener firms within industries. We focus on this question and further distinguish between active and passive shifts in banks' loan portfolios. We use the US and the EU syndicated loan datasets, as well as the Danish universal bank-firm linked dataset, to conduct a comprehensive empirical investigation of the credit allocation as a function of firm-level emissions. We find evidence of credit reallocation within industries towards greener firms, mainly concentrated in the industries with the highest emissions, especially since the Paris Agreement, and not in the greenest industries. Zooming in on Denmark, we show that most of the credit allocation to greener firms is a response to output shifts (i.e., passive credit reallocation), and there is a continued lack of active credit allocation to the greenest firms. In addition, on the extensive margin, firm-bank relationship formation responds little to firm emissions. Consistent with previous findings, we do not find any substantial impact of Net Zero Banking Alliance (NZBA) membership on banks' credit reallocation to greener firms or industries.

Keywords: climate change, banks, loans, firm-level emission

JEL classification: G21, F21, Q54

*We thank... All errors are ours.

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1 Introduction

Many banks have pledged to reduce their exposure to companies with high levels of greenhouse gas emissions. For instance, Citigroup became a Signatory to the Principles for Responsible Banking (PRB) in 2020, Wells Fargo joined the Net-Zero Banking Alliance (NZBA) in 2021. Goldman Sachs, Bank of America, Morgan Stanley, and JP Morgan have all made similar commitments to a net zero greenhouse gas (GHG) financing target in recent years.[1] The evidence on the effects of these commitments is, to date, mixed. Some recent studies find that banks that have made climate commitments reallocate their funding from high-emission firms and industries to low-emission ones (Kacperczyk and Peydro (2022); Reghezza et al. (2022)), others show opposite or mixed evidence (Mueller and Sfrappini (2022); Bruno and Lombini (2023); Giannetti et al. (2023); Miguel et al. (2024); Hale et al. (2024)). Despite this mixed evidence on the effects of banks' green commitments, there is quite a clear trend of banks gradually reducing their exposure to high-emission firms over time.

If this credit reallocation occurs at the industry level, from high-emission to greener industries, it can be counterproductive to green transition goals due to the rising cost of credit for the industries that need to invest in the greening of their technologies and inputs. Even at the firm level, such reallocation might not be effective. As Hartzmark and Shue (2022) demonstrate, a reduction in financing costs for low-emission firms leads to small improvements in impact, while increasing financing costs for high-emission firms leads to a large negative impact on firms' greening investment. Moreover, Kacperczyk and Peydro (2022) also find that high-emission firms reduce their investments and do not improve their environmental performance when their funding is reduced. An effective financing of green transition will occur if banks reallocate their portfolio towards the firms that are *becoming more green* rather than to firms that are green to begin with.

Thus, it is important to examine *how* credit is reallocated by banks in response to firms' emission intensities and changes in these intensities. Little has been done in answering these questions. Our analysis fills this gap by examining not only between-industry but also within-industry credit allocation in response to firm-level emission intensity and change in this intensity over time. Moreover, we distinguish between passive loan portfolio reallocation that follows changing market shares of firms, from active loan portfolio shifts. We document cross-country evidence using global syndicated lending. We also zoom in onto one of the "greenest" European countries, Denmark, for which we have data that covers the country's universe of firms and banks. In both cases, our analysis is conducted at loan level, using emissions reported by S&P Global Trucost. For the syndicated loans our sample period is 2010-2022, while for Danish data it is 2003-2019.

We find that on the global syndicated loan market, within-industry credit reallocation is mainly concentrated in the industries with highest emissions, especially since the Paris Agreement, not in the greenest ones. However, firm emissions' impact on credit varies by credit outcome and across

[1] However, many of them backed out of the Net Zero Banking Alliance and other commitments in early 2025.

countries. We also find that membership in the NZBA does not make a bank more likely to lend to the greenest firms in an industry or shift loans to the greener industries.

For Denmark, we find that banks are reallocating credit from higher-emitting to greener industries, to greener firms within industries, especially during the post-Paris period. However, most of this reallocation occurs within already-green industries, in contrast with our syndicated loan findings. We do not observe credit reallocation towards firms that are reducing their emissions, except in already-green industries post Paris. When decomposing credit reallocation into active shifting to greener and greening firms versus passive shifting, we find an active credit reallocation from the firms with the highest emissions to the middle-ranged firms and a lack of active credit allocation to the greenest firms. That said, most of the credit allocation to greener firms is passive credit reallocation in response to output shifts to greener firms.

This paper makes two distinct contributions. First, it enriches our understanding of how bank credit allocation has changed, between and within industries, in response to firms' greenhouse gas emissions levels and dynamics. Our result reveals banks' strategies to decarbonize their loan portfolios: banks do screen firms for their climate risks within industries in the most recent decade; however, whether they do this for firms in green industries or for brown industries varies by country. Our second main contribution lies in the use of data on the universe of firms and banks in Denmark to gain a more complete picture of firm emissions, bank credit reallocation, and bank-firm relationships. We distinguish active bank credit reallocation in response to firms' emissions from passive credit reallocation in response to firms' output changes. We also study bank-firm relationship formation and dissolution over time due to climate risk considerations.

Our paper contributes to the literature on climate risks and bank credit allocation, where the empirical findings are rather mixed. Bruno and Lombini (2023) find that banks in the global syndicated loan market do not adjust credit supply to account for higher climate transition risk after the Paris Agreement. Giannetti et al. (2023), using European banks' portfolio data, show that banks extend a higher volume of credit to browner borrowers, without charging higher interest rates or shortening debt maturity. In contrast, Kacperczyk and Peydro (2022) find that banks tend to reallocate credit away from high-emission firms using syndicated loan data and European bank lending data, respectively. Other papers have found mixed evidence depending on different factors. For instance, Mueller and Sfrappini (2022) show that banks reallocate credit to high-emission firms in the US but low-emission firms in Europe due to different regulatory environments. Miguel et al. (2024) find that after incorporating environmental risks in their capital assessments, large Brazilian banks reallocate their lending away from high-emission sectors, while smaller banks expand their lending to those sectors. All of the above papers do not distinguish banks' possible strategies in shifting credit between industries versus between firms within industries.

Two recent papers are closely related to our analysis. Mésonnier (2021), using French lending data, finds evidence that higher levels of self-reported climate commitments by banks are associated with a slower growth of lending to large firms in the five most carbon-intensive industries but do not

affect their lending to small and medium-sized enterprises. This paper, like ours, also distinguishes firms' characteristics within industries to examine banks' lending, but it focuses on firm size and lending in France only. Our paper focuses on firms' emission characteristics and has a much broader geographic coverage.

The second closely related paper is Hale et al. (2024). Using also syndicated loan data with global coverage, they find no substantial divestment of banks that made climate commitments from high-emission industries, and only find a limited decline in maturities of loans to firms in these industries. Since their focus is on bank credit allocation changes *across* industries. Our paper differs in that we examine credit allocation *across* firms *within* industries, and we believe that the latter would be more instrumental in achieving green transition goals than the former. Our use of Danish firm-bank-loan data also allows us to examine all the margins of credit adjustment more thoroughly.

We begin our analysis with cross-country evidence from the US and the EU, and then dive into an analysis of Demark using its universal firm-bank data. For each section, we provide the corresponding data description, empirical strategies, and results. Section 4 concludes.

2 Cross-Country Evidence

In this section, using the universe of all US and EU loans from the global syndicated loan market as contained in Dealscan and TruCost firm-level emission data, we examine how bank credit allocation has or has not changed in response to firm emissions, especially within-industry and between-industry.

2.1 Data and Descriptive

This section describes the datasets used in the cross-country analysis. Our sample period is 2010-2022.

2.1.1 Syndicated Loan

This dataset contains comprehensive information on the universe of all loans from the global syndicated loan market as contained in Dealscan. First, we obtain all observations available in the Dealscan data set from 2010 to 2022. We restrict the analysis to loans arranged by banks (rather than other financial institutions) to borrowers in the non-financial sector. Furthermore, we only include loans to borrowers for whom we find firm annual balance-sheet variables in Compustat and emission data in Trucost.[2]

[2]We distinguish between bank and non-bank lenders using the classification in the existing literature (Aldasoro et al., 2023; Elliott et al., 2021).

We merge loan-level data with firm-level emissions data in Trucost in two steps. We first do an exact merge using the borrowers' gvkey and company name using the Chava and Roberts (2008) Dealscan-Compustat link. We then use multi-variable fuzzy matching techniques for the unmatched firms by approximately matching the borrower name and borrower parent name in Dealscan to entity names in Dealscan. We use SIC 2-digit classification for the industrial classification of the borrower.

The resultant sample consists of 117155 loan-level observations with emission intensity data across 3562 firms and 1662 banks in 74 countries.

2.1.2 Emission Intensity

To measure firm-level emission intensity, we use S&P TruCost data. This dataset contains standardized climate and environmental data on more than 15,000 companies around the world. It contains Scope 1, Scope 2, and Scope 3 carbon emissions for each firm in the sample. Trucost uses a variety of publicly disclosed sources to collect the data, such as company financial reports (annual reports, financial statements, 10-K/20-F reports, SEC/regulatory filings), environmental data sources (corporate social responsibility [CSR], sustainability, or environmental reports, the CDP, EPA filings), and data published on company websites or other public sources. In the absence of reported data, Trucost uses its environmentally extended input-output (EEIO) model that combines industry-specific environmental impact data with input-output sectoral data to estimate firm emissions.

In particular, we use TruCost carbon intensity metric for our firm-level emission intensity measure. This metric captures the quantity of GHG emissions (e.g., tonnes of carbon dioxide equivalent [tCO2e] emissions) as a ratio of a company's annual consolidated revenues in millions of U.S. dollars. While TruCost provides information on firm-level emission intensity, it is necessary to account for emissions per unit of real output. Therefore, we reconstruct the emission intensity variable by estimating the ratio of total emissions to real revenue, i.e., total revenue of the firm deflated the country and year-specific GDP deflator. Now we describe the specific emission intensity measures we use for each of our analyses.

For general analysis

In our general analysis across firms, we use the following emission intensity measures:

$$EI_{ijt} = \frac{Firm\ emission_{ijt}}{Real\ value\ added_{ijt}} \tag{1}$$

$$\Delta EI_{ijt-1} = EI_{ijt} - EI_{ijt-1} \tag{2}$$

where EI stands for emission intensity. Notice that we use *real* value added to normalize the emissions. Since a company's real value added can be reasonably correlated with its scale of operations, at least within a sector, we believe it is a suitable normalizing factor.

For within-industry analysis

To capture a firm's emission intensity standing relative to other firms' within its industry, we construct a new metric called *Relative Emission Intensity (REI)* as follows:

$$REI_{ijt} = \frac{log(EI_{ijt}) - \sum_{i}^{i \in j} log(EI_{ijt})/N_{jt}}{Standard\ deviation\ of\ log(EI_{ijt})} \tag{3}$$

$$\Delta REI_{ijt-1} = REI_{ijt} - REI_{ijt-1} \tag{4}$$

where $log(EI)$ follows a normal distribution within an industry and N is the number of firms in the industry in the sample. REI essentially is a standard score of a firms' emission benchmarked within its own industry.

For between-industry analysis

In our analysis across industries, we use the following metric for industry-level emission intensity:

$$EI_{jt} = \frac{Industry\ emission_{jt}}{Real\ value\ added_{jt}} \tag{5}$$

$$\Delta EI_{jt-1} = EI_{jt} - EI_{jt-1} \tag{6}$$

We calculate industry emissions as the sum of the total emissions across all firms in a SIC 2-digit industry. Industry emission intensity is then calculated as the ratio of industry emissions to the real industry revenue.

Summary statistics for these measures and our control variables are included in Table 1.

Table 1: Summary Statistics

Variable	Mean	Median	S.D.	Min	Max
Loan Amount (USD million)	2637.48	1350.00	4548.00	0.25	75000.00
Scope 1 Emission Intensity	50349.11	2594.22	192820.01	0.00	4077616.24
Scope 2 Emission Intensity	6318.35	2305.50	16565.51	0.00	434113.58
Scope 1 Emission Intensity (Industry-level)	41510.14	5739.36	81906.15	7.30	539501.70
Scope 1 Emission Intensity (Industry-level)	5274.23	3292.31	5835.64	35.55	54166.56
Total Assets (USD)	690809.17	13301.97	7804746.93	34.56	351958000.00
Leverage Ratio	0.35	0.33	0.19	0.00	12.95
EBITDA/Total Assets	10.77	10.03	7.27	-192.26	94.89
Capex/Total Assets	0.37	0.30	0.27	0.00	1.60

2.2 Empirical Strategy and Results

We first describe a general analysis across all firm-bank pairs in our sample without distinguishing within- and between-industry effects. Then, we dig deeper into whether banks have been reallocating credit within an industry and whether they have been shifting credit towards greener industries. While both types of credit reallocation could reduce emissions, we believe that the former behavior could finance the greening transition of brown industries making the most effective reduction in emissions, while the latter behavior may only marginally reduce carbon emissions from already-green industries and deprive brown industries of credits that are necessary to improve their emission standing.

2.2.1 General Analysis

First, we conduct a general analysis to examine whether banks shift lending from browner firms to greener ones, similar to other papers in the literature. This allows us to compare the results using our data with those in others' works. We use firm-level emission intensities in the US and EU, respectively, and the following specifications:

$$\begin{aligned} Credit\ Outcome_{ijbt} = {} & \beta_1 EI1_{it-1} + \beta_2 EI2_{it-1} + \beta_3 \Delta EI1_{it-1} + \beta_4 \Delta EI2_{it-1} \\ & + \beta_5 EI1_{it-1} PostParis + \beta_6 EI2_{it-1} PostParis + \beta_7 \Delta EI1_{it-1} PostParis \\ & + \beta_8 \Delta EI2_{it-1} PostParis + X'_{it-1}\boldsymbol{\alpha} + \delta_i + \delta_{jt} + \delta_{bt} + \epsilon_{ijbt}. \end{aligned} \tag{7}$$

where i is a firm, b a bank, j an industry, and t a year. The dependent variable is one of the following four credit outcomes of firms: 1) loan amount growth, 2) logged loan amount, 3) new loan with any bank, and 4) first loan with a bank. The first two measures capture the loan amount overall changing margins. The last two measures focus on the extensive margins: loan initiations and new relationship establishment with a bank.

The key explanatory variables are EI_{it-1} and ΔEI_{it-1} (EI for emission intensity), measured as the ratio of a firm's emissions over its real value added and the ratio's change from last year, respectively. Both contain scope 1 as well as scope 2 emissions, separately. The former variable is also lagged by one year in the regressions to capture any possible delayed impact on credit allocation. In addition, we include a Post-Paris year dummy that is equal to 1 for 2016 and onward, otherwise zero, as well as its interaction term with the emission intensity variables to the above specifications to highlight, if any, changes after the Paris Agreement. X' is a matrix of firm characteristic controls over time, including logged total assets for the size of the firm, leverage ratio for indebtedness, capital expenditure ratio for long-term investment, and return on assets (EBITDA over total assets) for performance. δ_i is firm fixed effects, δ_{jt} is industry-year fixed effects, and δ_{bt} is bank-year fixed effects. Robust errors are clustered at the SIC 2-digit level.

Table 2 reports the general analysis for the US and the EU. FOr the US (columns 1-4), being

Table 2: General Analysis: Syndicated Loans - US and EU - Post Paris

	US				EU			
	Amount (Growth)	Log(Amount)	New Loan	First Loan	Amount (Growth)	Log(Amount)	New Loan	First Loan
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	Logit	Logit	OLS	OLS	Logit	Logit
Log (Intensity)$_{t-1}$($Scope1$)	3.075	0.018	-0.032	-0.075	2.914	0.017	0.022	0.102
	(1.762)	(0.019)	(0.061)	(0.062)	(1.900)	(0.019)	(0.045)	(0.059)
Log (Intensity)$_{t-1}$($Scope2$)	-0.943	0.005	-0.063	0.025	3.317	0.017	0.007	-0.058
	(1.691)	(0.011)	(0.037)	(0.032)	(2.170)	(0.020)	(0.059)	(0.063)
Δ(Intensity)$_{t-1}$($Scope1$)	-4.295	-0.019	-0.007	0.028	4.493	0.042**	-0.142*	0.115*
	(2.201)	(0.011)	(0.046)	(0.039)	(3.749)	(0.015)	(0.057)	(0.052)
Δ(Intensity)$_{t-1}$($Scope2$)	-1.066	0.011	-0.049*	-0.051	-0.391	-0.001	0.055	-0.160*
	(2.743)	(0.009)	(0.024)	(0.042)	(2.659)	(0.015)	(0.042)	(0.066)
Log (Total Assets)$_{t-1}$	12.064**	0.169*	0.172	-0.552***	9.872*	0.170***	0.384**	-0.317**
	(3.808)	(0.068)	(0.129)	(0.118)	(4.301)	(0.048)	(0.132)	(0.119)
Leverage Ratio$_{t-1}$	20.533	0.360*	0.462	-0.868	-8.831	-0.234	1.940***	-1.025
	(13.099)	(0.173)	(0.522)	(0.476)	(16.838)	(0.235)	(0.525)	(0.570)
CAPEX/Total Assets$_{t-1}$	-96.489**	-1.290**	-0.444	-1.748*	-37.787	-0.569	0.216	-0.294
	(28.470)	(0.417)	(0.903)	(0.782)	(35.149)	(0.474)	(1.673)	(1.182)
EBITDA/Total Assets$_{t-1}$	0.146	0.002	-0.007*	0.010**	1.015*	0.015*	-0.026	0.008
	(0.225)	(0.004)	(0.003)	(0.003)	(0.445)	(0.006)	(0.019)	(0.019)
Log (Intensity)$_{t-1}$($Scope1$) × Post-Paris	-0.355	-0.001	-0.035	0.090	-2.578	-0.052	-0.050	-0.032
	(2.249)	(0.028)	(0.076)	(0.068)	(2.801)	(0.033)	(0.064)	(0.084)
Log (Intensity)$_{t-1}$($Scope2$) × Post-Paris	0.446	-0.013	0.011	-0.012	-4.396	-0.046	0.031	0.088
	(1.464)	(0.016)	(0.061)	(0.051)	(2.625)	(0.036)	(0.094)	(0.106)
Δ(Intensity)$_{t-1}$($Scope1$) × Post-Paris	5.587*	0.043**	-0.073	0.062	-7.134	-0.009	0.003	0.051
	(2.360)	(0.014)	(0.059)	(0.064)	(3.797)	(0.012)	(0.061)	(0.064)
Δ(Intensity)$_{t-1}$($Scope2$) × Post-Paris	3.032*	0.012	0.099*	0.052	-3.786	-0.008	0.018	0.150
	(1.424)	(0.021)	(0.040)	(0.046)	(2.804)	(0.018)	(0.059)	(0.081)
R^2	0.08475	0.64066			0.16522	0.80714		
Observations	43,996	43,956	41,044	42,635	33,189	33,180	30,111	31,220
Borrower fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Lender-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Industry-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Country-Year fixed effects					✓	✓	✓	✓

brown has no impact on firms' loan amount, growth, initiation, or relationship-building with banks. However, being increasingly brown in scope 2 hurts new loan initiations before Paris agreement but the effect has been reversed after the agreement. Moreover, during post-Paris period, being increasingly brown in scope 1 also increases a firm's loan amount and growth.

For the EU regressions (columns 4-8), since multiple countries are in the EU sample, we have added country-year fixed effects to the EU specifications. The level of emissions again has no impact on loan supply, while the change of emissions has a mixed impact. Being increasingly brown has a positive impact on loan amount and new bank relationship, and a negative impact on new loans. There is no difference before and after Paris agreement.

Overall, the general analysis presents a mixed picture for both the US and the EU, consistent with the findings of previous papers in the literature. Now we dig deeper into the within- and between-industry analyses.

2.2.2 Within-Industry Analysis

This section explores our main question of interest: Do banks shift lending from browner firms to greener firms within an industry? We answer this question using all sample firms, the subsample of brown firms, and the subsample of non-brown firms, for the US and EU, respectively. Here, the brown industries are defined as those whose emission intensity (based on scope 1) is above the 75th percentile of the entire sample, a fixed threshold over the years. We conduct regressions using bank-firm-year level data, as well as bank-industry-year level data.

Bank-Firm Level

We use the following specifications:

$$\begin{aligned} Credit\ Outcome_{ijbt} = {} & \beta_1 REI1_{it-1} + \beta_2 REI2_{it-1} + \beta_3 \Delta REI1_{it-1} + \beta_4 \Delta REI2_{it-1} \\ & + \beta_5 REI1_{it-1} PostParis + \beta_6 REI2_{it-1} PostParis \\ & + \beta_7 \Delta REI1_{it-1} PostParis + \beta_8 \Delta REI2_{it-1} PostParis \\ & + X'_{it-1}\boldsymbol{\alpha} + \delta_i + \delta_{jt} + \delta_{bt} + \epsilon_{ijbt}. \end{aligned} \tag{8}$$

where i is a firm, b a bank, j an industry, and t a year. The key variables are REI_{it-1} and its change from last year ΔREI_{it-1}, where REI stands for relative emission intensity. REI is measured as a standard score:

$$REI_{ijt} = \frac{log(EI_{ijt}) - \sum_i^{i \in j} log(EI_{ijt})/N_{jt}}{Standard\ deviation\ of\ log(EI_{ijt})}$$

Here, a firm's REI is benchmarked against the firms in its own SIC 2-digit industry, instead of the entire universe of firms in a country's economy. These variables capture a firm's emission intensity relative to its own industry. X' is the same matrix of firm characteristic controls over time as in the general analysis. δ_i is firm fixed effects, δ_{jt} is industry-year fixed effects, and δ_{bt} is bank-year fixed effects. Robust errors are clustered at SIC 2-digit industry level.

Table 3 reports the within-industry analysis results for the US (column 1-4). Being brown and increasingly brown has a positive impact on US loan amount, growth, and new loan before the Paris agreement, but the effect has been reversed (partially) after the agreement. Increasing scope 2 emissions also has a negative impact on relationship-building with banks after the Paris agreement.

Columns 5-8 report the within-industry analysis results for the EU. Again, here we have added country-year fixed effects to the above specification. Being brown and increasingly brown has a positive impact on EU loan amount and growth before Paris agreement. After the agreement, relatively high scope 1 emissions in the industry has a negative impact on new loans.

Table 3: Within Industry Analysis - All Firms - US and EU - Post Paris

	US				EU			
	Loan Amount (Growth)	Log(Loan Amount)	New Loan	First Loan	Loan Amount (Growth)	Log(Loan Amount)	New Loan	First Loan
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	Logit	Logit	OLS	OLS	Logit	Logit
Relative Emission Intensity$_{t-1}$($Scope1$)	0.064	0.001*	0.003	-0.002	-0.059	-0.001	0.010	-0.002
	(0.039)	(0.000)	(0.003)	(0.001)	(0.139)	(0.002)	(0.005)	(0.002)
Relative Emission Intensity$_{t-1}$($Scope2$)	-0.042	0.000	-0.001	0.001	0.172**	0.002*	0.004	0.002
	(0.027)	(0.000)	(0.001)	(0.002)	(0.064)	(0.001)	(0.004)	(0.003)
Δ Relative Emission Intensity (Scope 1)	0.086*	0.001**	0.005*	-0.002	-0.020	-0.001	0.009	-0.001
	(0.033)	(0.000)	(0.002)	(0.001)	(0.144)	(0.002)	(0.005)	(0.002)
Δ Relative Emission Intensity(Scope 2)	-0.023	0.000	0.000	0.002	0.228***	0.002	0.007	-0.002
	(0.019)	(0.000)	(0.001)	(0.001)	(0.064)	(0.001)	(0.004)	(0.003)
Log (Total Assets)$_{t-1}$	12.447**	0.161*	0.183	-0.566***	11.446*	0.192**	0.410**	-0.424**
	(4.066)	(0.069)	(0.118)	(0.114)	(4.766)	(0.056)	(0.138)	(0.150)
Leverage Ratio$_{t-1}$	22.351	0.357	0.599	-1.077*	-14.728	-0.301	2.069***	-1.527**
	(13.036)	(0.179)	(0.554)	(0.499)	(18.901)	(0.247)	(0.521)	(0.519)
CAPEX/Total Assets$_{t-1}$	-97.120***	-1.309**	-0.433	-1.610*	-38.825	-0.586	0.097	-0.628
	(27.562)	(0.398)	(0.883)	(0.767)	(35.319)	(0.460)	(1.684)	(1.247)
EBITDA/Total Assets$_{t-1}$	0.136	0.002	-0.007*	0.008*	1.094*	0.016**	-0.019	0.004
	(0.218)	(0.003)	(0.003)	(0.004)	(0.453)	(0.006)	(0.017)	(0.018)
Relative Intensity$_{t-1}$($Scope1$) × Post-Paris	-0.058	-0.001**	-0.003	0.001	0.115	0.001	-0.014**	0.003
	(0.038)	(0.000)	(0.003)	(0.001)	(0.093)	(0.001)	(0.004)	(0.002)
Relative Intensity$_{t-1}$($Scope2$) × Post-Paris	0.057	0.000	-0.001	-0.003	-0.229	-0.002	0.003	-0.005
	(0.056)	(0.001)	(0.002)	(0.002)	(0.143)	(0.002)	(0.003)	(0.005)
Δ Relative Intensity (Scope 1) × Post-Paris	-0.070*	-0.001**	-0.004	0.002	0.064	0.000	-0.009	-0.001
	(0.031)	(0.000)	(0.002)	(0.001)	(0.120)	(0.001)	(0.005)	(0.004)
Δ Relative Intensity (Scope 2)× Post-Paris	0.049	0.000	-0.001	-0.004**	-0.272	-0.002	0.001	-0.001
	(0.038)	(0.001)	(0.002)	(0.002)	(0.149)	(0.002)	(0.005)	(0.005)
R^2	0.09520	0.63250			0.17406	0.79984		
Observations	36,653	37,222	35,392	36,158	30,154	30,674	28,145	28,865
Borrower fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Lender-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Industry-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Country-Year fixed effects					✓	✓	✓	✓

So far, the within-industry results are encouraging for a better green transition in that at least during post-Paris-agreement period US and EU firms' relatively high (growing) emissions in their industries can hurt their loan amount and chance of initiating new loans. Banks appear to have been shifting their credit to cleaner firms within an industry. Now we separate industries into brown and non-brown ones and conduct the within-industry analysis for each separately. Brown (non-brown) industries are those whose SIC 2-digit industry-level emission intensities score in the top (bottom) 25% of the distribution in the US sample and the EU sample, respectively.

Table 4 columns 1-4 report the within-industry analysis for the US brown industries. Being brown and increasingly brown has a positive impact on US brown industries' loan amount, growth, and new loan before Paris agreement. After the agreement, there is an offsetting negative effect on loan amounts only. The effects on firm-bank relationship have mainly been negative for the entire sample period, except for the coefficients on scope 1 emission variables during post-Paris period.

Columns 5-8 report the within-industry analysis for the EU brown industries. Being brown and increasingly brown has positive effects all four credit outcome variables before the Paris Agreement. After the agreement, the effect has been partially reversed on loan amount and new loans.

Overall, there is some good news for the US and the EU in recent years, as banks have been reallocating credit to greener firms within the brown industries, which can promote the greening process of the brown industries. However, the picture for the four credit outcomes are uneven and perhaps the EU has a slightly more promising outcome on loan amount and new loans than the US.

Table 4: Within-Industry Analysis: Brown Industries - US and EU - Post Paris

	US				EU			
	Loan Amount (Growth)	Log(Loan Amount)	New Loan	First Loan	Loan Amount (Growth)	Log(Loan Amount)	New Loan	First Loan
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	Logit	Logit	OLS	OLS	Logit	Logit
Relative Emission Intensity$_{t-1}$($Scope1$)	0.469**	0.004	0.007**	0.004	1.885***	0.024**	-0.003	0.042
	(0.162)	(0.002)	(0.002)	(0.004)	(0.470)	(0.007)	(0.040)	(0.023)
Relative Emission Intensity$_{t-1}$($Scope2$)	-0.045	0.000	0.008**	-0.004**	0.013	0.003	0.129**	-0.067
	(0.110)	(0.001)	(0.002)	(0.001)	(0.270)	(0.003)	(0.047)	(0.092)
Δ Relative Emission Intensity (Scope 1)	0.523**	0.004*	0.008**	-0.001	1.733**	0.024**	-0.005	0.046*
	(0.154)	(0.002)	(0.003)	(0.003)	(0.528)	(0.007)	(0.042)	(0.022)
Δ Relative Emission Intensity(Scope 2)	-0.051	0.000	0.007***	0.001	0.011	0.003	0.135**	-0.076
	(0.095)	(0.001)	(0.002)	(0.001)	(0.373)	(0.002)	(0.049)	(0.091)
Log (Total Assets)$_{t-1}$	-0.145	-0.024	0.799***	-0.623**	13.779	0.061	0.218	-0.299
	(3.506)	(0.069)	(0.083)	(0.195)	(8.313)	(0.077)	(0.368)	(0.371)
Leverage Ratio$_{t-1}$	62.854**	0.738**	0.457	-0.308	68.107	0.872	-2.359	-0.091
	(21.148)	(0.247)	(0.928)	(0.819)	(44.580)	(0.845)	(1.760)	(1.563)
CAPEX/Total Assets$_{t-1}$	-93.631*	-1.184	-2.116	0.156	-77.285	-1.104	0.460	1.986
	(33.618)	(0.604)	(1.562)	(1.492)	(88.837)	(0.734)	(1.934)	(3.760)
EBITDA/Total Assets$_{t-1}$	0.024	0.000	-0.010***	0.006	1.201***	0.021**	-0.022	0.029
	(0.078)	(0.002)	(0.002)	(0.003)	(0.311)	(0.007)	(0.056)	(0.037)
Relative Intensity$_{t-1}$($Scope1$) × Post-Paris	0.034	0.002	-0.006	0.011***	0.095	0.002	-0.050	0.019
	(0.114)	(0.001)	(0.003)	(0.003)	(0.863)	(0.008)	(0.079)	(0.104)
Relative Intensity$_{t-1}$($Scope2$) × Post-Paris	0.032	-0.002	0.002	-0.011***	-0.578	-0.007*	-0.117**	0.002
	(0.124)	(0.001)	(0.002)	(0.003)	(0.292)	(0.003)	(0.039)	(0.016)
Δ Relative Intensity (Scope 1) × Post-Paris	-0.089	0.002	-0.001	0.015**	0.231	0.002	-0.040	0.012
	(0.135)	(0.002)	(0.004)	(0.005)	(0.873)	(0.008)	(0.082)	(0.105)
Δ Relative Intensity (Scope 2)× Post-Paris	-0.039	-0.003*	-0.003	-0.016***	-0.291	-0.007*	-0.126**	0.014
	(0.117)	(0.001)	(0.003)	(0.003)	(0.346)	(0.003)	(0.044)	(0.017)
R^2	0.16464	0.65718			0.27635	0.84783		
Observations	11,788	11,974	10,772	11,165	10,025	10,169	8,426	8,849
Borrower fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Lender-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Industry-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Country-Year fixed effects					✓	✓	✓	✓

Table 5 columns 1-4 report the within-industry analysis results for the US non-brown industries. Being relatively brown within its non-brown industry has a negative impact on firms' first loans (relationship building with banks) before the Paris agreement. But after the agreement, the effect has been reversed. There is no other significant effect on credit. We can conclude that banks have no major credit reallocation according to firm emissions within the non-brown industries. Columns 5-8 report the within-industry analysis results for the EU non-brown industries. We find little impact of emissions on credit within those industries as well.

Table 5: Within-Industry Analysis: Non-Brown Industries - US and EU - Post Paris

	US				EU			
	Loan Amount (Growth)	Log(Loan Amount)	New Loan	First Loan	Loan Amount (Growth)	Log(Loan Amount)	New Loan	First Loan
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	Logit	Logit	OLS	OLS	Logit	Logit
Relative Emission Intensity$_{t-1}$($Scope1$)	-0.035	0.001	0.003	-0.009*	-0.152	-0.003	0.010	-0.001
	(0.083)	(0.002)	(0.004)	(0.004)	(0.170)	(0.003)	(0.006)	(0.003)
Relative Emission Intensity$_{t-1}$($Scope2$)	-0.168	0.000	0.002	0.003	0.094	0.001	0.001	0.002
	(0.202)	(0.002)	(0.005)	(0.003)	(0.061)	(0.001)	(0.006)	(0.004)
Δ Relative Emission Intensity (Scope 1)	-0.019	0.001	0.005	-0.008	-0.088	-0.002	0.009	0.000
	(0.078)	(0.002)	(0.003)	(0.004)	(0.175)	(0.003)	(0.005)	(0.002)
Δ Relative Emission Intensity(Scope 2)	-0.153	0.000	0.002	0.002	0.150	0.001	0.004	-0.002
	(0.191)	(0.002)	(0.005)	(0.003)	(0.085)	(0.002)	(0.005)	(0.004)
Log (Total Assets)$_{t-1}$	22.094***	0.297***	0.064	-0.868***	6.327	0.117*	0.526***	-0.752***
	(4.819)	(0.073)	(0.123)	(0.233)	(3.452)	(0.054)	(0.151)	(0.205)
Leverage Ratio$_{t-1}$	18.811	0.290	0.830	-1.743**	-38.182	-0.586	2.927**	-1.359
	(16.700)	(0.237)	(0.622)	(0.630)	(26.355)	(0.342)	(1.069)	(0.758)
CAPEX/Total Assets$_{t-1}$	-114.111**	-1.515**	0.134	-3.699***	42.995	0.757	1.675	-2.328
	(40.048)	(0.466)	(1.069)	(1.034)	(37.574)	(0.578)	(2.266)	(1.817)
EBITDA/Total Assets$_{t-1}$	1.191**	0.014*	-0.014	0.001	0.263	0.008	-0.025	-0.009
	(0.423)	(0.006)	(0.015)	(0.015)	(0.508)	(0.007)	(0.029)	(0.024)
Relative Intensity$_{t-1}$($Scope1$) × Post-Paris	0.044	-0.001	-0.002	0.008*	0.188	0.002	-0.010	0.002
	(0.086)	(0.002)	(0.004)	(0.004)	(0.134)	(0.002)	(0.005)	(0.003)
Relative Intensity$_{t-1}$($Scope2$) × Post-Paris	0.049	-0.001	-0.003	0.000	-0.032	0.001	0.001	0.003
	(0.205)	(0.002)	(0.006)	(0.004)	(0.201)	(0.002)	(0.006)	(0.009)
Δ Relative Intensity (Scope 1) × Post-Paris	0.036	-0.001	-0.004	0.007	0.103	0.001	-0.008	0.000
	(0.078)	(0.001)	(0.003)	(0.004)	(0.144)	(0.002)	(0.006)	(0.003)
Δ Relative Intensity (Scope 2)× Post-Paris	0.075	-0.001	-0.001	-0.002	-0.079	0.001	-0.002	0.006
	(0.193)	(0.002)	(0.006)	(0.004)	(0.203)	(0.003)	(0.007)	(0.010)
R^2	0.09961	0.64556			0.19719	0.80099		
Observations	24,865	25,248	23,827	24,350	20,129	20,505	18,496	18,843
Borrower fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Lender-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Industry-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Country-Year fixed effects					✓	✓	✓	✓

To summarize, from the bank-firm-year level data, it is encouraging to see that the within-industry credit reallocation is mainly concentrated in the brown industries, not in the non-brown ones. However, firm emissions' impact on credit varies by credit outcome and the US versus the EU, with the latter having a slightly more promising outlook.

Bank-Industry Level

In addition to the bank-firm level analysis, we also conduct bank-industry analysis using the following specification to study within-industry credit reallocation:

$$\frac{Bank\ Loan\ to\ Green\ Firms_{bjt}}{Bank\ Loan_{bjt}} = \beta_1 EI_{jt-1} + \beta_2 EI_{jt-1} \times post\ Paris + \beta_3 EI_{jt-1} \times NZBA + \alpha NZBA + \delta_t + \delta_j + \epsilon_{bjt} \quad (9)$$

for bank b, industry j, and year t. $Bank\ Loan\ to\ Green\ Firms_{bjt}$ is a bank's loan amount to the greenest firms (in the bottom 25% of firm emission intensity) within an industry. This specification

has a different interpretation from the previous within-industry analysis. It examines how the loan share to the greenest firms within an industry varies with the brownness of the industry.

The results are reported in Table 6. Banks have a higher share of greenest firms in the browner industries in the US, but this share has declined after Paris agreement and the Net Zero Banking Alliance (NZBA) has no impact on banks' lending. This is consistent with our previous results using the US bank-firm level data that the credit-greening actions within industries have been happening within the brownest industries, not the greenest industries. EU banks have a lower share of greenest firms in the browner industries and this share has been even lower for NZBA banks and unchanged since the Paris agreement. This result appears contradictory to our previous results using the EU bank-firm level data. Since our previous results have focused on the top 25% most brown and the most green industries in the sample and estimated the linear impact of firm emissions, while the current result has used a continuous measure of industry intensity and focused only on the loan shares to the greenest firms, the difference in results is understandable. Perhaps in the EU, although the brownest industries have experienced credit-greening actions, the other industries have not, especially in terms of getting bank credits to the greenest firms in those industries.

Table 6: Within Industry Analysis: Bank-Industry Level

	loan_ratio_nonbrown		
	All	US	EU
Log (Industry Intensity)$_{t-1}$($Scope1$)	0.001	0.027***	-0.021**
	(0.009)	(0.007)	(0.008)
NZBA	0.111	0.172	0.219*
	(0.075)	(0.087)	(0.097)
Log (Industry Intensity)$_{t-1}$($Scope1$) × NZBA	-0.011	-0.011	-0.021*
	(0.008)	(0.010)	(0.010)
Log (Industry Intensity)$_{t-1}$($Scope1$) × Post-Paris	-0.001	-0.013*	0.011
	(0.005)	(0.006)	(0.013)
R^2	0.07698	0.17639	0.14109
Observations	25,312	9,015	10,618
Year fixed effects	✓	✓	✓
Industry fixed effects	✓	✓	✓

Table 7: Between Industry Analysis (Bank-level loans and Industry Intensity) - US and EU - Post-Paris

	Loan Amount (Growth)	Log(Loan Amount)	New Loan	First Loan	Loan Amount (Growth)	Log(Loan Amount)	New Loan	First Loan
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	Logit	Logit	OLS	OLS	Logit	Logit
Log (Industry Intensity)$_{t-1}$($Scope1$)	5.377*	0.069*	-0.113*	-0.037	-3.674	-0.043	-0.116	-0.017
	(2.435)	(0.030)	(0.053)	(0.064)	(2.642)	(0.037)	(0.096)	(0.075)
Log (Industry Intensity)$_{t-1}$($Scope2$)	-1.258	-0.043	0.096	0.002	5.172	0.045	0.142	0.057
	(3.241)	(0.059)	(0.105)	(0.094)	(3.835)	(0.051)	(0.147)	(0.130)
ΔLog (Industry Intensity) (Scope 1)	3.232	0.061*	-0.171**	0.005	-3.876	-0.044	-0.112	-0.043
	(2.678)	(0.027)	(0.059)	(0.070)	(2.745)	(0.037)	(0.102)	(0.074)
ΔLog (Industry Intensity)(Scope 2)	2.451	-0.012	0.141	-0.004	5.540	0.051	0.066	0.204
	(3.219)	(0.054)	(0.120)	(0.116)	(3.891)	(0.054)	(0.170)	(0.139)
Log (Total Assets)$_{t-1}$	20.732***	0.294***	0.213*	-0.434***	15.410***	0.222***	0.197	-0.296*
	(3.629)	(0.055)	(0.092)	(0.093)	(4.021)	(0.055)	(0.162)	(0.131)
Leverage Ratio$_{t-1}$	18.037	0.315	0.471	-0.977**	-5.586	-0.022	1.423*	-0.487
	(14.399)	(0.205)	(0.352)	(0.351)	(18.097)	(0.242)	(0.725)	(0.452)
CAPEX/Total Assets$_{t-1}$	-50.136**	-0.532*	-0.959	-0.543	-10.718	-0.251	-0.284	0.487
	(17.778)	(0.217)	(0.622)	(0.688)	(27.258)	(0.418)	(0.925)	(0.861)
EBITDA/Total Assets$_{t-1}$	0.169	0.003	-0.011**	0.008*	1.124*	0.016*	-0.017	0.009
	(0.188)	(0.003)	(0.004)	(0.003)	(0.516)	(0.006)	(0.012)	(0.014)
Log (Industry Intensity)$_{t-1}$($Scope1$) × Post-Paris	-4.068	-0.076*	0.008	0.046	0.791	-0.015	0.118*	0.013
	(2.213)	(0.030)	(0.041)	(0.042)	(1.903)	(0.028)	(0.057)	(0.049)
Log (Industry Intensity)$_{t-1}$($Scope2$) × Post-Paris	-0.173	0.035	0.021	-0.034	-2.795	0.004	-0.209	-0.016
	(3.858)	(0.064)	(0.101)	(0.113)	(3.499)	(0.053)	(0.138)	(0.088)
ΔLog (Industry Intensity) (Scope 1) × Post-Paris	-1.650	-0.060	0.072	0.028	-1.054	-0.031	0.124	0.054
	(2.775)	(0.035)	(0.058)	(0.059)	(2.390)	(0.033)	(0.086)	(0.082)
ΔLog (Industry Intensity)(Scope 2) × Post-Paris	-3.925	-0.011	-0.012	-0.030	-2.316	0.018	-0.152	-0.139
	(3.815)	(0.053)	(0.106)	(0.128)	(3.768)	(0.053)	(0.158)	(0.094)
R^2	0.05331	0.62307			0.10626	0.77604		
Observations	45,046	46,038	43,141	44,883	33,802	34,532	31,882	32,807
Borrower fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Lender-Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Industry fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓
Country-Year fixed effects					✓	✓	✓	✓

2.2.3 Between-Industry Analysis

Now, we examine credit allocation across industries and answer the question: Do banks shift lending from brown industries to non-brown industries? We use the following specifications:

$$\begin{aligned} Credit\ Outcome_{ijbt} =& \beta_1 EI_{jt-1} + \beta_1 \Delta EI_{jt-1} + \beta_3 EI_{jt-1} PostParis \\ &+ \beta_4 \Delta EI_{jt-1} PostParis + X'_{it-1}\boldsymbol{\beta_2} + \delta_i + \delta_j + \delta_{bt} + \epsilon_{ijbt} \end{aligned} \tag{10}$$

where i is a firm, b a bank, j an industry, and t a year. The key variables are EI_{jt-1}, industry emission intensity, measured as the ratio of industry emission over its real value added and the ratio's change from last year, ΔEI_{jt-1}. The former variable is lagged by one year in the regressions to capture any possible delayed impact on credit allocation. X' is again a matrix of firm characteristic controls over time. δ_i is firm fixed effects, δ_j is industry fixed effects, and δ_{bt} is bank-year fixed effects. Robust errors are clustered at the NACE-2-digit industry level.

Table 7 columns 1-4 report the between-industry results for the US. Columns 5-8 report the between-industry results for the EU.

We also use an alternative specification at the bank-year level to test credit reallocation across industries. As shown below, the left-hand side is a bank's share of loans in the relatively green

industries. Relatively green industries are defined as those at the bottom 25% in accounting scope 1 industry-level emission intensity in the US or the EU. On the right-hand side, we have time trend, NZBA dummy, post-Paris dummy, and their interactions. The standard errors are clustered at bank (for the US) or country (for the EU) level.

$$\frac{Bank\ Loan\ to\ Green\ Industries_{bt}}{Bank\ Loan_{bt}} = \beta_1 Trend_t + \beta_2 NZBA_{bt} + \beta_3 PostParis_t + \beta_4 Trend_t \times NZBA_{bt} + \beta_4 Trend_t \times PostParis_t + \epsilon_{bt} \tag{11}$$

for bank b and year t. Notice that we cannot have $NZBA \times PostParis$ because banks only sign up for $NZBA$ after the Paris agreement and thus $NZBA \times PostParis = NZBA$.

Table 8 shows the results for banks' loan share in the greenest industries. In the US, banks have been increasing loans to the greenest industries, while in the EU banks have experienced the opposite before the Paris agreement and reversed the course afterwards.

Table 8: Between Industry Analysis: Bank-Level

	Ratio of bank-level loans to greener industries		
	All	US	EU
Trend	0.002	0.021*	-0.022*
	(0.005)	(0.008)	(0.008)
NZBA	-0.545*	0.076	-0.102
	(0.238)	(0.443)	(0.569)
Post-Paris	-0.038	0.012	-0.105
	(0.046)	(0.053)	(0.099)
Trend × NZBA	0.051*	0.000	0.013
	(0.021)	(0.039)	(0.050)
Trend × Post-Paris	0.002	-0.016	0.030*
	(0.007)	(0.009)	(0.012)
R^2	0.07269	0.16730	0.13246
Observations	25,386	9,029	10,647
Industry fixed effects	✓	✓	✓

To summarize our bank-firm level analysis, we have created a result summary table.

Table 9: Result Summary: US and EU

	Cleaner firms/industries	**Greening firms/industries**
US borrowers:		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	More new loans	No effect
Within industries (scope 1)	Lower amount	Lower amount, lower growth, fewer new loans
Within ind (scope 2)	No effect	No effect
Between ind (scope 1)	Lower amount, lower growth, more new loans	More new loans, lower amount
Between ind (scope 2)	No effect	No effect
Post-Paris		
Overall (scope 1)	No effect	Lower amount, lower growth
Overall (scope 2)	No effect	Lower growth, more new loans
Within ind (scope 1)	Higher amount	Higher growth, higher amount
Within ind (scope 2)	No effect	More first loans
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect
EU borrowers:		
Overall (scope 1)	No effect	Lower amount, more new loans, fewer first loans
Overall (scope 2)	No effect	More first loans
Within ind (scope 1)	Lower amount, lower growth	No effect
Within ind (scope 2)	No effect	Lower growth
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect
Post-Paris		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	No effect	No effect
Within ind (scope 1)	More new loans	No effect
Within ind (scope 2)	No effect	No effect
Between ind (scope 1)	Fewer new loans	No effect
Between ind (scope 2)	No effect	No effect

Notes: Green means encouraging evidence for green transition. Red means discouraging evidence. Post-Paris effects are for additional effects. Industry-level analysis is not summarized here.

Table 10: Result Summary: US and EU, Dirtiest Industries

Dirtiest ind	Cleaner firms/industries	Greening firms/industries
US borrowers:		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	No effect	No effect
Within ind (scope 1)	Lower amount, fewer new loans	Lower growth, lower amount, fewer new loans
Within ind (scope 2)	Fewer new loans, more first loans	Fewer new loans
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect
Post-Paris		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	No effect	No effect
Within ind (scope 1)	Fewer first loans	Fewer first loans
Within ind (scope 2)	More first loans	Higher amount, more first loans
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect
EU borrowers:		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	No effect	No effect
Within ind (scope 1)	Lower growth, lower amount	No effect
Within ind (scope 2)	Fewer new loans	No effect
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect
Post-Paris		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	No effect	No effect
Within ind (scope 1)	No effect	No effect
Within ind (scope 2)	Higher amount, more new loans	Higher amount, more new loans
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect

Notes: Green means encouraging evidence for green transition. Red means discouraging evidence. Post-Paris effects are for additional effects. Industry-level analysis is not summarized here.

Table 11: Result Summary: US and EU, Cleanest Industries

Cleanest ind	Cleaner firms/industries	Greening firms/industries
US borrowers:		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	No effect	No effect
Within ind (scope 1)	Higher growth, more first loans	No effect
Within ind (scope 2)	No effect	No effect
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect
Post-Paris		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	No effect	No effect
Within ind (scope 1)	Fewer first loans	No effect
Within ind (scope 2)	No effect	No effect
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect
EU borrowers:		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	No effect	No effect
Within ind (scope 1)	No effect	No effect
Within ind (scope 2)	No effect	No effect
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect
Post-Paris		
Overall (scope 1)	No effect	No effect
Overall (scope 2)	No effect	No effect
Within ind (scope 1)	No effect	No effect
Within ind (scope 2)	No effect	No effect
Between ind (scope 1)	No effect	No effect
Between ind (scope 2)	No effect	No effect

Notes: Green means encouraging evidence for green transition. Red means discouraging evidence. Post-Paris effects are for additional effects. Industry-level analysis is not summarized here.

3 The Danish Case

EU countries seem to have made more progress towards banking credit reallocation in response to firms' emission intensities than the US has, at least within industries. Now we turn to a specific EU country, Denmark, and obtain the data on the universe of firms and bank credits to conduct analyses. Denmark has been actively pushing its climate initiatives and ensured ambitious climate action by passing its 2020 Climate Act into law. It would be important to examine whether these actions translate into results in the banking sector. Moreover, the advantage of the Danish data is

the universal coverage of firms and banks, which enables us to examine any changes to the entire distribution of firm emissions and bank credits.

3.1 Data and Descriptive

This section describes the Danish data we are using. Our sample period runs from 2003 to 2019. While we obtain the data on the universe of banks and firms, we drop firms operating in the financial industry, micro firms with fewer than 10 employees, and micro banks with fewer than 50 employees for data accuracy. We further restrict firms operating outside of the financial industry.

3.1.1 Firm and Emission Data

We start by collecting firm-level information from registers administered by Statistics Denmark, i.e., general firm statistics (FIRM) and firm-level accounting statistics (FIRE). Specifically, FIRM covers the universe of private-sector firms from 1995 to 2019 and includes detailed information on firm characteristics, such as size, age, capital, revenue, location, and industry affiliation. FIRE provides detailed accounting information at the firm level.[3] This allows us to construct several important firm-level controls for the empirical analysis, such as return on assets (ROA), leverage ratio, and firm age.

Firm energy intensity

Due to the lack of firm-level emission data, we use firm-level energy consumption obtained from the FIRE register (KENE) as a proxy. The data contains firms' energy purchase amounts for heating and production. This includes, among other things, expenses for electricity, oil, gas, and district heating. We consider such energy consumption a scope-1+scope-2 type of emission intensity measurement.[4] To further account for firm size differences, we normalize firms' energy consumption by their real value added.[5] Specifically, the energy intensity for firm i in industry j at time t is calculated as follows:

$$EgI_{ijt} = \frac{Firm\ energy\ use_{ijt}}{Real\ value\ added_{ijt}} \tag{12}$$

$$\Delta EgI_{ijt-1} = EgI_{ijt} - EgI_{ijt-1} \tag{13}$$

Industry emission intensity

[3] We deflate all monetary values using the GDP deflator provided by Statistics Denmark (pris112), with 2015 as the base year.

[4] Given *KENE* is only available for the period 2000-2016; we therefore impute the missing emission intensity in years 2017-2019 based on the mean energy consumption at the firm level over a 3-year rolling window.

[5] This is captured by the variable GF_VTV in the FIRM register. See more information at https://www.dst.dk/da/TilSalg/Forskningsservice/Dokumentation/hoejkvalitetsvariable/firmastatistik/gf-vtv.

Industry emission data is obtained from the air emission accounts from StatBank Denmark administered by Statistics Denmark, which show emissions of greenhouse gases as well as other polluting substances caused by the industries' or households' use of energy. We focus on the greenhouse gas account (in CO2 equivalents) that captures the total emissions from the production of electricity and district heat distributed by actual use at the industry level.[6] We consider this as a scope-2 emission measure.

Industry emission intensity is then calculated by

$$EI_{jt} = \frac{Industry\ emission_{jt}}{Real\ value\ added_{jt}} \tag{14}$$

$$\Delta EI_{jt-1} = EI_{jt} - EI_{jt-1} \tag{15}$$

for industry j at time t.

3.1.2 Bank and Loan Data

To link firms with banks and their corresponding loan account information, we use a unique database based on tax records that report the account-level data for the universe of bank loan relationships available at Statistics Denmark.[7] We use the part of this dataset that covers firms (URTEVIRK). Using unique banks' and firms' identifiers, we link each loan account to the corresponding banks and borrowing firms. Then we merge it back to the firm data constructed in the previous section using the unique firm identifiers (CVRNR) to obtain the characteristics of the corresponding banks and firms.[8]

Finally, we collapse the raw data at the firm-bank-account-year level to the firm-bank-year level by taking the sum of the loan account balance. This allows us to measure credit outcomes at different adjustment margins at the firm-bank-year level, including loan (outstanding) amount, change of loan (outstanding) amount, new loan initiations, and bank-firm relationship formation/dissolution. The final sample consists of 421602 firm-bank-year observations with 38382 firms and 129 banks across 17 years.

3.1.3 Summary Statistics and Facts

Summary Statistics

[6] For more information, see the link to the data https://www.statistikbanken.dk/statbank5a/SelectVarVal/Define.asp?MainTable=DRIVHUS2&PLanguage=1&PXSId=0&wsid=cftree.

[7] Every year, all Danish entities that have extended credit during the previous 12 months are requested to report to the Danish Tax Authority (SKAT), including the account's number, type, and balance, together with its ownership status and the sum of interest payments on December 31st of each year. Since these reports are used to calculate tax obligations, the data is of high quality.

[8] During the merge, we only include firms with at least one bank account connection and non-negative account balance and interest payments. But we keep those firms when the account balance is zero.

Table 12: Summary Statistics, Danish Sample

Variable	Mean	Sd
Loan outstanding	12.458	3.642
Loan growth	-14.204	119.352
New loan initiation	0.376	0.484
Log (firm energy intensity)	2.352	1.436
Firm energy intensity change	-6.194	754.011
Relative energy intensity	0.053	1.008
Relative energy intensity change	0.012	0.957
Industry emission intensity	-3.928	0.932
Industry emission intensity change	-0.027	0.127
Log (assets)	10.395	1.581
Fixed assets ratio	0.332	0.242
Leverage ratio	0.526	8.668
ROA	1.285	1008.02
Log (size)	3.538	1.226
Log (firm age)	3.211	0.57

Table 12 presents the summary statistics for the key variables of interest, including firm-bank-level credit outstanding amount, firm energy intensity, industry emission intensity, and other firm controls.

Facts

1) Figure 1 plot the distribution of all firms' energy intensity on average for each 5 quantile bins for the first 3 years of the sample (2003-2005) and for the last 3 years (2017-2019).

Figure 1: Average Firm Energy Intensity for Each Quantile Bin: First 3 Years (Left) vs Last 3 Years (Right)

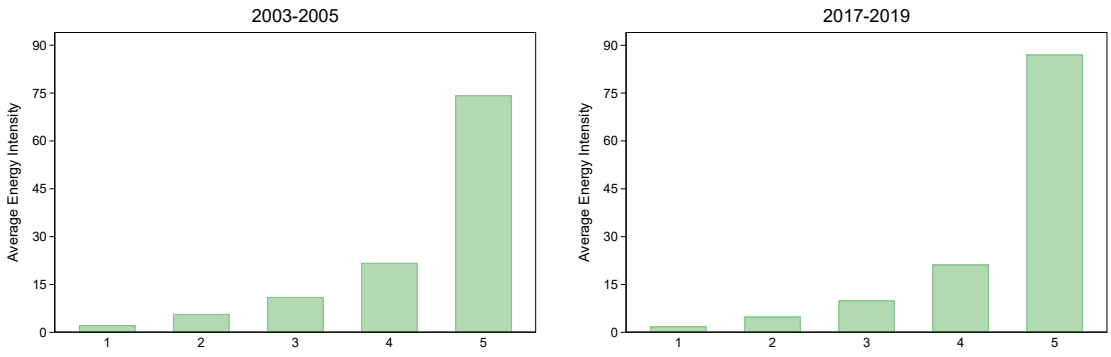
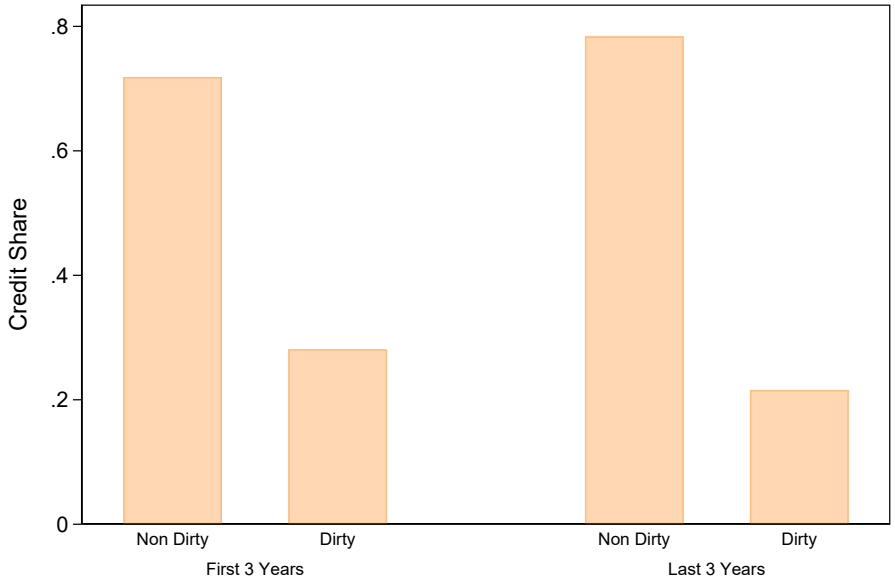


Figure 2: Credit Share to Dirty vs Non-Dirty Firms in General



2) Do banks shift lending from browner firms to greener firms in general: Figure 2 split firms into 0-75%ptil (non-brown) and 75-100% (brown) by their energy intensity and plot the total credit allocation in percent to each type of firms for the first 3 years together and for the last 3 years together in the sample (e.g., for the first 3 years, how much credit was located to brown firms as a share of total credit). Intensity threshold does not change by year.

3) Do banks shift lending from browner firms to greener firms within a green/brown industry (within industry): Figure 3 split firms into 0-75%ptil (non-brown) and 75-100% (brown) by their RELATIVE energy intensity and plot the total credit allocation in percent to each type of firms for the first 3 years together and for the last 3 years together in the sample. Intensity threshold does not change by year.

4) Are industries getting greener: Figure 4 plot the distribution of average industry emission intensity for the first 3 years of the sample and for the last 3 years in 5 quantile bins.

5) Do banks shift lending from brown industries to green industries (between industry): Figure 5 split 2-digit industries into 0-75%ptil (non-brown) and 75-100% (brown) by their INDUSTRY emission intensity and plot the total credit allocation in percent to each type of industries for the first 3 years together and for the last 3 years together in the sample (e.g., for the first 3 years, how much credit was located to brown industries as a share of total credit). Intensity threshold does not change by year.

6) Passive vs active credit reallocation: Figure 6 split 5 bins based on firm energy intensity in the first 3 years and plot credit and output density bar plots.

7) Passive vs active credit reallocation within industries: Figure 7 split 5 bins based on RELA-

Figure 3: Credit Share to Dirty vs Non-Dirty Firms Within Industry

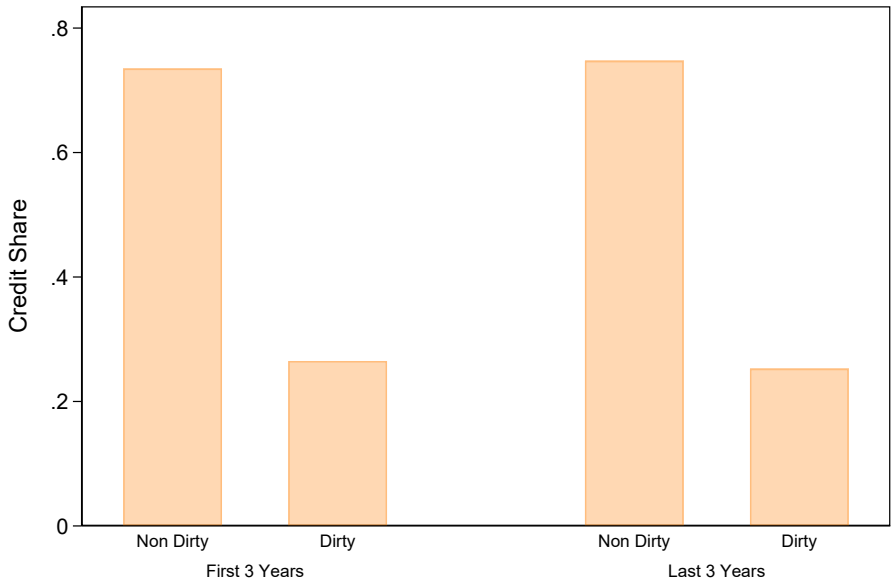


Figure 4: Average Industry Emission Intensity for Each Quantile Bin: First 3 Years (Left) vs Last 3 Years (Right)

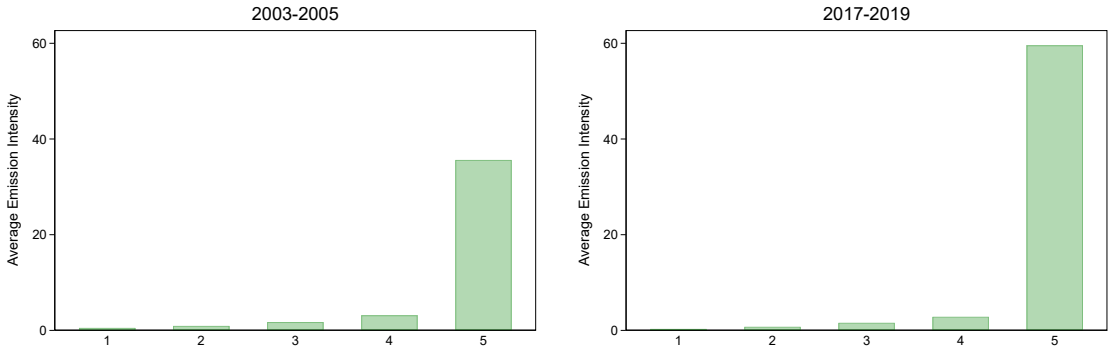


Figure 5: Credit Share to Dirty vs Non-Dirty Firms Between Industry

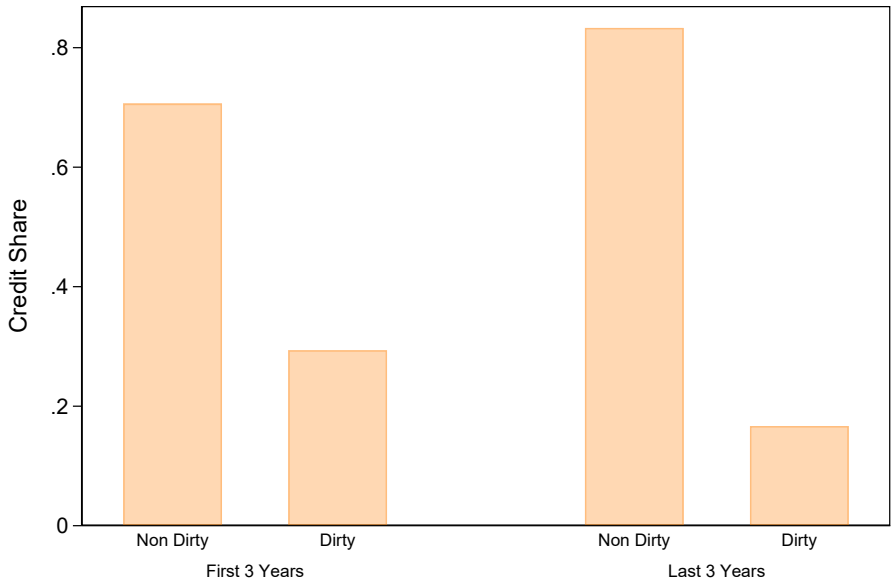


Figure 6: Passive vs Active Credit Reallocation: Credit and Output Density by Firm Energy Intensity

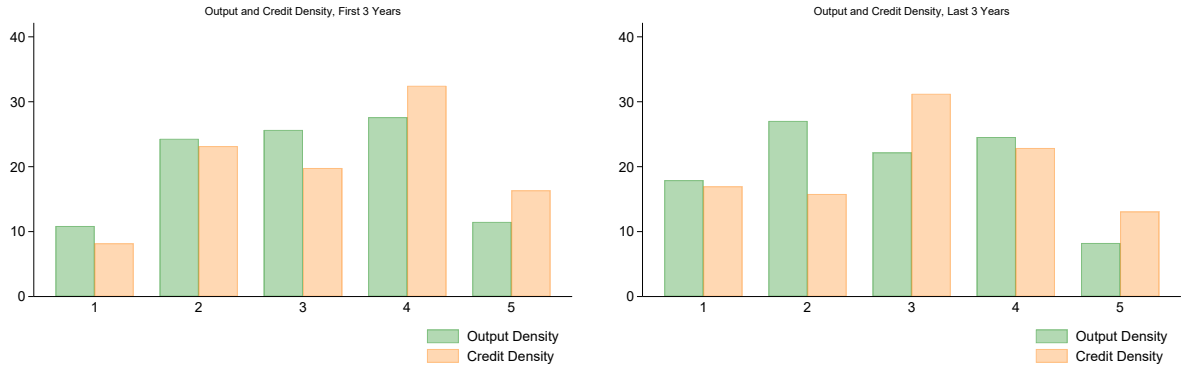


Figure 7: Passive vs Active Credit Reallocation Within Industry: Credit and Output Density by Relative Energy Intensity

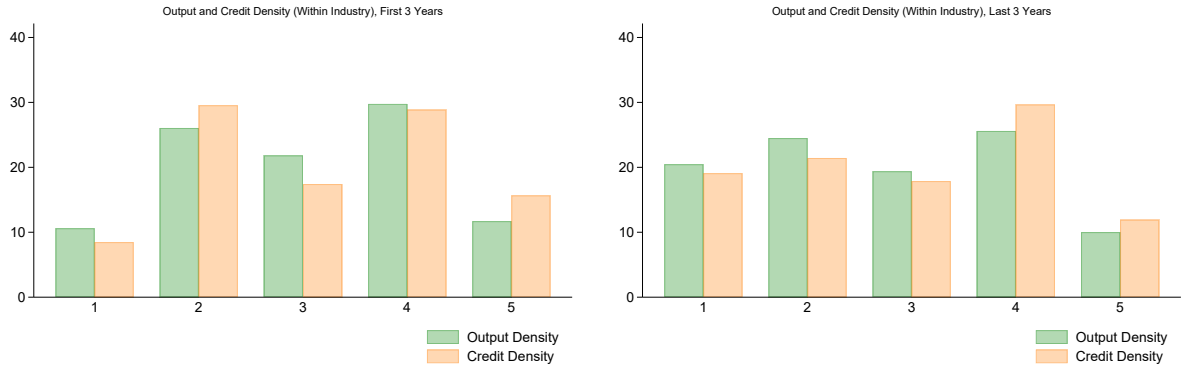
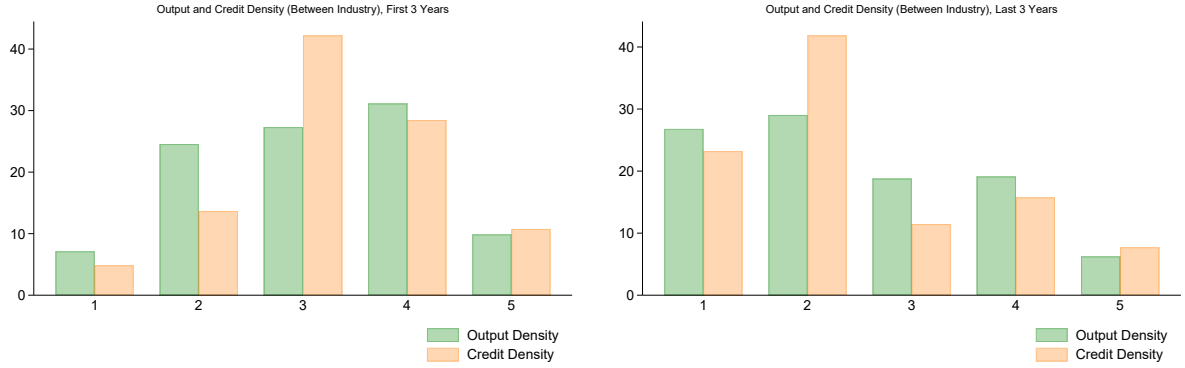


Figure 8: Passive vs Active Credit Reallocation Between Industry: Credit and Output Density by Industry Emission Intensity



TIVE energy intensity in the first 3 years and then plot credit and output density bar plots.

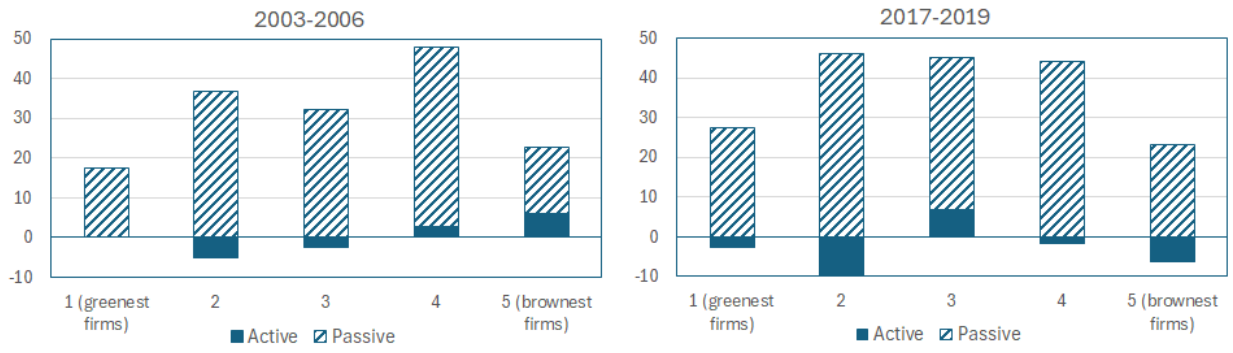
8) Passive vs active credit reallocation between industries: Figure 8 creates 5 bins based on INDUSTRY emission intensities in the first 3 years and then plots credit and output density bar plots for the first and last 3 years' credit share and output share for each bin.

Do banks shift credit allocation passively proportional to firm output or actively seek out firms with certain levels of energy intensity?

To separate the passive credit allocation from the active credit allocation in response to firms' climate risks, we construct the ratio of credit-density to output-density for each year in our sample, run an AR1 model, and use the estimates and the previous year's output density to generate predicted credit-density for each bin of firm energy intensity.[9] Then, we calculate passive credit allocation for each bin using the predicted credit density and the actual total credit of that year. The active allocation is thus what is left in the actual credit in each bin after deducting the passive

[9]Wooldridge test for autocorrelation shows strong first-order autocorrelation in the ratio of credit-density to output-density.

Figure 9: Active vs Passive Credit Allocation by Firm Energy Intensity



credit allocation.

Figure 9 plots the active and passive credit allocations for the median of the first three years in our sample and the last three years. When the active credit allocation is negative, it means that even passive allocation of credit is not enough to catch up with the output density changes in the bin, i.e., being underallocated in credit. We can see that bins 1 and 2 (the greenest bins) are usually underallocated in credit. Bin 3 was underallocated in the first three years, but credit was able to catch up to the output, and more credit was actively allocated to bin 3 in the last three years in the sample. Bins 4 and 5 (the bronwest bins) were overallocated in credit in the earlier years, i.e., more credit was actively allocated to them beyond its output density changes. But they became underallocated in the latter years. Overall, we see that most of the credit allocation to greener firms is a response to output shifts (i.e., passive credit reallocation).

3.2 Empirical Results

3.3 General Analysis

Table 13 reports the results. We find that prior to the Paris Agreement, energy intensity level increases loan amount but decreases loan growth with occasional statistical significance while having no significant impact on new loan initiation. In addition, energy intensity growth rate increases loan amount but has an insignificant impact on loan growth and initiation. This is largely consistent with the literature that finds mixed results. During the post-Paris-Agreement period, firms with higher energy intensity or with increasing energy intensity tend to receive lower loan amounts, loan growth, and fewer new loan initiations, than the pre-Paris-Agreement period. This shows the progress of credit reallocation according to firm energy intensity after the Paris Agreement.

Table 13: General Analysis: All Firms (Post Paris)

	Log (Balance) (1)	Loan Growth (2)	New Loan Initiation (3)	Log (Balance) (4)	Loan Growth (5)	New Loan Initiation (6)	Log (Balance) (7)	Loan Growth (8)	New Loan Initiation (9)
Log (Energy Intensity)$_{t-1}$	0.013*	-0.679**	-0.002*				0.031**	-0.606	-0.001
	(0.008)	(0.288)	(0.001)				(0.014)	(0.421)	(0.002)
Δ Log (Energy Intensity)$_t$				0.001	0.471*	0.002*	0.015*	0.172	0.001
				(0.004)	(0.278)	(0.001)	(0.009)	(0.346)	(0.001)
Post Paris $\times$ Log (Energy Intensity)$_{t-1}$	-0.071***	0.668	0.003				-0.077**	0.081	0.001
	(0.024)	(0.760)	(0.003)				(0.030)	(0.937)	(0.004)
Post Paris $\times$ Δ Log (Energy Intensity)$_t$				0.024	-2.309*	-0.008**	-0.022	-2.372	-0.007**
				(0.022)	(1.175)	(0.003)	(0.031)	(1.468)	(0.003)
Log (Assets)$_{t-1}$	0.153***	-3.552***	-0.021***	0.154***	-3.710***	-0.021***	0.153***	-3.719***	-0.021***
	(0.027)	(1.030)	(0.004)	(0.027)	(1.030)	(0.004)	(0.027)	(1.036)	(0.004)
Fixed Assets Ratio$_{t-1}$	0.484***	-2.942	0.018*	0.493***	-3.692	0.017*	0.491***	-3.656	0.017*
	(0.079)	(2.748)	(0.009)	(0.078)	(2.736)	(0.009)	(0.078)	(2.743)	(0.009)
Leverage Ratio$_{t-1}$	0.183**	-11.418**	-0.027***	0.196**	-12.379**	-0.028***	0.196**	-12.343**	-0.028***
	(0.089)	(5.207)	(0.009)	(0.096)	(5.642)	(0.010)	(0.095)	(5.622)	(0.010)
ROA$_{t-1}$	0.001	-0.022*	0.000	0.001	-0.023*	0.000	0.001	-0.023*	0.000
	(0.001)	(0.013)	(0.000)	(0.001)	(0.013)	(0.000)	(0.001)	(0.013)	0.000
Log (Size)$_{t-1}$	0.293***	-2.762**	0.004	0.289***	-2.806**	0.003	0.286***	-2.799**	0.003
	(0.051)	(1.245)	(0.005)	(0.051)	(1.227)	(0.005)	(0.051)	(1.229)	(0.005)
Log (Firm Age)$_{t-1}$	0.007	-18.268***	-0.017*	0.010	-18.957***	-0.018*	0.002	-18.953***	-0.018*
	(0.077)	(2.414)	(0.009)	(0.075)	(2.469)	(0.009)	(0.077)	(2.456)	(0.009)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.569	0.115	0.164	0.569	0.116	0.166	0.569	0.116	0.166
N	172,629	198,941	232,295	168,547	194,160	226,722	168,547	194,160	226,722

Notes: This table presents the estimation results for general analysis of all firms, including the Post Paris dummy. The dependent variables are Log (Balance), Loan Growth, and New Loan Initiation. Robust standard errors clustered at the industry level are reported in parentheses. Significance levels: ***1%, **5%, *10%.

3.3.1 Within-Industry Analysis

Now we examine whether banks shift lending from browner firms to greener firms within an industry, using the same empirical strategy (i.e., relative energy intensity to peer-firms in the same industry) as before in the cross-country evidence. We answer this question using all firms, the subsample of brown firms, and the subsample of non-brown firms. Here, the brown industries are again defined as those whose emission intensity (based on scope 1) is above the 75th percentile of the entire sample, a fixed threshold over the years. In addition to the credit outcomes of loan amount, loan growth, and new loan initiation, we also examine firm-bank relationship changes in this section.

Bank-Firm Level

Table 14 reports the results using the entire sample. Prior to the Paris Agreement, firms with high energy intensity relative to their own industries have experienced slightly higher loan amount but slower loan growth and loan initiation. However, this result is offset by a positive effect on loan growth and loan initiation for firms with *increasing* energy intensity relative to their peers in the same industries. When focusing on the post-Paris period, firms with higher energy intensity relative to their own industries have received less loan amounts, and those with increasing relative energy intensity have also experienced lower loan growth and fewer new loan initiations.

Table 14: Within-Industry Analysis: All Firms (Post Paris)

	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Relative Energy Intensity$_{t-1}$	0.013	-0.919**	-0.002*				0.032*	-0.709	0.000
	(0.009)	(0.399)	(0.001)				(0.016)	(0.564)	(0.002)
Δ Relative Energy Intensity$_t$				0.002	0.692**	0.003**	0.018*	0.333	0.002
				(0.006)	(0.306)	(0.001)	(0.011)	(0.395)	(0.001)
Post Paris $\times$ Relative Energy Intensity$_{t-1}$	-0.062**	0.537	0.001				-0.072**	-0.132	-0.001
	(0.025)	(0.746)	(0.003)				(0.032)	(0.782)	(0.003)
Post Paris $\times$ Δ Relative Energy Intensity$_t$				0.006	-3.009**	-0.007**	-0.031	-3.166**	-0.007**
				(0.022)	(1.298)	(0.003)	(0.033)	(1.393)	(0.003)
Log (Assets)$_{t-1}$	0.153***	-3.560***	-0.021***	0.154***	-3.708***	-0.021***	0.153***	-3.727***	-0.021***
	(0.027)	(1.027)	(0.004)	(0.027)	(1.032)	(0.004)	(0.027)	(1.035)	(0.004)
Fixed Assets Ratio$_{t-1}$	0.485***	-2.914	0.018**	0.494***	-3.662	0.017*	0.492***	-3.634	0.017*
	(0.079)	(2.750)	(0.009)	(0.078)	(2.743)	(0.009)	(0.078)	(2.752)	(0.009)
Leverage Ratio$_{t-1}$	0.183**	-11.390**	-0.027***	0.196**	-12.360**	-0.028***	0.196**	-12.314**	-0.028***
	(0.089)	(5.200)	(0.009)	(0.096)	(5.635)	(0.010)	(0.095)	(5.613)	(0.010)
ROA$_{t-1}$	0.001	-0.022*	0.000	0.001	-0.023*	0.000	0.001	-0.024*	0.000
	(0.001)	(0.013)	0.000	(0.001)	(0.013)	0.000	(0.001)	(0.013)	0.000
Log (Size)$_{t-1}$	0.293***	-2.774**	0.004	0.288***	-2.833**	0.003	0.285***	-2.835**	0.003
	(0.050)	(1.246)	(0.005)	(0.051)	(1.229)	(0.005)	(0.051)	(1.234)	(0.005)
Log (Firm Age)$_{t-1}$	0.008	-18.316***	-0.018*	0.010	-18.944***	-0.018*	0.004	-18.994***	-0.018*
	(0.077)	(2.417)	(0.009)	(0.075)	(2.466)	(0.009)	(0.077)	(2.454)	(0.009)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.569	0.115	0.164	0.569	0.116	0.165	0.569	0.116	0.165
N	172,611	198,920	232,267	168,528	194,136	226,690	168,528	194,136	226,690

Notes: This table presents the estimation results for within-industry analysis of all firms, including the Post Paris dummy. The dependent variables are Log (Balance), Loan Growth, and New Loan Initiation. Robust standard errors clustered at the industry level are reported in parentheses. Significance levels: ***1%, **5%, *10%.

Table 15 reports the results when we constrain the sample to only brown industries. Again, the brown industries are defined as those with top 75% industry emission intensities. In Appendix **??**, we list all the industries that we consider brown here.

Table 15: Within-Industry Analysis: Brown Industry (Post Paris)

	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Relative Energy Intensity$_{t-1}$	-0.008	-1.812**	-0.009***				-0.021	-1.574	-0.007**
	(0.013)	(0.755)	(0.003)				(0.027)	(1.039)	(0.003)
Δ Relative Energy Intensity$_t$				-0.009	1.747**	0.006*	-0.02	0.977	0.002
				(0.010)	(0.700)	(0.003)	(0.020)	(0.982)	(0.004)
Post Paris $\times$ Relative Energy Intensity$_{t-1}$	-0.065	1.388	0.006				-0.034	1.578	0.009
	(0.060)	(2.653)	(0.012)				(0.078)	(2.897)	(0.013)
Post Paris $\times$ Δ Relative Energy Intensity$_t$				0.137	-2.923	0.000	0.114	-2.230	0.005
				(0.100)	(3.534)	(0.014)	(0.129)	(3.050)	(0.011)
Log (Assets)$_{t-1}$	0.248***	-1.560	-0.016**	0.241***	-1.345	-0.014	0.241***	-1.297	-0.013
	(0.061)	(2.145)	(0.008)	(0.062)	(1.998)	(0.008)	(0.062)	(1.986)	(0.008)
Fixed Assets Ratio$_{t-1}$	0.626***	4.447	0.081**	0.628***	3.190	0.077**	0.631***	3.060	0.076**
	(0.133)	(6.674)	(0.029)	(0.145)	(6.914)	(0.030)	(0.147)	(6.828)	(0.029)
Leverage Ratio$_{t-1}$	0.713**	-34.221***	-0.100***	0.719***	-35.382***	-0.100***	0.724***	-35.116***	-0.099***
	(0.267)	(9.471)	(0.034)	(0.257)	(9.527)	(0.034)	(0.256)	(9.554)	(0.034)
ROA$_{t-1}$	0.001**	-0.004	0.000	0.001**	-0.004	0.000	0.001**	-0.004	0.000
	0.000	(0.015)	0.000	0.000	(0.014)	0.000	0.000	(0.014)	0.000
Log (Size)$_{t-1}$	0.281***	-0.483	0.005	0.291***	-0.326	0.006	0.286***	-0.350	0.007
	(0.098)	(3.519)	(0.017)	(0.102)	(3.510)	(0.016)	(0.100)	(3.535)	(0.017)
Log (Firm Age)$_{t-1}$	0.133	-33.270***	-0.029	0.165	-38.047***	-0.037	0.163	-37.895***	-0.036
	(0.225)	(8.457)	(0.035)	(0.229)	(11.182)	(0.035)	(0.231)	(11.232)	(0.035)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.604	0.152	0.200	0.604	0.152	0.202	0.604	0.152	0.202
N	26,496	30,166	33,756	25,821	29,386	32,895	25,821	29,386	32,895

Notes: This table presents the estimation results for within-industry analysis of brown industry, including the Post Paris dummy. The dependent variables are Log (Balance), Loan Growth, and New Loan Initiation. Robust standard errors clustered at the industry level are reported in parentheses. Significance levels: ***1%, **5%, *10%.

Prior to the Agreement, we see similar effects as above for the full sample, but stronger. However, most of the post-Paris progress found above has not been made in brown industries: little significance is found, but in non-brown industries (see Table 17). When we further constrain the sample to only firms in the traditional dirty industries (see list here at **??**), things have gone worse after the Paris Agreement, firms with relatively high emission intensity in those dirty industries have gotten significantly more loan growth and initiations. This is problematic for the green transition as the most effective way to reduce emissions is to finance the greening of the firms in the (most) brown industries, not in non-brown industries.

Table 16: Within-Industry Analysis: Traditional Brown Industry (Post Paris)

	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Relative Energy Intensity$_{t-1}$	-0.044	-1.436	-0.009**				-0.064*	-0.461	-0.006*
	(0.029)	(1.402)	(0.004)				(0.031)	(2.023)	(0.003)
Δ Relative Energy Intensity$_t$				0.007	2.491**	0.009***	-0.025	2.319	0.007**
				(0.015)	(0.932)	(0.002)	(0.015)	(1.428)	(0.003)
Post Paris $\times$ Relative Energy Intensity$_{t-1}$	-0.024	7.849***	0.027**				0.027	9.071***	0.032*
	(0.113)	(1.787)	(0.009)				(0.141)	(1.220)	(0.015)
Post Paris $\times$ Δ Relative Energy Intensity$_t$				0.166	-5.019	-0.020	0.174	-0.117	-0.004
				(0.147)	(6.187)	(0.015)	(0.197)	(6.338)	(0.020)
Log (Assets)$_{t-1}$	0.300*	2.148	-0.009	0.298*	2.151	-0.005	0.298*	2.277	-0.005
	(0.135)	(3.622)	(0.014)	(0.136)	(3.026)	(0.014)	(0.137)	(3.151)	(0.014)
Fixed Assets Ratio$_{t-1}$	0.714***	17.409**	0.136***	0.710***	16.448**	0.134***	0.707**	15.552**	0.130***
	(0.200)	(6.015)	(0.025)	(0.221)	(6.750)	(0.026)	(0.225)	(6.550)	(0.026)
Leverage Ratio$_{t-1}$	1.360**	-43.756**	-0.100	1.333**	-43.325**	-0.096	1.340**	-44.004**	-0.097
	(0.469)	(17.365)	(0.059)	(0.449)	(17.141)	(0.057)	(0.450)	(17.025)	(0.057)
ROA$_{t-1}$	-0.287	-0.453	0.000	-0.253	-0.500	-0.001	-0.277	-0.441	0.000
	(0.275)	(1.304)	(0.004)	(0.260)	(1.304)	(0.003)	(0.270)	(1.301)	(0.003)
Log (Size)$_{t-1}$	0.261	-1.294	0.010	0.262	-1.803	0.010	0.260	-1.244	0.012
	(0.178)	(6.461)	(0.024)	(0.186)	(6.518)	(0.025)	(0.180)	(6.585)	(0.024)
Log (Firm Age)$_{t-1}$	-0.018	-38.441***	-0.031	0.007	-40.210***	-0.031	0.014	-38.544***	-0.027
	(0.260)	(8.722)	(0.058)	(0.291)	(9.762)	(0.053)	(0.299)	(9.517)	(0.054)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.586	0.162	0.217	0.585	0.161	0.218	0.585	0.161	0.218
N	10,399	12,012	13,992	10,073	11,636	13,563	10,073	11,636	13,563

Notes: This table presents the estimation results for within-industry analysis of lists of traditional brown industry, including the Post Paris dummy. The dependent variables are Log (Balance), Loan Growth, and New Loan Initiation. Robust standard errors clustered at the industry level are reported in parentheses. Significance levels: ***1%, **5%, *10%.

When we constrain the sample to only non-brown industries (Table 17), before the Paris Agreement, relatively high energy intensity (growth) increases loan balance and new loan initiations, similar to the previous results but weaker. During the post-Paris-Agreement period, however, relatively high energy intensity (growth) decreases all loan variables of interest.

Table 17: Within-Industry Analysis: Non-Brown Industry (Post Paris)

	Log (Balance) (1)	Loan Growth (2)	New Loan Initiation (3)	Log (Balance) (4)	Loan Growth (5)	New Loan Initiation (6)	Log (Balance) (7)	Loan Growth (8)	New Loan Initiation (9)
Relative Energy Intensity$_{t-1}$	0.014	-0.722	-0.001				0.038**	-0.504	0.001
	(0.011)	(0.463)	(0.001)				(0.018)	(0.690)	(0.002)
Δ Relative Energy Intensity$_t$				0.005	0.527	0.002*	0.023*	0.267	0.002
				(0.007)	(0.325)	(0.001)	(0.012)	(0.448)	(0.002)
Post Paris × Relative Energy Intensity$_{t-1}$	-0.060**	0.243	0.001				-0.074**	-0.591	-0.001
	(0.029)	(0.835)	(0.003)				(0.036)	(0.869)	(0.003)
Post Paris × Δ Relative Energy Intensity$_t$				-0.001	-2.815*	-0.007**	-0.038	-3.205**	-0.008**
				(0.024)	(1.414)	(0.003)	(0.036)	(1.551)	(0.003)
Log (Assets)$_{t-1}$	0.141***	-4.140***	-0.022***	0.143***	-4.294***	-0.022***	0.142***	-4.322***	-0.022***
	(0.030)	(1.134)	(0.005)	(0.030)	(1.161)	(0.005)	(0.030)	(1.162)	(0.005)
Fixed Assets Ratio$_{t-1}$	0.447***	-3.294	0.010	0.458***	-4.035	0.008	0.455***	-4.024	0.008
	(0.086)	(2.883)	(0.009)	(0.084)	(2.836)	(0.010)	(0.084)	(2.852)	(0.010)
Leverage Ratio$_{t-1}$	0.153*	-10.348**	-0.024***	0.165*	-11.212**	-0.025***	0.166*	-11.173**	-0.025***
	(0.079)	(5.030)	(0.009)	(0.085)	(5.454)	(0.009)	(0.084)	(5.437)	(0.009)
ROA$_{t-1}$	0.006***	-0.008	0.000	0.006***	-0.002	0.000	0.006***	-0.004	0.000
	(0.002)	(0.116)	0.000	(0.002)	(0.125)	0.000	(0.002)	(0.126)	0.000
Log (Size)$_{t-1}$	0.277***	-2.909**	0.003	0.273***	-3.069**	0.003	0.269***	-3.080**	0.003
	(0.060)	(1.341)	(0.006)	(0.061)	(1.336)	(0.006)	(0.061)	(1.341)	(0.006)
Log (Firm Age)$_{t-1}$	0.018	-17.500***	-0.019*	0.008	-17.931***	-0.020**	0.001	-18.036***	-0.020**
	(0.083)	(2.589)	(0.010)	(0.080)	(2.555)	(0.010)	(0.081)	(2.535)	(0.010)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.572	0.119	0.169	0.572	0.121	0.17	0.572	0.121	0.17
N	140,271	162,093	190,905	137,002	158,248	186,365	137,002	158,248	186,365

Notes: This table presents the estimation results for within-industry analysis of non-brown industry, including the Post Paris dummy. The dependent variables are Log (Balance), Loan Growth, and New Loan Initiation. Robust standard errors clustered at the industry level are reported in parentheses. Significance levels: ***1%, **5%, *10%.

Overall, it appears that there exists within-industry credit reallocation to greener firms in an industry to a certain degree, and most of the reallocation happens after the Paris Agreement. However, such post-Paris credit reallocation mostly occurs within non-brown industries, not within brown industries. Traditionally dirty industries have even done worse, where credits are increasingly flowing into the dirtiest firms in those industries after the Paris Agreement.

Extensive Margin: Firm-Bank Relationship

Now we turn to answer the question: Are browner firms in the industry more likely to form new relations with banks and exit old ones? With the entire sample, prior to the Agreement, firms with higher (increasing) relative energy intensity in their own industry are much more likely to separate from their banking relationships. After the Agreement, mixed results emerge on entering new relationships. Firms with higher (increasing) relative energy intensity in their own industry are more (less) likely to enter into a new banking relationship.

Table 18: Within-Industry Analysis: Relation Change, All Firms (Post Paris)

	Entry	**Exit**	**Entry**	**Exit**	**Entry**	**Exit**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Relative Energy Intensity$_{t-1}$	-0.001	0.001			-0.001	0.005**
	(0.001)	(0.001)			(0.001)	(0.002)
Δ Relative Energy Intensity$_t$			0.000	0.002**	-0.000	0.004***
			(0.001)	(0.001)	(0.001)	(0.001)
Post Paris $\times$ Relative Energy Intensity$_{t-1}$	0.003*	-0.001			0.002	-0.001
	(0.002)	(0.002)			(0.002)	(0.002)
Post Paris $\times$ Δ Relative Energy Intensity$_t$			-0.004**	0.001	-0.003	0.001
			(0.002)	(0.003)	(0.002)	(0.004)
Log (Assets)$_t$		-0.000	0.003**	-0.000	0.003**	0.000
		(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Fixed Assets Ratio$_t$		-0.011	-0.004	-0.009	-0.003	-0.010
		(0.009)	(0.006)	(0.008)	(0.006)	(0.008)
Leverage Ratio$_t$		0.001***	-0.000	0.001***	-0.000	0.001***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ROA$_t$		-0.000***	0.000***	-0.000***	0.000***	-0.000***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (Size)$_t$		-0.091***	-0.002	-0.090***	-0.002	-0.089***
		(0.006)	(0.003)	(0.006)	(0.003)	(0.006)
Log (Firm Age)$_t$		0.172***	-0.119***	0.173***	-0.119***	0.173***
		(0.009)	(0.012)	(0.010)	(0.012)	(0.010)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Variables	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.354	0.369	0.355	0.371	0.355	0.371
N	278,627	278,209	271,854	271,854	271,854	271,854

Notes: This table presents the estimation results for within-industry analysis of relation changes for all firms, including the Post Paris dummy. The dependent variables are Entry and Exit, with robust standard errors clustered at the industry level reported in parentheses. Significance levels: ***1%, **5%, *10%.

We then separate the firms into a sample of incumbents during the entire sample period (Table 19) and a sample of entrants (Table 20). Evidence strongly suggests that entrants, not incumbents, are the driving force in firm-bank relationship exits in response to climate risks. Increasing relative energy intensity of an entrant in an industry leads to more relationship exits before and after the Paris Agreement.

Table 19: Within-Industry Analysis: Relation Change, Incumbent Firms (Post Paris)

	Entry	**Exit**	**Entry**	**Exit**	**Entry**	**Exit**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Relative Energy Intensity$_{t-1}$	0.000	-0.001			-0.001	0.000
	(0.001)	(0.001)			(0.001)	(0.002)
Δ Relative Energy Intensity$_t$			0.000	0.001*	-0.001	0.001
			(0.001)	(0.001)	(0.001)	(0.001)
Post Paris $\times$ Relative Energy Intensity$_{t-1}$	0.001	0.000			0.001	0.000
	(0.002)	(0.002)			(0.001)	(0.002)
Post Paris $\times$ Δ Relative Energy Intensity$_t$			-0.004	-0.001	-0.003	-0.001
			(0.003)	(0.004)	(0.003)	(0.004)
Log (Assets)$_t$	0.004**	-0.001	0.005***	-0.001	0.005***	-0.001
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Fixed Assets Ratio$_t$	-0.009	-0.007	-0.010	-0.006	-0.010	-0.006
	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)
Leverage Ratio$_t$	0.001	-0.003	0.001	-0.003	0.001	-0.003
	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)
ROA$_t$	0.000***	0.000	0.000***	0.000	0.000***	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
Log (Size)$_t$	0.000	-0.002	0.000	-0.002	0.000	-0.002
	(0.003)	(0.004)	(0.003)	(0.005)	(0.003)	(0.005)
Log (Firm Age)$_t$	-0.121***	-0.003	-0.120***	0.000	-0.120***	0.000
	(0.018)	(0.008)	(0.019)	(0.009)	(0.019)	(0.009)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Variables	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.349	0.399	0.349	0.399	0.349	0.399
N	115,656	115,656	113,967	113,967	113,967	113,967

Notes: This table presents the estimation results for within-industry analysis of relation changes for incumbent firms, including the Post Paris dummy. The dependent variables are Entry and Exit, with robust standard errors clustered at the industry level reported in parentheses. Significance levels: ***1%, **5%, *10%.

Table 20: Within-Industry Analysis: Relation Change, Entrant Firms (Post Paris)

	Entry	**Exit**	**Entry**	**Exit**	**Entry**	**Exit**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Relative Energy Intensity$_{t-1}$	-0.006	-0.018*			-0.010	-0.005
	(0.009)	(0.009)			(0.010)	(0.009)
Δ Relative Energy Intensity$_t$			-0.003	0.015**	-0.008	0.012**
			(0.007)	(0.007)	(0.009)	(0.006)
Post Paris $\times$ Relative Energy Intensity$_{t-1}$	0.002	-0.002			0.012	-0.003
	(0.019)	(0.015)			(0.020)	(0.014)
Post Paris $\times$ Δ Relative Energy Intensity$_t$			0.014	0.004	0.021	0.001
			(0.016)	(0.018)	(0.016)	(0.015)
Log (Assets)$_t$	0.008	0.000	0.006	-0.000	0.006	-0.001
	(0.009)	(0.015)	(0.009)	(0.019)	(0.009)	(0.018)
Fixed Assets Ratio$_t$	-0.026	0.038	-0.030	0.021	-0.026	0.024
	(0.040)	(0.049)	(0.040)	(0.048)	(0.038)	(0.050)
Leverage Ratio$_t$	0.001	-0.000	0.000	-0.003	0.001	-0.003
	(0.007)	(0.008)	(0.007)	(0.006)	(0.007)	(0.006)
ROA$_t$	0.003	0.004**	0.004***	0.005	0.004***	0.005
	(0.002)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)
Log (Size)$_t$	-0.006	-0.090***	0.002	-0.088**	0.001	-0.089**
	(0.026)	(0.033)	(0.024)	(0.035)	(0.024)	(0.035)
Log (Firm Age)$_t$	-0.136***	0.285***	-0.148***	0.287***	-0.151***	0.288***
	(0.045)	(0.081)	(0.041)	(0.082)	(0.041)	(0.082)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Variables	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.478	0.537	0.480	0.541	0.480	0.541
N	4,736	4,736	4,624	4,624	4,624	4,624

Notes: This table presents the estimation results for within-industry analysis of relation changes for entrant firms, including the Post Paris dummy. The dependent variables are Entry and Exit, with robust standard errors clustered at the industry level reported in parentheses. Significance levels: ***1%, **5%, *10%.

Bank-Industry Level

We now use an alternative specification at the bank-industry-year level to test credit reallocation within industries. Similar to the cross-country evidence section, the left hand is a bank's share of loans in the relatively green (brown) firms within each industry. Relatively green firms in an industry are defined as those being at the bottom (top) 25% with the lowest (highest) scope 1

firm-level emission intensity in an industry. On the right hand, we have the industry emission intensity, its interaction with post-Paris period, year fixed effects, bank fixed effects, and industry fixed effects. The difference is that we do not have bank identities to include the $NZBA$ dummy. The standard errors are clustered at NACE-2-digit industry level.

$$\begin{aligned}\frac{Bank\ Loan\ to\ Green\ Firm_{bjt}}{Bank\ Loan_{bjt}} =& \beta_1 Industry\ Emission\ Intensity_{jt-1} \\ &+ \beta_2 Industry\ Emission\ Intensity_{jt-1} \times post\ Paris \\ &+ \delta_t + \delta_j + \delta_b + \epsilon_{bjt} \end{aligned} \tag{16}$$

for bank b, industry j, and year t.

Table 21 shows the results for bank's loan share in relatively green firms of an industry. No significant impact is found before 2016. During post-Paris period, when an industry is browner with a higher energy or emission intensity level, banks also tend to have a higher share of greener firms in such an industry.

Table 21: Within-Industry Analysis: Bank's Loan in Relatively Green Firms

	Green Firm Share	**Green Firm Share**	**Green Firm Share**
	(1)	**(2)**	**(3)**
Industry Emission Intensity$_{t-1}$	0.015		0.002
	(0.049)		(0.054)
Industry Energy Intensity$_{t-1}$	-0.001		(0.001)
	(0.005)		(0.006)
Δ Industry Emission Intensity$_t$		-0.022	-0.030
		(0.042)	(0.050)
Δ Industry Energy Intensity$_t$		-0.001	-0.001
		(0.005)	(0.005)
Post Paris $\times$ Industry Emission Intensity$_{t-1}$	-0.060		-0.046
	(0.040)		(0.040)
Post Paris $\times$ Industry Energy Intensity$_{t-1}$	0.013***		0.013***
	(0.004)		(0.004)
Post Paris $\times$ Δ Industry Emission Intensity$_t$		0.427**	0.341*
		(0.175)	(0.181)
Post Paris $\times$ Δ Industry Energy Intensity$_t$		-0.022	0.003
		(0.023)	(0.020)
Industry Real Value Added Growth$_t$	-0.009	-0.010	-0.010
	(0.009)	(0.009)	(0.009)
Bank Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
2-digit Industry Fixed Effects	Yes	Yes	Yes
R-sq	0.172	0.171	0.172
N	262,972	262,865	262,865

Notes: This table presents the estimation results for bank industry analysis. Green firm share is the share of bank's loan in relatively green firms of an industry. Robust standard errors clustered at the industry level are reported in parentheses in all columns. Significance levels: ***1%, **5%, *10%.

To summarize the Danish within-industry results, there is some evidence that banks are reallocating credit to greener firms within industries, especially during the post-Paris period. However, although banks tend to have a higher share of greenest firms in browner industries, the within-industry credit-greening actions have mostly been seen in the greenest industries instead of the brownest industries. There is mixed evidence on firm-bank relationship formation and separation.

3.3.2 Between-Industry Analysis

Now, we examine credit allocation across industries and answer the question: Do banks shift lending from brown industries to non-brown industries?

Table 22 presents the results using firm-bank-level data. Before the Paris Agreement, we do not see credit allocation from firms in high emission (scope 1) or high energy (scopes 1+2) intensity industries to those in low emission/energy intensity industries, except high scope 1 emission intensity industries are experiencing lower loan growth and more new loan initiations. But it appears that industries that are getting browner with higher scope-1 emission intensity are receiving more loan amounts, higher loan growth, and more new loan initiations, while those that are getting browner with higher energy (scopes 1+2) intensity are receiving less. Hence, which scopes banks take into account matter in analysis. After the Paris Agreement, we find that loan amount reacts negatively to the level of emission/energy intensities as well.

We also run the regression at the industry level:

$$Credit\ Outcome_{jt} = \beta_1 Industry\ Emission\ Intensity_{jt-1} + \delta_j + \delta_t + \epsilon_{jt} \tag{17}$$

$$Credit\ Outcome_{jt} = \beta_1 \Delta Industry\ Emission\ Intensity_{jt-1} + \delta_j + \delta_t + \epsilon_{jt} \tag{18}$$

clustered at the industry level.

The industry-level results in Table 23 confirm the above firm-level results for intensity changes. In addition, the industry-level results also show a significant impact of emission/energy intensity levels. Industries with higher scope-1 emission intensity tend to receive more loan amounts and loan growth. However, industries with high scopes 1+2 energy intensity tend to have less of both. The results, however, are reversed after the Paris Agreement. Banks are paying more attention than before to scope-1 emission levels in their credit allocation.

Table 22: Between-Industry Analysis, Firm Level Regression (Post Paris)

	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Industry Emission Intensity$_{t-1}$	-0.072	-7.891*	0.011				0.150	3.435	0.051*
	(0.238)	(4.724)	(0.025)				(0.285)	(6.559)	(0.026)
Industry Energy Intensity$_{t-1}$	0.002	0.969	0.001				-0.010	0.071	-0.001
	(0.025)	(0.712)	(0.002)				(0.035)	(0.794)	(0.003)
Δ Industry Emission Intensity$_t$				0.537***	23.935***	0.072***	0.584***	24.888***	0.093***
				(0.159)	(6.685)	(0.022)	(0.151)	(7.606)	(0.026)
Δ Industry Energy Intensity$_t$				-0.030	-2.364***	-0.006**	-0.034	-2.249**	-0.006
				(0.018)	(0.830)	(0.003)	(0.033)	(0.857)	(0.004)
Post Paris $\times$ Industry Emission Intensity$_{t-1}$	-0.500*	-8.17	-0.026				-0.508*	-6.737	-0.026
	(0.269)	(6.360)	(0.027)				(0.288)	(6.591)	(0.026)
Post Paris $\times$ Industry Energy Intensity$_{t-1}$	-0.057***	-0.038	0.004				-0.057***	0.035	0.003
	(0.019)	(0.510)	(0.003)				(0.019)	(0.627)	(0.003)
Post Paris $\times$ Δ Industry Emission Intensity$_t$				-0.46	-5.637	0.01	-0.762	-10.898	-0.015
				(2.924)	(61.370)	(0.171)	(2.328)	(63.244)	(0.177)
Post Paris $\times$ Δ Industry Energy Intensity$_t$				0.162	4.651	-0.018	0.017	4.233	-0.015
				(0.141)	(5.562)	(0.026)	(0.115)	(6.131)	(0.028)
Log (Assets)$_{t-1}$	0.149***	-3.439***	-0.019***	0.150***	-3.459***	-0.020***	0.149***	-3.463***	-0.020***
	(0.031)	(0.974)	(0.004)	(0.032)	(0.972)	(0.004)	(0.032)	(0.972)	(0.004)
Fixed Assets Ratio$_{t-1}$	0.508***	-1.595	0.023**	0.506***	-1.54	0.023**	0.510***	-1.527	0.023**
	(0.075)	(2.881)	(0.009)	(0.075)	(2.873)	(0.009)	(0.075)	(2.875)	(0.009)
Leverage Ratio$_{t-1}$	0.169**	-11.607**	-0.026***	0.170**	-11.592**	-0.026***	0.169**	-11.591**	-0.026***
	(0.084)	(5.215)	(0.008)	(0.085)	(5.210)	(0.008)	(0.084)	(5.211)	(0.008)
ROA$_{t-1}$	0.001*	-0.013	0.000	0.001*	-0.013	0.000	0.001*	-0.013	0.000
	(0.001)	(0.012)	0.000	(0.001)	(0.012)	0.000	(0.001)	(0.012)	0.000
Log (Size)$_{t-1}$	0.296***	-2.176**	0.005	0.297***	-2.189**	0.005	0.296***	-2.184**	0.005
	(0.051)	(1.068)	(0.005)	(0.051)	(1.071)	(0.005)	(0.051)	(1.067)	(0.005)
Log (Firm Age)$_{t-1}$	0.007	-19.696***	-0.021**	0.024	-19.599***	-0.021**	0.007	-19.645***	-0.021**
	(0.071)	(2.553)	(0.009)	(0.072)	(2.524)	(0.009)	(0.071)	(2.559)	(0.009)
Industry Real Value Added Growth$_t$	-0.079**	-2.918	0.003	-0.075**	-3.142	0.002	-0.074**	-3.149	0.002
	(0.033)	(2.103)	(0.008)	(0.036)	(2.199)	(0.009)	(0.035)	(2.218)	(0.009)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.570	0.109	0.161	0.570	0.109	0.161	0.570	0.109	0.161
N	173,653	200,251	234,180	173,590	200,174	234,093	173,590	200,174	234,093

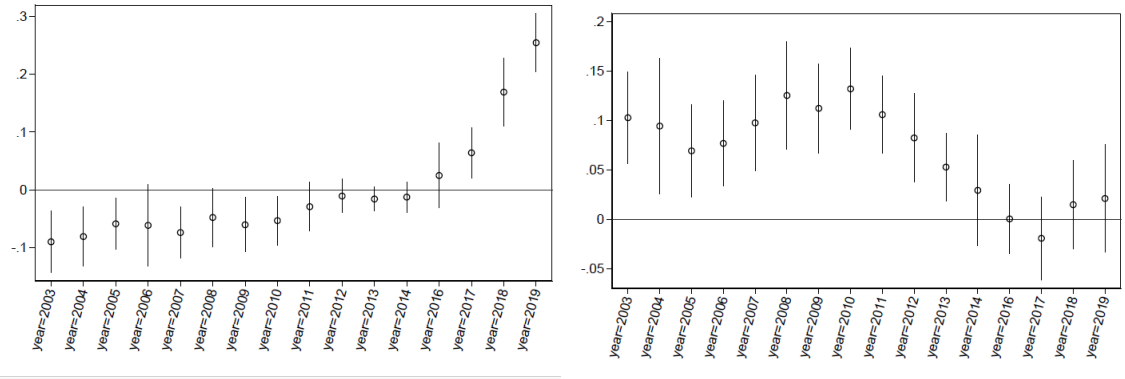
Notes: This table presents the estimation results for between industry analysis at the firm level regression, including the Post Paris dummy. Robust standard errors clustered at the industry level are reported in parentheses in all columns. Significance levels: ***1%, **5%, *10%.

Table 23: Between-Industry Analysis, Industry Level Regression (Post Paris)

	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation	Log (Balance)	Loan Growth	New Loan Initiation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Industry Emission Intensity$_{t-1}$	0.759***	18.887***	0.003				0.838***	20.403***	0.023
	(0.070)	(3.442)	(0.034)				(0.065)	(3.184)	(0.032)
Industry Energy Intensity$_{t-1}$	-0.065***	-0.849*	0.018***				-0.064***	-1.394**	0.015*
	(0.012)	(0.465)	(0.006)				(0.010)	(0.578)	(0.008)
Δ Industry Emission Intensity$_t$				0.052	1.83	0.097**	0.328***	6.016	0.088**
				(0.094)	(4.860)	(0.039)	(0.103)	(4.589)	(0.038)
Δ Industry Energy Intensity$_t$				(0.003)	(0.744)	-0.014***	-0.023*	(0.872)	(0.005)
				(0.017)	(0.662)	(0.005)	(0.013)	(0.649)	(0.006)
Post Paris $\times$ Industry Emission Intensity$_{t-1}$	-1.011***	-55.168***	-0.204***				-0.928***	-55.496***	-0.216***
	(0.148)	(6.753)	(0.057)				(0.129)	(7.331)	(0.062)
Post Paris $\times$ Industry Energy Intensity$_{t-1}$	0.015	6.047**	0.065***				-0.02	7.913***	0.068**
	(0.065)	(2.696)	(0.024)				(0.074)	(2.727)	(0.026)
Post Paris $\times$ Δ Industry Emission Intensity$_t$				-4.382***	-193.135***	-0.333	-2.970***	-86.439**	-0.072
				(0.930)	(33.476)	(0.241)	(0.795)	(36.675)	(0.285)
Post Paris $\times$ Δ Industry Energy Intensity$_t$				(0.130)	60.932**	0.029	(0.618)	57.853**	0.088
				(0.453)	(25.160)	(0.186)	(0.554)	(25.330)	(0.209)
Industry Real Value Added Growth$_t$	0.000	-15.587	-0.028	0.099	-12.397	0.024	0.107	-11.948	0.018
	(0.165)	(9.516)	(0.073)	(0.337)	(12.056)	(0.087)	(0.330)	(12.138)	(0.087)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2-digit Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sq	0.834	0.12	0.143	0.828	0.098	0.137	0.835	0.123	0.144
N	1,148	1,150	1,151	1,148	1,150	1,151	1,148	1,150	1,151

Notes: This table presents the estimation results for between industry analysis at the industry level regression, including the Post Paris dummy. Robust standard errors clustered at the industry level are reported in parentheses in all columns. Significance levels: ***1%, **5%, *10%.

Figure 10: Bank Loans in Green (left) and Dirty (right) Industries



At last, we use an alternative specification at the bank-year level to test credit reallocation across industries. As shown below, the left-hand side is a bank's share of loans in the relatively green industries. Relatively green industries are defined as those being at the bottom 25% with the lowest scope 1 industry-level emission intensity in a country. On the right-hand side, we have time fixed effects and bank fixed effects. The standard errors are clustered at bank level.

$$\frac{Bank\ Loan\ to\ Green\ Industries_{bt}}{Bank\ Loan_{bt}} = \beta_t + \beta_b + \epsilon_{bt} \tag{19}$$

for bank b and year t.

The estimated coefficients for the year fixed effects using 2015 as the base year are plotted below. The plot on the left is bank loans in the most green industries, while the right plot is bank loans in the most brown industries. There is a clear shift in credit after the Paris Agreement.

Overall, we find industry-level evidence that banks have been reallocating credit in recent years from browner industries to greener ones, especially when we measure the brownness in scope-1 emissions. However, the firm-bank level evidence is weaker.

Table 24: Result Summary: Denmark

Denmark:	**Cleaner firms/industries**	**Greening firms/industries**
Overall (scopes 1+2)	Lower amount, lower growth, more new loans	Lower amount, lower growth, fewer new loans
Within ind (scopes 1+2)	Lower amount, higher growth, more new loans	Lower amount, lower growth, fewer new loans
Between ind (scopes 1+2)	No effect	Higher growth, more new loans
Between ind (scope 2)	More growth, fewer new loans	Lower amount, lower growth, fewer new loans
Bank relations	Fewer exits	Fewer exits
Younger firms:	More exits	Fewer exits
Post-Paris		
Overall (scopes 1+2)	Higher amount	Higher growth, more new loans
Within ind (scopes 1+2)	Higher amount	Higher growth, more new loans
Between ind (scopes 1+2)	Higher amount	No effect
Between ind (scope 2)	Higher amount	No effect
Bank relations	Fewer formations	More formations
Younger firms:	No effect	No effect

Notes: Green means encouraging evidence for green transition. Red means discouraging evidence. Post-Paris effects are for additional effects. Industry-level analysis is not summarized here. Firm energy consumption intensity is scopes 1+2 and industry-level emission intensity is scope 2.

Table 25: Result Summary: Denmark, Dirtiest and Traditionally Dirty Industries

Dirtiest ind:	**Cleaner firms/industries**	**Greening firms/industries**
Overall (scopes 1+2)	No effect	No effect
Within ind (scopes 1+2)	Higher growth, more new loans	Lower growth, fewer new loans
Between ind (scopes 1+2)	No effect	No effect
Between ind (scope 2)	No effect	No effect
Post-Paris		
Overall (scopes 1+2)	No effect	No effect
Within ind (scopes 1+2)	No effect	No effect
Between ind (scopes 1+2)	No effect	No effect
Between ind (scope 2)	No effect	No effect
Traditionally dirty ind:		
Overall (scopes 1+2)	No effect	No effect
Within ind (scopes 1+2)	Higher growth, more new loans	Lower growth, fewer new loans
Between ind (scopes 1+2)	No effect	No effect
Between ind (scope 2)	No effect	No effect
Post-Paris		
Overall (scopes 1+2)	No effect	No effect
Within ind (scopes 1+2)	Lower growth, fewer new loans	No effect
Between ind (scopes 1+2)	No effect	No effect
Between ind (scope 2)	No effect	No effect

Notes: Green means encouraging evidence for green transition. Red means discouraging evidence. Post-Paris effects are for additional effects. Industry-level analysis is not summarized here. Firm energy consumption intensity is scopes 1+2 and industry-level emission intensity is scope 2.

Table 26: Result Summary: Denmark, Cleanest Industries

Cleanest ind:	**Cleaner firms/industries**	**Greening firms/industries**
Overall (scopes 1+2)	No effect	No effect
Within ind (scopes 1+2)	Lower amount	Lower amount, fewer new loans
Between ind (scopes 1+2)	No effect	No effect
Between ind (scope 2)	No effect	No effect
Post-Paris		
Overall (scopes 1+2)	No effect	No effect
Within ind (scopes 1+2)	Higher amount	Higher growth, more new loans
Between ind (scopes 1+2)	No effect	No effect
Between ind (scope 2)	No effect	No effect

Notes: Green means encouraging evidence for green transition. Red means discouraging evidence. Post-Paris effects are for additional effects. Industry-level analysis is not summarized here. Firm energy consumption intensity is scopes 1+2 and industry-level emission intensity is scope 2.

4 Conclusion [TBC]

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