Decarbonization without Divestment: Evidence from Intra-Group Loan Reallocation

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Abstract:

We examine whether banks' net-zero proclamations, via participation in the Net-Zero Banking Alliance (NZBA), lead to meaningful shifts in lending behavior. We find no evidence that NZBA signatories reduce the overall amount of their lending to groups with a brown parent firm. However, we observe shifts *within* borrowers: after signing the pledge, and conditional on making a loan to a brown group, NZBA signatories increase the proportion of the loans that flow to clean subsidiaries of that group. This is offset by a proportionate reduction in lending directly to the parent and its brown subsidiaries. These shifts in loan patterns do not appear to be offset by internal capital reallocations within borrowers. We also find evidence consistent with NZBA banks facilitating shifts in borrowers' behavior by charging higher interest rates to brown subsidiaries relative to the clean subsidiaries within a group. Collectively, our findings are inconsistent with banks primarily using the NZBA as a greenwashing vehicle. Our study further highlights the importance of measurement choices in assessing climate footprints in banks' lending portfolios – and the impacts of net-zero commitments.

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1. Introduction

In 2024, the Tax Justice Network published a report on 'greenlaundering', a form of greenwashing, which it defined as indirectly lending money to fossil fuel firms through those firms' subsidiaries.[1] Because loans are typically labelled as 'brown' or 'clean' based on the industry classification of the direct borrower rather than its parent, a loan to a clean subsidiary of a brown firm (e.g., Shell Wind Energy) is typically labelled as clean. Lending to such subsidiaries can therefore allow originating banks to report a lower carbon footprint – even if the money is subsequently shifted to a brown subsidiary. However, such lending behavior need not reflect an intent to greenwash. Extant research (e.g., Edmans 2023; Edmans, Levit, and Schneemeier 2024) highlights that shifting loans to brown groups' clean subsidiaries may be a more efficient way to facilitate low-carbon transitions. In this paper, we use the Net-Zero Banking Alliance (NZBA) as a setting to examine the origination behavior of banks and to examine potential greenlaundering. We address two primary research questions: (1) to what extent does intra-group loan reallocation occur after banks join the NZBA, and (2) if such actions occur, are they more consistent with greenlaundering—where borrower operations remain unchanged—or with actual shifts in borrowers' activities away from brown sectors?

Firms', asset managers', and banks' net zero pledges have become increasingly controversial in recent years, and it is ex-ante unclear whether banks would actually shift their behavior after signing such pledges. For example, several US states have attacked net zero and other ESG-related commitments as inconsistent with fiduciary duties to financial stakeholders (Rajgopal, Srivastava, and Zhao 2024), creating nontrivial costs of genuinely following through on such proclamations. Perhaps because of these attacks, several large American banks recently withdrew from the NZBA in the wake of the 2024 US election.[2]

[1] https://taxjustice.net/2024/09/11/how-greenlaundering-conceals-the-full-scale-of-fossil-fuel-financing/

[2] https://www.spglobal.com/market-intelligence/en/news-insights/articles/2025/1/with-jpmorgan-gone-all-major-us-banks-have-now-left-global-climate-alliance-85961423

Underlying these politicians' arguments is the assumption that net zero pledges reflect credible commitments (Desai, Lam, Li, and Rajgopal 2023), which in turn will shape investment and lending decisions. Conversely, other politicians, as well as several academic studies, have questioned the credibility of such commitments, labelling them as little more than greenwashing (e.g., Raghunandan and Rajgopal 2022; Kim and Yoon 2023; Sastry, Verner, and Marques-Ibanez 2024). Within the context of net zero commitments, greenwashing is enabled by the long-term horizon of such commitments and the frequent lack of meaningful short-term targets accompanying such commitments (Jiang, Kim, and Lu 2025). Moreover, banks' participation in the NZBA is voluntary rather than mandated by law or standard, and to that end banks may join primarily as a short-term reputational boost.

Given competing arguments about the impact of net zero pledges, we first examine banks' lending behavior to brown companies after signing up to the NZBA. However, our focus in this paper is on the extent to which banks reallocate loan capital *within* borrowing groups rather than *away* from borrowing groups. In this regard, our study differs from prior work on banks' net zero commitments that focuses on divestment (e.g., Morse and Sastry 2024; Sastry, Verner, and Marques-Ibanez 2024). These studies find minimal evidence of outright divestment, arguing that this is consistent with greenwashing by banks.[3] However, a lack of divestment need not necessarily indicate a lack of action. Prior work focuses on differences in lending *between* individual borrowers (either groups or standalone firms) rather than *within* individual borrower groups, making it difficult for researchers to identify real actions banks may take in lieu of divestment. Our focus on banks' relationships with borrowing *groups*, in contrast, allows us to speak to the question of whether banks may still be shifting lending behavior. Further, conditional on shifting, we are interested in distinguishing between actual decarbonization (Edmans, Levit, and Schneemeier 2024; Edmans 2023) and greenlaundering.

[3] For ease of exposition, we use the term 'divestment' in our setting to refer to the practice of a bank no longer originating loans to a given borrower, irrespective of how it treats previous outstanding loans.

When lending to standalone firms – typically smaller, and operating in a single sector – banks have two feasible actions after signing the NZBA pledge: (i) continuing to lend as before, or (ii) divesting.[4] Inasmuch as outright divestment may have high short-term costs, when these are a bank's only options it may choose to operate as before (i.e., option (i)). Conversely, when lending to groups, banks have an additional option: (iii) lending to *other* clean subsidiaries of the group. We view the exploration of option (iii) as the primary differentiator of our study relative to prior work. Indeed, banks may find option (iii) particularly attractive given that it allows them to maintain lending relationships, which prior studies highlight as particularly valuable to banks (Bird, Hertzel, Karolyi, and Ruchti 2024; Bharath, Dahiya, Saunders, and Srinivasan 2007). To formalize this insight, we develop a parsimonious model of bank lending to better understand the conditions under which banks would prefer each option. The model, outlined in detail in Appendix A, highlights three conditions that would lead NZBA banks to view within-borrower loan shifting as preferable to both divestment and maintaining the status quo. First, divestment is costly, e.g., due to risks associated with new borrowers. Second, the reputational benefits gained from lending to clean firms (or, equivalently, reputational costs associated with continuing to lend to brown firms) are modest but not zero. Third, foregone interest income from shifting away from brown loans is not sufficiently high. All three conditions are plausible within the set of bank-years in our sample, suggesting the possibility of within-borrower loan shifting.

To empirically test our paper's research questions we examine whether, after signing up to the NZBA, banks shift their lending away from fossil fuel groups.[5] We identify NZBA signees based on the date they signed up to the NZBA, and our sample period ends before the

[4] These are the firms that are most likely to find it prohibitively costly to pivot toward 'greener' business models, even under pressure from their lenders. To this end, it may also not be feasible for banks to insert meaningful contractual terms tied to these borrowers' environmental performance.

[5] While the NZBA is concerned with more than just the fossil fuel industry, we focus on fossil fuel companies because these are the companies that have been accused of greenlaundering.

recent (January 2025) departures of many prominent banks.[6] The first signatory banks joined the alliance in April 2021, while others joined in a staggered fashion over the subsequent two years. We identify loans to oil-related companies using data from DealScan. The borrowing groups' subsidiary structures are identified using DealScan and supplemented with ownership data from Orbis Historical, which provides detailed ownership links and industry classifications. This combined approach allows us to trace lending patterns to the group as a whole as well as to the specific subsidiaries that comprise the group.

Our research design relies on a stacked-cohort regression, following Baker, Larcker, and Wang (2022). We group NZBA member banks into cohorts depending on the year in which they made their commitment, and include (never-treated) control banks in these cohorts. To account for covariate imbalance between groups, we employ entropy balancing. In addition, we use a granular fixed-effects structure to account for any potential impact of concurrent shifts in the market for brown loans, e.g., if clean investment opportunities have become more (or less) attractive over time or if governments offer green subsidies.

We find no evidence of divestment at the group level: banks' lending to groups with brown parents does not change after signing the NZBA pledge. This result is consistent with Sastry, Verner, and Marques-Ibanez (2024). On the surface, the observed lack of group-level divestment supports the argument that joining the NZBA amounts to, on average, little more than greenwashing.

Although we do not observe group-level divestment, subsidiary companies within an oil group can be diverse in their operations, and some subsidiaries may even be clean. Our next set of tests therefore classifies loans based on the operations of the specific company

[6] In the face of political pressure on many of its member banks, the NZBA temporarily paused operations in August 2025 and suggested that it would transition to an advisory group rather than a membership-based group. Nonetheless, given the prominence of the NZBA during our sample period – and the fact that regulatory decarbonization initiatives targeting financial institutions continue to gain traction, especially in the EU – we view understanding banks' behavior in the wake of joining NZBA as worthwhile.

receiving the loan rather than their ultimate parent. When doing so, contrary to prior research, we find that lending to brown companies – i.e., brown parent companies as well as subsidiaries also operating in the fossil fuel industry – does actually decrease for banks after they join the NZBA. However, while these analyses are consistent with the notion that banks may be reallocating loan capital within brown groups, they do not provide direct evidence of such behavior; we turn to this issue next.

Given the importance of relationship lending, banks may find it too costly to completely divest from oil and gas groups on average after signing the NZBA. Thus, our next set of tests examines shifts *within* groups that banks may make subsequent to joining the NZBA. To do this, we conduct a series of tests at the bank-by-group level. In unconditional analyses – i.e., assuming that any bank could have originated a loan to an observed borrowing group – we find that NZBA signatory banks are not more likely to originate loans to clean subsidiaries of oil groups. This result further suggests that NZBA banks do not reallocate capital away from brown companies to other borrowers. However, if they have a previous relationship with the group, NZBA banks are incrementally more likely to originate the clean loans. Instead of divestment, this result is consistent with banks proactively shifting their lending decisions to abide by their NZBA commitments, while also keeping their lending relationships alive. To provide more concrete evidence on this conjecture, we restrict the sample to originations and include bank-by-group fixed effects. We find that NZBA banks shift some of their lending from a group's brown companies to the group's clean companies. Our results suggest that while banks may not choose to immediately stop lending to brown groups after joining the NZBA, they may still take actions consistent with the pledge.

One possible explanation for our findings thus far is that banks' response to the net zero pledge – by shifting which subsidiaries of a group they lend to – is consistent with greenlaundering. This is likely to be the case if borrowers' internal capital markets are fully efficient; in such a scenario, banks' choice of which subsidiary in a group to lend to has no

impact on the borrower's operations. However, if borrowers cannot – or do not – internally reallocate capital, then the shifts in lending we observe may translate into operational changes in borrowers. Put another way, if borrowers do not freely reallocate internally, as prior research suggests (e.g., Buchuk, Larrain, Prem, and Urzua Infante 2020), then a shift in lending toward clean subsidiaries should correlate to a greater increase in investment by a borrower's clean subsidiaries, relative to its brown subsidiaries. Reallocation frictions are especially plausible in our setting, given that subsidiaries can be located in different countries from each other where internal transfers to offset shifts in lending are subject to currency exchange risk, tax implications, and regulatory scrutiny.[7]

As expected, we find that net investment is greater for brown companies receiving loans. However, we do not find that brown companies' investment depends on the extent to which other companies within the group receive loans, consistent with borrowers being unable – or choosing not – to reallocate capital internally after another group member obtains external cash. We also undertake two more direct examinations of greenlaundering. First, we examine whether brown companies' investment is related to other non-brown subsidiaries' loans. We do not find any evidence for this, regardless of whether the lender is a NZBA member. Second, we repeat our bank-by-group analyses with a focus on finance subsidiaries rather than clean subsidiaries. We do this as these may be the easiest vehicles through which to engage in greenlaundering, as highlighted by the Tax Justice Network's 2024 report. We find no change in the proportion of loans made to finance subsidiaries of brown firms. Collectively, these results are consistent with banks' incentives potentially driving real shifts in borrowers' behavior.

[7] For example, a U.S. based Chevron subsidiary borrowed money from a bank at an interest rate of 1.2%. Subsequently, the subsidiary lent money to another Chevron subsidiary in Australia at 9%. The Australian Taxation Office (ATO) alleged that this transaction was not made at "arm's length" and took Chevron Australia to court. In 2017, the Australian courts ruled in favor of the ATO (https://www.pwc.com/th/en/pwc-thailand-blogs/blog-20220422-en.html).

The fact that borrowers do not fully reallocate loan capital is consistent with real within-group operational shifts rather than greenwashing by banks (facilitated by borrowing groups). However, it is not clear whether these shifts are driven by bank or borrower preferences. To shed light on this, we examine the interest rate spreads at which the loans are originated. If it is a supply side driven phenomenon, we would expect clean loans to be originated at a discount to brown loans. On the other hand, if it is demand side driven, we would expect clean loans to be originated at a premium to brown loans. We find empirical evidence consistent with a supply side effect. That is, banks may be able to drive within-borrower shifts consistent with NZBA commitments by offering discounts to clean subsidiaries. Importantly, subsidiary debt is generally guaranteed by the parent of the group (Lee, Liu, and Stebunovs 2017). Thus, within-group but between-subsidiary differences in interest rate spreads are unlikely to be explained by differences in risk.

Our paper makes three primary contributions. First, we contribute to the growing literature on the credibility of firms' and financial institutions' commitments to net zero and whether they 'walk the talk' with respect to environmental claims more generally (Larcker and Watts 2020; Raghunandan and Rajgopal 2022). This literature obtains mixed results, highlighting the importance of accounting for differences in the ways that firms and financial institutions shift their behavior – or don't – after signing up to green initiatives. Consistent with prior work (e.g., Sastry, Verner, and Marques-Ibanez 2024) we find minimal evidence of divestment at the group level. However, we find evidence of potential shifts in the set of borrowers within a group that banks lend to, consistent with recent arguments that tilting may be a more effective strategy than divesting (Edmans et al. 2024). To that end, we view our evidence as inconsistent with banks using net zero commitments as a form of greenwashing, although future work may find it beneficial to examine potential shifts in the types of projects that banks are lending to. Our findings also suggest that, while driving away borrowers

outright may be costly for NZBA banks (Morse and Sastry 2024), lower-cost mechanisms exist within the context of relationship lending for banks to meet their net zero commitments.

Second, we contribute to the literature on relationship lending. Prior literature has documented that lenders accrue significant benefits from ongoing relationships with their clients (e.g., Drucker and Puri 2005; Bharath, Dahiya, Saunders, and Srinivasan 2007; Bird et al. 2024). We contribute to this literature by providing evidence of a novel way to maintain a lending relationship when the bank faces constraints: shifting which subsidiary within a group to originate loans to. Our results highlight opportunities for future work within the context of other constraints that may inhibit banks' loans to some, but not all, subsidiaries in a group. Our results also suggest that, while business groups may have heightened flexibility in avoiding pressures to improve green performance (Cascino and Correia 2024), banks may still be able to drive shifts in borrowing groups' green investments via lending relationships.

Finally, we contribute to the literature on the consequences of measurement choices for financial institutions. Prior research has shown that the way in which regulatory banking ratios are measured impacts bank behavior (e.g., Chircop and Novotny-Farkas 2016; Ott 2025). We add to this line of research by showing that the measurement of banks' loans as brown based on the borrowing parent company versus the borrowing subsidiary company is important in the context of the NZBA. As a result, in the event that mandatory rules surrounding brown lending are adopted, our paper also has important policy implications.

2. Background and Related Literature

2.1 Green Lending

In April 2021, 43 of the world's largest banks formed the Net-Zero Banking Alliance. The NZBA requires signatories to make a variety of emissions related commitments. For example, signatories are required to commit to reaching net-zero emissions in their lending and investment portfolios by 2050. In addition, banks are required to set intermediate targets

for priority sectors by 2030. Importantly, these net-zero commitments extend to most of the banks' on-balance sheet lending and investing activities.[8]

Prior research is mixed on the effects of voluntary green commitments on bank lending. For example, Kacperczyk and Peydró (2022) find evidence that firms with high scope 1 emissions receive less funding from banks who have committed to the Science Based Targets Initiative. Using an international sample, Green and Vallee (2024) find that the adoption of coal exit policies by banks has led to less financing for coal plants. They further find that this reduction of financing has led to a reduction in coal-based emissions. On the other hand, Haushalter et al. (2023) find no such effect of exit policies on lending in a sample of U.S. banks while Billings, Ryan, and Yan (2025) document that banks' lending policies may have helped increase societal exposure to climate risk. Similarly, Aleszczyk, Loumioti, and Serafeim (2024) find that sustainability-linked loans (SLLs) – which tie loan pricing to green initiatives – have minimal impact on borrower behavior. Kleymenova, Li, and Li (2024) suggest that one benefit of SLLs may be to generate reputational gains and attract clients. The latter paper highlights a potential incentive to banks in obtaining green credentials. In turn, these incentives represent a potential reason for banks to join the NZBA as a form of greenwashing.

Perhaps the closest paper to ours is Sastry, Verner, and Marques-Ibanez (2024), who examine loans by European NZBA member banks. Sastry, Verner, and Marques-Ibanez (2024) do not find that these banks reduce credit supply to their targeted sectors after joining the NZBA, and that borrowers also do not improve in terms of sustainable practices. Two features distinguish our study from theirs. First, because Sastry, Verner, and Marques-Ibanez (2024) rely on a large sample derived from administrative data, most of the borrowers in their sample

[8] At its height, the NZBA was comprised of banks with a combined $70 trillion in assets. Starting in late 2024 into early 2025, the largest U.S. and Canadian signatories left the NZBA. Later in 2025, some of the largest European banks left the NZBA. However, many of the exiting banks have reaffirmed their commitment to sustainability (https://www.wsj.com/articles/net-zero-banking-alliance-suspends-activities-amid-wave-of-departures-fc1beef1?reflink=desktopwebshare_permalink).

are small firms, which are more likely to operate in a single line of business and cannot easily pivot. For example, a firm that *only* mines coal will find it more difficult to engage in green business activity, relative to a firm that both mines coal and generates wind energy; it is likely easier for the second firm to incrementally grow its 'green' business line than it is for the first firm to enter a completely new line of business. Second, we consider a global rather than European sample of banks. Given differential threats of regulation in Europe relative to the rest of the world (Morse and Sastry, 2024), European banks may have higher incentives to join the NZBA regardless of their intentions.

In light of the findings documented above, it is not ex-ante clear what shifts, if any, we would observe in banks' lending behavior after joining the NZBA. If banks behave in accordance with the NZBA commitment, they will aim to reduce greenhouse gas emissions in their lending portfolios, leading to a reduction in lending to brown firms. However, since the NZBA is a voluntary commitment without an associated enforcement regime, it may represent a method for banks to greenwash. We thus present our first hypothesis in null form: Hypothesis 1*: Joining the NZBA is not associated with a change in lending to brown companies.*

2.2 Relationship Lending

Prior literature details the benefits of relationship lending for both the borrower (e.g., Bharath et al. 2011) and the lender (e.g., Drucker and Puri 2005; Bharath et al. 2007; Bird et al. 2024). For example, Bharath et al. (2007) find that private lending relationships are positively associated with the likelihood of a bank underwriting future public debt and equity issuances. More recent research attempts to estimate the value of the lending relationship from the lender's perspective: Bird et al. (2024) estimate that the value of relationships is, on average, 6.6% of bank assets and 11.6% of individual loans' principals.

The studies above highlight the importance and economic significance of relationship lending to banks. To that end, if NZBA banks want to maintain valuable relationships with

brown groups, outright divestment will be costly. This, in turn, creates an incentive to shift their lending to clean companies within brown groups: doing so (i) preserves lending relationships, while (ii) allowing NZBA banks to take actions that are, on the surface, consistent with commitments to net zero. In our analytical model, presented in Appendix A, we highlight the conditions under which banks may find such behavior optimal. These actions could be consistent either with the desire to greenlaunder or to genuinely influence brown groups to increase their share of cleaner investments. Both greenlaundering and a genuine desire to impact borrowers would be consistent with banks having incentives to shift their within-group lending toward clean subsidiaries, leading to our second hypothesis:

Hypothesis 2: *Past lending relationships are associated with shifts in within-group lending by NZBA banks toward clean subsidiaries.*

2.3 Capital (Re)allocation Among Subsidiaries

Our model, presented in Appendix A, highlights banks' potential incentives to shift their lending to clean firms within a brown group. However, it is not clear if this represents behavior consistent with the NZBA or greenlaundering. To be consistent with greenlaundering, we would expect that loans to nonoil subsidiaries would eventually find their way to the oil subsidiaries within the group, i.e., we would expect minimal to no impact on borrowing groups' capital allocation. Conversely, a lack of reallocation would be inconsistent with greenlaundering by banks.

Capital reallocation across subsidiaries in a group could arise in borrowing groups with efficient internal capital markets. However, while a large literature documents internal capital reallocation within multi-segment firms (e.g., Shin and Stultz, 1998; Duchin and Sosyura, 2013; Giroud and Mueller, 2015), the circumstances under which reallocation *across* firms in a group – which have their own financial statements, are subject to their own taxes, and are subject to several restrictions on related-party transactions – occurs are less clear. Prior literature largely focuses on financial distress (e.g., Almeida, Kim, and Kim 2015; Beaver,

Cascino, and Correia 2024; Gopalan, Nanda, and Seru 2007), finding that groups reallocate capital to mitigate bankruptcy risk and the impact of financial crises. However, these are settings in which within-group reallocation occurs in response to extreme negative shocks; it is less clear that borrowing groups would respond in a similar way to positive shifts in capital allocation to specific subsidiaries. We therefore present our third hypothesis in null form:

Hypothesis 3*: Companies in brown groups do not re-allocate loans among themselves.*

3. Data

3.1 Lender Data

Our primary data source on syndicated loans is Refinitiv's DealScan, which provides information on syndicated lending at the bank-tranche level. DealScan includes detailed data on lenders, lead arrangers, borrowers, and tranche-specific characteristics such as loan amount, maturity, and interest rate. In our analyses, we focus on lead banks involved in syndicated loan transactions, given their pivotal role in deal facilitation, contract structuring, and subsequent borrower monitoring (Sufi 2007; Ivashina 2009). We classify a bank as a lead bank in a tranche if DealScan lists it in either the *Primary Role* or *Additional Role* fields as "administrative agent," "lead bank," "lead arranger," "agent," "arranger," "lead manager," or "bookrunner," following Ivashina (2009).

To identify banks that have committed to the NZBA, we manually collect the list of pledge-related banks directly from the official NZBA website.[9] We collected the data in December 2024, prior to several large U.S. banks leaving the alliance. We match lender names from DealScan with the official NZBA signatory list from April 2021 (the date of the first bank signature) to December 2024 (the latest period for which DealScan provides complete and updated lending data). During this period, a total of 146 banks signed the NZBA pledge.

[9] https://www.unepfi.org/net-zero-banking/members/

To control for time-varying bank-level characteristics, we use data from Orbis Financials for Banks. This dataset provides detailed financial statement information for banks globally, including profitability, loan exposure, capital ratios, non-performing loans, and geographic identifiers. We match lenders in Orbis to those in DealScan using a combination of methods, including exact matching and cosine similarity, followed by manual verification to ensure accuracy. Appendix C provides a detailed description of our matching process.

3.2 Borrower Data

Our empirical strategy relies on accurately identifying subsidiaries and their respective parent companies. Although DealScan provides parent-company information for borrowers, these records are often inaccurate.[10] To address this issue, we match DealScan borrowers to firms in Bureau van Dijk's Orbis Historical database, which contains time-stamped global ownership and financial information for both public and private companies. This allows us to fill in ownership gaps or correct inaccuracies present in DealScan data. Detailed descriptions of our matching methodology are presented in Appendix D.

3.3 Sample Construction

To construct our bank–year panel, we start from syndicated loan data in DealScan (2017–2024) and retain only loans whose borrowers can be matched to firms in Orbis Historical. We further require each matched borrower to have a valid global ultimate owner identifier (GUO BvDID) and retain the observation only if the GUO is a corporate entity. Borrowers whose GUO is non-corporate (e.g., an individual or family) are excluded. On the bank side, we restrict the sample to lead arrangers in syndicated deals and further remove

[10] During our sample period, DealScan reports that the borrower and parent company are the same for 92.3% of borrowers. We randomly selected 50 of these cases and, through Google searches and Orbis verification, found that for 7 out of the 50 borrowers, the actual parent information differs from what is listed in DealScan.

non-bank lenders—e.g., asset managers, development banks, and finance companies—that participate in syndications but are ineligible or unlikely to sign the NZBA (e.g., Citadel Securities, D.E. Shaw & Co., Adani Rail Infra Pvt. Ltd.).

We then aggregate syndicated lending data from DealScan to the bank–year level. For each bank–year observation, we compute the percentage of loans extended to: (1) brown groups and (2) brown borrowers. We define brown groups as business groups whose parent company operates in fossil fuel-related industries (namely, the oil & gas and mining sectors). Industry classification is based on SIC codes following Trinks (2018) and Ferro (2025). We define brown borrowers as individual firms operating in these sectors regardless of parent classification. We report a detailed list of SIC code classifications in Appendix E. We calculate percentages using the number of loans led by each bank in a given year, rather than loan volumes. This choice reflects a key limitation of the DealScan data: while total facility sizes are reported at the loan level, lender-specific allocations are often missing. In our sample, only 8.1% of observations contain non-missing lender share information. Counting the number of loans led by a bank offers a more consistent measure of its lending activity.

To account for bank-specific, time-varying characteristics, we merge the aggregated bank-year dataset with financial information from Orbis Financials for Banks and exclude unmatched banks. We further merge in NZBA pledge data. Of the 146 banks that signed the NZBA pledge, we are able to match 84 to our lending sample.

NZBA signatories are predominantly large, public, multinational banks. In our matched sample, 70 signatories are public (83%). To address differences between treated (NZBA) and control banks—which tend to be smaller and more often private—we take two steps. First, we restrict the analysis to public banks. Restricting to public banks mitigates coverage and data-quality differences in DealScan/Orbis that disproportionately affect private banks. Second, public and private banks differ in ownership, governance, funding access, and disclosure requirements, which could confound NZBA effects. To address other

differences in observable characteristics between NZBA and non-NZBA banks, we use entropy balancing to construct weights that ensure covariate balance across key pre-treatment characteristics (Hainmueller 2012). For each cohort, we keep the first observation for each bank in the pre-period and balance on observable covariates—including log assets (*Ln Assets*), return on assets (*ROA*), loan to asset ratio (*Total Loan*), capital ratio (*Capital Ratio*), non-performing loans (*NPL),* net interest margin (*Net Interest Margin*), and syndicated lending (*Syn Loans*). The entropy balancing algorithm assigns weights to control observations such that the reweighted control group matches the treated banks in terms of the first moments of the covariates.[11] Treated banks retain a weight of one. The weights for each bank are then assigned to the other observations of that bank within each cohort. After excluding banks with missing data or insufficient pre-treatment observations, 53 NZBA signatories remain in the estimation sample.

4. Research Design and Results

4.1 Bank-year regressions

We begin our analysis by examining the share of banks' syndicated lending directed toward brown business groups each year after they sign the NBZA. Since banks in our sample adopted the pledge at different times, we employ a stacked cohort difference-in-differences design to effectively address biases arising from already-treated observations being used as controls for later treatments and from time-varying treatment effects due to staggered treatment adoption (Gormley and Matsa 2011, Baker, Larcker, and Wang 2022). Each cohort is composed of treatment observations (banks that have signed the NZBA) and control

[11] We begin by entropy balancing each cohort on the first two moments (means and variances) of the covariates. If the algorithm does not converge, we match only the first moment (means) using the smallest tolerance that leads to convergence.

observations (banks that have never signed the NZBA) in a t-4 to t+3 event window including the treatment year.[12] We then estimate the following equation:

$$Y_{itc} = a_{tkc} + a_{ic} + \beta NZ\ Signed_{itc} + \gamma X_{it-1c} + \epsilon_{itc}\ (1)$$

The subscripts *i, t, k*, and *c* denote bank, year, country, and cohort, respectively. Y_{itc} is a set of dependent variables that measure the share of total syndicated lending (in terms of the number of loans) by bank *i* in year *t* extended to (1) *Brown Group%:* the share of loans to the overall business groups with brown parents; (2) *Brown Borr in Brown Group%:* the share of loans to the brown companies within brown business groups, and (3) and *Brown Borr%* the share of loans provided to firms that are classified as brown (regardless of whether they are in a brown business group). *X* represents a vector of bank-year control variables that capture observable, time-varying bank characteristics potentially influencing lending decisions. These include the natural logarithm of total assets (*Ln Assets*), the ratio of total loans to total assets (*Total Loan*), non-performing loans scaled by total loans (*Non-performing Loan*), net interest margin (*Net Interest Margin*), total capital ratio (*Capital Ratio*), and return on assets (*ROA*) (Sapienza 2004; Ivashina and Scharfstein 2010). All control variables are measured at year *t*-1. Additionally, we control for a bank's overall syndicated lending activity by including the number of syndicated and bilateral loans it extends in the current year (*Syn Loans*). We also include cohort-bank fixed effects to control for time-invariant bank characteristics within each treatment cohort, and cohort-country-year fixed effects to capture cohort-specific, country-time varying factors influencing banks' lending decisions. Our bank-level analyses contain 3,874 bank-year observations covering 292 unique banks from 2017 to 2024. We provide full details of our sample construction in Table 1.

4.2 Descriptive statistics

[12] In order to have data in the post-period, our sample only includes cohorts for banks that adopted in 2021, 2022, and 2023.

Table 2 provides descriptive statistics on the distribution of our sample. Panel A reports the distribution by year. We observe a declining trend in loans extended to brown borrowers while lending to brown groups remains relatively constant. However, we observe fluctuations across years in loans extended to clean-related subsidiaries within these groups.

Panel B reports the top 20 banks leading syndicated loans to oil business groups. Among the top 20 lenders to brown groups, 16 banks are NZBA signatories. Large multinational banks, including Wells Fargo, JP Morgan, and Bank of America Securities, led the highest number of syndicated loans to brown groups. On average, the top 20 banks exhibit greater exposure to brown groups: approximately 7.3% of syndicated loans arranged by these banks are extended to brown groups, compared to 5.8% in the full sample. When considering loans to brown firms regardless of group classification, the top 20 banks allocate an average of 7.8% of their portfolio, slightly higher than the overall average of 7.7%.

4.3 Bank-year results

Table 3 Panel A reports summary statistics showing that, on average, lending to brown business groups (*Brown Group%)* represents 5.7% of lead banks' annual syndicated lending. Of this, loans to brown firms within brown business groups (*Brown Borr in Brown Group%)* account for 5.2% of total lending. When considering all brown firms, regardless of parent classification (*Brown Borr%),* the share rises to 7.5% of banks' annual syndicated lending. We present these figures to contextualize our results from estimating equation (1).

Table 3 Panel B reports results from estimating equation (1). In column (1) the dependent variable measures the share of lending (in number of loans) to brown business groups (*Brown Group%).* The coefficient on NZ Signed is insignificant. This result is consistent with banks undertaking no meaningful changes in overall lending volume to oil-related groups after joining the NZBA, consistent with Sastry, Verner, and Marques-Ibanez (2024).

While the parents of the groups we examine are all brown, it is not the case that their subsidiaries are all brown. To that end, we refine our dependent variables by classifying loans based on the operations of the specific company receiving the loan rather than their ultimate parent. Specifically, we use *Brown Borr in Brown Group%*, which measures the share of loans extended to brown parents and subsidiaries within a brown business group. In addition, because not all brown borrowers belong to brown groups, we also examine *Brown Borr%*, which captures the overall share of lending to all brown firms. Column (2) reports results for *Brown Borr in Brown Group%*. We find a coefficient of –0.018, significant at the 5% level, indicating that NZBA adoption is associated with reduced lending to brown firms within brown groups. This effect corresponds to an average relative reduction of approximately 30% of the standard deviation. Column (3) reports results for Brown Borr%, where we find a similar decline (–0.021 at the 5% level) in banks' overall lending to brown borrowers. Relative to the standard deviation of 0.088, this represents about a 25% relative decrease.

These results suggest that although banks do not reduce their overall lending to brown business groups, they shift lending away from brown-specific operations toward subsidiaries that are not directly brown (i.e., oil & gas and mining related). We take this as evidence against the null hypothesis 1. One interpretation of this result, based on our analytical model in Appendix A, is that banks do not view the reputational benefits accrued from reducing overall lending to brown business groups as a sufficient offset to the risk associated with originating loans to a new set of borrowers.

Our empirical approach relies on the parallel trends assumption, i.e., that lending patterns to brown groups by banks signing the NZBA pledge would have evolved similarly to those of banks that never signed. To evaluate this assumption, we define indicator variables for each event year from t−4 through t+3 and replace *NZ Signed* in equation (1) with these indicators interacted with a treatment-bank indicator. We omit the year t−4 to avoid multicollinearity. Figure 1a plots the results using *Brown Group%* as the dependent variable,

while Figures 1b and 1c present the results for *Brown Borr in Brown Group%* and *Brown Borr%*, respectively. We observe no significant differences between treated and control banks in the pre-treatment period, providing support for the parallel trends assumption.

4.4 Unconditional Bank-Borrower Group-Year

While the evidence presented above is consistent with banks shifting away from brown companies, it is not clear whether the loans are shifted to other companies in the group or to other groups altogether. Our next set of tests, at the bank-borrower group-year level, attempts to distinguish between these two explanations. Conducting analyses at the bank-borrower group-year level allows us to examine changes in the likelihood of banks' lending to clean operations within brown groups and to assess how existing bank–borrower relationships influence these lending decisions.

We restrict our analysis to brown business group and then aggregate DealScan loan-level data at the bank–borrower group–year level. We further expand the dataset to account for all potential bank–borrower group lending relationships by including all possible bank-borrowing group pairs. For observations in which no lending occurs, we assign a value of zero. This approach is similar to Bharath et al. (2007) and offers the advantage of capturing all potential lending relationships, thereby enabling us to examine how prior bank-borrower relationship affects credit allocation to brown groups.[13] We apply a similar stacked cohort difference-in-differences research design as before, where cohorts are defined by the year in which banks sign onto the NZBA. As in our bank-year analysis, we use entropy balancing at

[13] For example, if there are *n* loans originated in a year and there are *i* banks in our sample that year, then the unconditional analysis would include *n*i* observations for the year. That is, we assume that *ex-ante* any of our sample banks could have originated a given loan whereas *ex-post* only one (or a few) banks will have actually originated the loan.

the bank-cohort level to construct weights that ensure covariate balance across pre-treatment characteristics.[14] Using an event window from $t - 4$ to $t + 3$, we estimate:

$$Clean\ Sub\ Loan_{iktc} = a_{ktc} + a_{ic} + \beta NZ\ Signed_{itc} + \gamma X_{it\text{-}1c} + \epsilon_{iktc} \quad (2)$$

Subscripts i, k, t, and c denote bank, business group, year, and cohort, respectively. Our dependent variable, *Clean Sub Loan,* is an indicator capturing whether a bank extends a loan to the clean subsidiaries within a brown group in year t. We begin this analysis by focusing on all clean subsidiaries and all potential bank–subsidiary pairs. In addition, we examine whether lending relationships influence the likelihood that clean subsidiaries within brown groups receive loans following a bank's NZBA commitment. To do so, we partition the sample based on whether the bank-group pair has a prior lending relationship. We define a relationship as the bank having acted as a lead arranger in a deal to the same group at least once in the five-year window from t–6 to t–1.[15] We repeat the baseline analysis separately within these two subsamples to test whether lending relationships interact with the effect of NZBA commitments on loan allocation to clean subsidiaries. All specifications include a vector of bank-year control variables (X) consistent with prior analyses.

We present the results in Table 4. Panel A presents the sample construction process; Panel B reports summary statistics for the regression sample. Panel C presents the regression results. Column (1) reports results for clean subsidiaries across all possible bank–subsidiary pairs, regardless of prior lending relationships. We find no evidence that, on average, banks increase lending to clean subsidiaries within brown groups following NZBA adoption. Columns (2) and (4) restrict the sample to pairs with five- or ten-year lead lending relationships between the bank and the business group. Within these relationships, clean subsidiaries are significantly more likely to receive loans after the bank signs the NZBA pledge. Columns (3)

[14] We entropy balance at the bank-cohort level. However, for each bank within a cohort-year there is an observation for each borrower group. As a result, when assigning the bank-weights to the bank-borrower observations, we value weight them by the size of the borrowing group's loan.
[15] Alternatively, we define a relationship from t-11 to t-1.

and (5) report results for subsamples without such prior relationships, where we find no evidence of increased lending. In both cases, the differences are significant.[16] Taken together, these results suggest that banks expand lending to clean subsidiaries within brown groups only when a pre-existing lending relationship with the group exists.

4.5 Conditional Bank-Borrower Group-Year

In this section, we further investigate how banks shift their lending within a business group. To do so, we again construct bank-borrower group-year data. However, we restrict the sample to originated loans. As in our unconditional analyses, we restrict the analysis to brown business groups and employ entropy balancing.[17] We estimate the following regression:

$$Clean\ Sub\%_{iktc} = a_{ikc} + a_{tc} + \beta NZ\ Signed_{itc} + \gamma X_{ikt\text{-}1c} + \epsilon_{iktc} \quad (3)$$

The subscripts *i, k, t*, and *c* denote bank, business group, year, and cohort, respectively. The dependent variable *Clean Sub%* is the share of loans made to subsidiaries that are neither brown nor finance. Each share is computed relative to the total number of syndicated loans extended by bank *i* to group *k* in year *t*. *X* represents a vector of bank-year control variables consistent with previous analyses. In our most rigid specification, we employ cohort-bank-group fixed effects to focus on within bank-group lending shifts and cohort-country-year fixed effects to control for country-specific time-varying factors. As in our other analyses, we stack bank-borrower group-year observations to form our conditional bank-borrower group-

[16] The number of observations in the subsamples are imbalanced because this is an unconditional analysis. Specifically, for every group that receives a loan in a given year, every single bank in our sample during that year is matched to that observation as a potential lender. Very few of these bank-borrowing group pair matches, on average, have a prior relationship.

[17] Unlike the unconditional analysis, the number of bank-group observations within a bank-cohort-year varies, because one bank may make loans to more groups than another bank. As a result, in order to prevent large lenders with relatively more observations from solely driving the results, we follow prior literature and value weight the observations within a bank-cohort-year by loan volume (Iselin, Nicoletti, Ott, and Zhang 2025).

year regression dataset. Our conditional bank- borrower group -year regression dataset consists of 103 unique banks lending to 354 brown business groups.

Table 5 presents results. Panel A details sample construction. Panel B reports summary statistics showing that, conditional on a brown group receiving loans, approximately 10.1% of those loans are directed to clean operations within the group. Panel C reports results from estimating of equation (3). Column (1) includes cohort-bank, cohort-group, and cohort-country-year fixed effects to absorb unobservable variation within banks, groups, and countries over time. Column (2) further adds cohort-bank-group fixed effects to account for specific bank–group relationships that may influence lending to clean subsidiaries. Across both specifications, the coefficients on *NZ Signed* are positive and significant at either the 5% or 1% level. This indicates that, after controlling for observable bank characteristics, NZBA adoption is associated with a reallocation of lending within brown groups away from brown operations toward clean subsidiaries. Collectively, Tables 4 and 5 support Hypothesis 2 and highlight the potential importance of lending relationships for clean financing.

5. Mechanisms

5.1 Borrower Capital Allocation

While we provide evidence that banks shift their lending to clean subsidiaries within brown conglomerates, it is unclear whether banks are undertaking other shifting activities which may be inconsistent with the goals of the NZBA. For example, a bank may also direct credit to finance subsidiaries within a brown group—e.g., lending to Glencore Finance Europe Ltd. rather than to the parent company Glencore International AG—allowing these entities to channel capital across the group as needed. Second, even when banks lend to non-brown, non-finance subsidiaries (i.e., clean subsidiaries as we define them), the funds could still be redistributed through internal capital markets to brown subsidiaries. Both channels would run counter to the spirit of the NZBA and could be viewed as forms of greenwashing.

To shed light on these mechanisms, we design three empirical tests. First, we examine whether banks increase lending to finance subsidiaries within brown business groups, as alleged by the Tax Justice Network. We repeat our unconditional bank–group–year analysis but replace the dependent variable with *Finance Sub Loan*, an indicator equal to one if bank *i* extends a loan to group *k*'s finance subsidiaries in year *t* (finance subsidiaries are defined as those with SIC codes beginning with 6). Second, we repeat the conditional bank–group–year analysis and replace the dependent variable with *Finance Sub%*, which measures the share of bank *i*'s lending directed to finance subsidiaries of brown group *k* in year *t*. Finally, we shift focus to borrowing groups and investigate whether they reallocate capital internally after obtaining syndicated loans. To test this, we restrict the sample to brown firms within business groups—both parents and subsidiaries—and estimate the following regression model at the subsidiary-year level (i.e., from the borrower's perspective):

$$NetInv_{st+1} = a_s + a_{tjc} + \beta_1 Loan_{st} + \beta_2 Num\ Other\ Group\ Loans_{st} + X_{st} + \epsilon_{st+1} \quad (4)$$

The subscripts *s, t, j,* and *c* denote subsidiary, year, industry, and country, respectively. The sample consists of all brown companies within the brown groups that received syndicated loans from 2017-2024. The dependent variable is net investment in the subsequent year (*NetInv*). We measure *NetInv* as the annual change in tangible assets scaled by total assets in year *t*. The primary independent variables in Equation (4) include *Loan,* an indicator equal to one if firm *s* receives a syndicated loan in year *t,* and *Num Other Group Loans*, the number of firms in the same business group who received a syndicated loan, excluding firm *s*. Firm-level control variables include return on assets (*ROA*), size (*Ln Assets*), firm age (*Ln Age*), and leverage (*Lev*).

The above analysis is meant to provide a baseline understanding of the functioning of internal capital markets across a group of subsidiaries. However, in the context of the NZBA, we are particularly interested in these reallocation dynamics (or lack thereof) for oil

companies, and further, whether these dynamics are influenced by the lending banks' participation in the NZBA. To accomplish this, we estimate the following regression model:

$$NetInv_{st+1} = a_s + a_{tjc} + \beta_1 Loan_{st} + \beta_2 Num\ Other\ NonBrown\ Sub\ Loans_{st} + \beta_3 Num\ Other\ NonBrown\ Sub\ Loans_{st} * NZ_{st} + \beta_4 Num\ Other\ NonBrown\ Sub\ Loans_{st} * NZ * Post_{st} + X_{st} + \epsilon_{st+1} \quad (5)$$

The subscripts *s, t, j,* and *c* denote borrower, year, industry, and country, respectively. This is similar to Equation (4), but we replace *Num Other Sub Loans* with the number of syndicated loans received by non-brown subsidiaries within the firm's business group (*Num Other NonBrown Sub Loans*). We further interact this measure with the average proportion (from these loans) of lead lenders that have joined or will join the NZBA (*Num Other NonBrown Sub Loans*NZ*). *Num Other NonBrown Sub Loans*NZ*Post* is defined in a similar manner, but is based off of lead lenders who have already joined the NZBA. We again control for return on assets (*ROA*), firm size (*Ln Assets*), firm age (*Ln Age*), and leverage (*Lev*).

Table 6 presents the results. Panel A reports summary statistics. On average, 11.3% of firm-year observations involve a syndicated loan. The average number of other firms in the same business group receiving a loan in a given year is 0.76, with, on average 0.39 loans going to other non-brown subsidiaries. Additionally, we report the dependent variables *Finance Sub Loan* and *Finance Sub%*, which are used in our unconditional and conditional bank–group–year analyses of lending to finance subsidiaries.

Table 6 Panel B reports the results of re-estimating our unconditional bank–group–year analysis using *Finance Sub Loan* as the dependent variable. Across all samples and specifications, we find no evidence that banks change their likelihood of extending loans to finance subsidiaries within business groups after signing the NZBA, regardless of whether a prior relationship exists. Panel C of Table 6 reports the results of re-estimating our conditional bank–group–year analysis with *Finance Sub%* as the dependent variable. Here, we again find no evidence that banks increase the share of lending directed to finance subsidiaries within

brown groups. In fact, in the specification including cohort-bank-group and cohort-country-year fixed effects, NZBA-signing banks appear to reduce their lending to finance subsidiaries.

Panel D of Table 6 presents the regression results of estimating equation (4) and (5). Column (1) reports estimates from Equation (4). The coefficient on *Loan* is positive and statistically significant, indicating that brown firms increase investment following the receipt of a syndicated loan. *Num Other Sub Loans* is statistically insignificant, indicating that syndicated loans to other firms within the group do not appear to influence the focal firm's investment. Taken together, the results provide a nuanced view of capital allocation within groups: we do not find any evidence for loans passing through to other companies within a group for investment purposes. Column (2) presents the results from Equation (5), which focuses on loans made to non-brown subsidiaries within business groups. We find no evidence that loans to these non-brown subsidiaries—whether led by banks that have or have not signed the NZBA—affect subsequent investment by brown companies in the same group. These results suggest limited flows of loan funding from non-brown to brown subsidiaries, regardless of bank sustainability commitments. Columns (3) and (4) replicate the analysis in Columns (1) and (2), but replace group fixed effects with firm fixed effects.

The results from this set of analyses provide no evidence that banks increase lending to finance subsidiaries after signing the NZBA pledge, nor that business groups redirect financing obtained by clean subsidiaries to brown subsidiaries. As a result, we are unable to reject Hypothesis 3.

5.2 Interest Rate Spreads

The fact that borrowers do not fully reallocate loan capital is consistent with real within-group operational shifts rather than greenwashing by banks (facilitated by borrowing groups). However, given that borrowers can borrow from other (non-NZBA) banks, it is not clear why the borrowers are receptive to this shift. We propose and examine a mechanism by

which banks can induce these shifts: differential interest rates. In particular, we examine whether banks adjust the pricing of syndicated loans depending on whether the loans are going to brown or clean companies. If banks intend to reallocate credit away from brown entities, they may offer more favorable terms to clean affiliates to facilitate this shift. Importantly, subsidiary debt is generally guaranteed by the parent of the group (Lee et al. 2017). Thus, within-group but between-subsidiary differences in interest rates are unlikely to be explained by differences in risk. To that end, if we observe a discount (premium) for clean loans this is suggestive of a supply (demand) increase. To test this conjecture, we examine individual loan facilities that are originated and we adopt a research design similar to the conditional bank–borrower–level analysis. Specifically, we estimate the following:

$$Spread_l = a_{tsc} + a_{ikc} + \beta_1 NZ\ Signed_{itc} + \gamma X_{ikt\text{-}1c} + \eta Z_{itc} + \epsilon \quad (6)$$

The subscripts *i, k, l, t, s,* and *c* denote bank, borrower, loan, year, country, and cohort, respectively. The dependent variable, *Spread*, is Interest rate (net of LIBOR of SOFR) of the syndicated loan facility extended by bank *i* to brown group *k* in year *t*. As in previous specifications, we include controls for bank-year covariates. We also incorporate borrower-level characteristics (*Z*) known to influence pricing: loan size (*Size*), loan maturity (*Maturity*), and the incidence of covenant usage (*Covenants*). Following our main approach, we construct the regression sample by stacking bank–borrower group–year observations. To address potential imbalance in pre-treatment characteristics, we apply entropy balancing as in our conditional analysis to generate weights that achieve covariate balance across treated and control observations. We further split the sample into brown firms within brown groups and clean firms within brown groups to examine whether rate adjustments differ across subsidiary types.

Table 7 presents the results. Panel A reports summary statistics, and Panel B presents the regression estimates from the above specification. In column (1), the coefficient on *NZ Signed* is statistically insignificant. This result is consistent with *NZBA* banks keeping their

pricing for brown group loans relatively consistent with non-*NZBA* banks. However, when we examine the operations of individual companies within the group who are the recipients of loans, we find evidence that clean loans (column (2)) are offered at a discount to brown loans (column (3)). This difference is significant and consistent with a supply side effect as noted above. We repeat this analysis in columns (4) – (6) with more granular fixed effects and find similar results. Overall, the evidence indicates that after signing the NZBA, banks systematically reprice credit within brown business groups—charging relatively lower spreads to clean entities. This induces a shift in the companies which take on loans-and could ultimately impact the real operations of the group**.**

6. Conclusion

We examine banks' lending behavior subsequent to joining the Net-Zero Banking Alliance (NZBA). Ex-ante, it is unclear whether (i) banks will shift their lending behavior at all in line with the NZBA's goals, and, if so, (ii) whether these shifts are associated with any changes in borrowers' operations. We find that after signing up to NZBA, banks' overall lending to groups in the brown industry does not change; however, banks appear to shift loans within brown groups toward those groups' clean subsidiaries. Borrowers do not appear to fully internally reallocate borrowed capital, suggesting that these lending patterns may help facilitate shifts in borrowers' operations.

Our study has implications both for the literature on the credibility of net-zero commitments as well as on relationship lending. Our finding that banks do not appear to outright divest from brown borrowing groups after joining NZBA, but that they may shift *how* they lend to such groups, provides context for prior studies that document the lack of outright divestment that we do. Divestment reflects a costly action on the part of a lender, without necessarily facilitating change in borrowers' behavior if other sources of loan capital are readily available. By contrast, engagement via strategic subsidiary lending-facilitated by shifts

in interest rates represents a less costly action for banks that join the NZBA but wish to still maintain valuable lending relationships. The fact that brown borrowers do not appear to fully reallocate capital internally in the wake of lending shifts is inconsistent with such behavior being purely reflective of greenwashing. Overall, our results highlight the importance of measurement and an assessment of the costs of the various forms of compliance with green pledges in understanding the credibility of financial institutions' net zero pledges.

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APPENDICES

Appendix A – Model

A unique feature of our setting, relative to that in prior literature, is our focus on clean borrowers with both brown and clean subsidiaries. These borrowers' subsidiaries are typically not all considered brown. For example, Shell Plc has several oil and gas subsidiaries but also a prominent 'clean' subsidiary (Shell Wind Energy). To that end, if the carbon footprint of a 'borrower' is calculated based on the specific entity receiving the loan rather than the parent company – as is typically the case – a bank that signs up to NZBA may subsequently prefer lending to clean subsidiaries of a firm relative to brown subsidiaries. Moreover, the financial risk associated with lending to any two subsidiaries of a firm should also be equivalent given that parents typically guarantee subsidiary debt. Thus, if the bank has a preexisting lending relationship with (any member of) a brown group, after signing up to NZBA the bank may also prefer the clean subsidiary of the brown group over divesting from the brown group outright. We provide a simple model in this Appendix to illustrate how this can happen and characterize conditions that may give rise to this scenario as an optimal choice for lenders.

A.1 Model Setup

We model the behavior of a single representative bank that has signed up to the NZBA and intends to originate a loan. There are two types of borrowers: brown firms and clean firms.

The bank can make a single loan, of an amount normalized to \$1, to one of three borrowers. The first two borrowers, *B* and *C,* are brown and clean subsidiaries of the same

brown parent company, respectively.[18] The third borrower, D, is a clean firm. We assume that the bank has a prior lending relationship with the parent company of borrowers B and C, but no prior relationship with borrower D. In this regard, the bank lending to D can be thought of as representing divestment from B's and C's parent.

The bank can charge interest rate r to each of the three borrowers to fund a project undertaken by that borrower. Thus, if the borrower successfully repays the loan, the bank's payoff is $(1+r)$. In addition, after having signed up to NZBA, the bank enjoys reputational benefit R_i for lending to borrower $i \in \{B, C, D\}$. We assume that $R_D > R_C > R_B = 0$. In other words, the NZBA bank gains higher reputational benefit from lending to a 'pure play' clean firm than lending to a clean subsidiary of a brown firm, and zero reputational benefit from lending to a brown firm. We also assume that a non-NZBA bank gains no reputational benefit from making a clean loan.[19]

Lending is risky. When borrower $i \in \{B, C, D\}$ takes out a loan from the bank, it uses the proceeds to fund a project with return $\tilde{v}_i$. When $\tilde{v}_i$ exceeds a threshold $\theta < \mu_i$, the borrower repays the loan in full. Otherwise, we assume that the borrower does not repay any of the loan.[20] The threshold θ could represent, for example, the point at which the borrower's returns are sufficiently low that the borrower is only able to pay off more senior debt. We assume that individual rationality constraints hold, i.e., that θ is low enough that the bank always prefers to make a loan to at least one of the three borrowers and that $\mathbb{E}[\tilde{v}_i]$ is high enough (and r low enough) that the borrower always takes the loan if offered by the bank.

Under this setup, the bank's payoff from lending to borrower type i can be written as

$$\pi_i = R_i + (1 + r) \cdot \mathbb{P}(\tilde{v}_i > \theta) - 1 \qquad (1)$$

[18] B could also be the brown parent company itself.
[19] An alternative interpretation – which does not change the model's predictions – is that NZBA banks face costs for *not* making green loans, while non-NZBA banks face no such costs.
[20] We make this assumption for tractability. Assuming that the borrower makes partial repayments when $\tilde{v}_i < \theta$ does not affect the model's conclusions.

For simplicity, we assume $\tilde{v}_i$ is drawn from a uniform distribution $[\mu_i - a_i, \mu_i + a_i]$ where $\mu_i > 1$ (i.e., the project is profitable in expectation).[21] The a_i characterize the bank's beliefs about the spread of the distribution of $\tilde{v}_i$. This lets us rewrite Equation (1) as

$$\pi_i = R_i + (1 + r) \cdot \frac{\mu_i + a_i - \theta}{2a_i} - 1 \quad (2)$$

We assume that $a_B = a_C < a_D$. Under this assumption, the bank is more certain of the potential range of outcomes for a project arising from firms with which it has a prior lending relationship; the variance of the outcome distribution (from the bank's perspective) is the same for the two subsidiaries *B* and *C* of the parent which the bank has a prior relationship with, and in turn lower than for outside firm *D* which the bank has no prior relationship with. In this regard, a_i captures the uncertainty (and, hence, risk) associated with project *i*. Prior lending relationships facilitate lower uncertainty.

We also assume that $\mu_B > \mu_C = \mu_D$, i.e., that the potential project's return is equal across the two clean firms and lower than for the brown firm. Were this not the case, the bank would already have chosen to lend to one of the clean firms even in the absence of NZBA and any reputational benefits for decarbonization in its lending portfolio.

A.2 Model Predictions

We first illustrate that, in equilibrium, lending to the clean subsidiary of the oil parent firm can be the bank's optimal action. To see this, we characterize the conditions under which the bank prefers each of the three options (lend to brown subsidiary, lend to clean subsidiary, divest and lend to outside firm).

The bank lends to the clean subsidiary when $\pi_C > \max(\pi_D, \pi_B)$, i.e., when the following two inequalities are true:

[21] We obtain similar conclusions with a normal distribution.

$$R_C + (1+r) \cdot \frac{\mu_C + a_C - \theta}{2a_C} > (1+r) \cdot \frac{\mu_B + a_B - \theta}{2a_B} \quad (3a)$$

$$R_C + (1+r) \cdot \frac{\mu_C + a_C - \theta}{2a_C} > R_D + (1+r) \cdot \frac{\mu_D + a_D - \theta}{2a_D} \quad (3b)$$

Because $a_B = a_G$, inequality (3a) simplifies to

$$R_C > (1+r) \cdot \frac{\mu_B - \mu_C}{2a_B} \quad (4a)$$

Similarly, because $\mu_C = \mu_D$, inequality (3b) simplifies to

$$(1+r) \cdot \left(\frac{\mu_C + a_C - \theta}{2a_C} - \frac{\mu_C + a_D - \theta}{2a_D} \right) > R_D - R_C \quad (4b)$$

Intuitively, the first inequality implies that the bank is more likely to prefer the clean subsidiary to the brown option when the reputational benefit it obtains from shifting to the clean borrower is higher, or when the difference in outcomes between the clean and brown projects is lower. The second inequality implies that the bank is more likely to prefer the clean subsidiary to divestment when the difference in reputational benefits between the two is lower, or when the risk associated with the outside option (characterized by a_D) is higher.

Similarly, the bank prefers the brown subsidiary when $\pi_B > \max(\pi_D, \pi_C)$, i.e., when the following two inequalities are true:

$$(1+r) \cdot \frac{\mu_B + a_B - \theta}{2a_B} > R_C + (1+r) \cdot \frac{\mu_C + a_C - \theta}{2a_C} \quad (5a)$$

$$(1+r) \cdot \frac{\mu_B + a_B - \theta}{2a_B} > R_D + (1+r) \cdot \frac{\mu_D + a_D - \theta}{2a_D} \quad (5b)$$

Finally, the bank prefers the outside option when $\pi_D > \max(\pi_B, \pi_C)$, i.e., when inequalities (3b) and (5b) are reversed. Intuitively, the bank is more likely to prefer lending to the brown subsidiary when reputational benefits to clean lending (R_C, R_D) are lower and when the expected returns of the clean project (μ_C) are lower. Similarly, the bank prefers to divest and lend to the outside borrower when the reputational benefits for doing so are higher (i.e., $R_D - R_C$ is higher) or the relative riskiness of the outside option is lower (i.e., when $a_D - a_C$ is lower).

A.3 Model Insights

Our main goal in presenting the model is to illustrate that all of these scenarios are plausible and, more specifically, that it can be optimal for NZBA banks to prefer lending to clean subsidiaries of brown parent firms that they have had a prior lending relationship with. Below, we briefly characterize how NZBA banks' lending preferences vary according to (i) reputational capital, (ii) the riskiness of the outside option, and (iii) the extent of the wedge between expected profits from clean and brown lending.

With respect to risk, as a_D increases, lending to the outside firm becomes relatively less attractive compared to staying within the preexisting lending relationship. This, in turn, makes within-borrower shifting feasible only when the bank derives *some* reputational benefit from shifting within a borrowing relationship (e.g., shifting lending from Shell Oil to Shell Wind Energy); when this is zero, the bank never prefers to lend to the clean subsidiary.

With respect to forgone profits, when *r* is low (as was the case during the low-interest-rate era of 2008-2022), a greater share of the bank's payoff comes from its reputational benefits. This makes it more likely that the bank will prefer one of the clean options. Conversely, when *r* is higher, the fact that $\mu_B > \mu_C$ matters more, leading the bank to increasingly prefer lending to the brown firm. In all cases, there are scenarios under which the bank may find it optimal to lend to the clean subsidiary. However, given that the bank's preference for doing so depends on the uncertainty associated with the outside option, the extent of forgone profits, and the extent of reputational benefits gained from clean lending, it is unclear that we would empirically observe this scenario in practice.

Appendix B - Variable Definitions

Variable Name	Description	Data Source
Brown Group%	Share of total syndicated or bilateral lending (measured by number of loans) by bank *i* in year *t* that is extended to all companies within a brown group.	DealScan & Orbis
Brown Borr in Brown Group%	Share of total syndicated or bilateral lending (measured by number of loans) by bank *i* in year *t* that is extended to the brown group's parent and its brown subsidiaries.	DealScan & Orbis
Brown Borr%	Share of total syndicated or bilateral lending (measured by number of loans) by bank *i* in year *t* that is extended to the brown companies regardless of parent industry classifications.	DealScan & Orbis
Clean Sub Loan	Indicator equal to 1 if bank *i* extends at least one loan in year *t* to a non-brown, non-finance subsidiary within brown group *k*; 0 otherwise.	DealScan & Orbis
Finance Sub Loan	Indicator equal to 1 if bank *i* extends at least one loan in year *t* to a finance subsidiary within brown group *k*; 0 otherwise. Finance subsidiaries are identified as firms with SIC codes in 60–69 (i.e., codes starting with "6")	DealScan & Orbis
Clean Sub%	The share of syndicated loans (measured by the number of loans) made by bank *i* to the brown group *k*'s non-brown, non-finance related subsidiaries in year *t*, relative to the total number of syndicated loans made by bank *i* to group *k* in that same year.	DealScan & Orbis
Finance Sub%	The share of syndicated loans (measured by the number of loans) made by bank *i* to the brown group *k*'s finance-related subsidiaries in year *t*, relative to the total number of syndicated loans made by bank *i* to group *k* in that same year.	DealScan & Orbis
NZ Signed	Indicator equal to 1 if bank *i* has signed the Net-Zero Banking Alliance by year *t*, and 0 otherwise.	Net-Zero Banking Alliance (NZBA)-United Nations
Ln Assets	Natural logarithm of total assets of bank *i* in year *t-1* (Orbis item _191100: TOTAL ASSETS).	Orbis Financials for Banks
ROA	Return on assets of bank *i* in year *t-1* (Orbis item roa: ROA USING NET INCOME (%)).	Orbis Financials for Banks

Total Loan	Ratio of total loans to total assets for bank *i* in year *t-1* (Orbis item _190000 LOANS/Orbis item _191100: TOTAL ASSETS).	Orbis Financials for Banks
Non-Performing Loans	Non-performing loan of bank *i* in year *t-1*, scaled by total loans (Orbis item _195030: NON PERF.LOANS/GROSS LOANS (%)).	Orbis Financials for Banks
Net Interest Margin	Net interest margin of bank *i* in year *t-1* (Orbis item _195190: NET INTEREST MARGIN (%)).	Orbis Financials for Banks
Capital Ratio	Total capital ratio of bank *i* in year *t-1* (Orbis item _195090: TOTAL CAPITAL RATIO (%)).	Orbis Financials for Banks
Syn Loans	Natural logarithm of total number of loans of bank *i* extended to borrowers (matched with Orbis) in year *t*.	DealScan
Size	Natural logarithm of the loan *g* size issued by bank *i* to borrower *j* in year t.	DealScan & Orbis
Maturity	Natural logarithm of the maturity (in months) loan *l* issued by bank *i* to borrower *s* in year *t*.	DealScan & Orbis
Covenants	Indicator equal to 1 if a loan *l* issued to borrower *s* in year *t* includes a covenant, and 0 otherwise.	DealScan & Orbis
Spread	Interest rate (net of LIBOR of SOFR) of loan *l* issued by bank *i* to borrower *s* in year *t*. Expressed as a percent.	
Net Inv	Change in firm *s*' tangible fixed assets from year *t* to *t+1*, scaled by total assets in year *t*.	Orbis
Ln Age	Natural logarithm of firm *s*' age as of year *t*.	Orbis
Lev	Leverage ratio of firm *s* in year *t*, defined as the sum of short-term and long-term liabilities divided by total assets.	Orbis
Loan	Indicator equal to 1 if firm *s* receives a syndicated or bilateral loan in year *t*, and 0 otherwise.	DealScan & Orbis
Num Other Group Loans	Number of other firms in firm *s*' business group who receive at least one syndicated or bilateral loan in year *t*.	DealScan & Orbis
Num Other NonBrown Sub Loans	Number of other non-brown firms in firm s' business group who receive at least one syndicated or bilateral loan in year *t*.	DealScan & Orbis

*Num Other NonBrown Sub Loan Loans*NZ*	Number of other non-brown firms in firm *s'* business group who receive at least one syndicated or bilateral loan in year *t* multiplied by the average proportion of lead lenders that have joined or will join the NZBA. Specifically, for each non-brown company, we multiply an indicator for having received a loan by the average proportion of lead lenders who are (or will be) NZ banks. We then sum this measure across all non-brown companies within a group.	Orbis & DealScan & NZBA
*Num Other NonBrown Sub Loans*NZ*Post*	Number of other non-brown firms in firm *s'* business group who receive at least one syndicated or bilateral loan in year *t* multiplied by the average proportion of lead lenders that have joined the NZBA. Specifically, for each non-brown subsidiary, we multiply an indicator for having received a loan by the average proportion of lead lenders who are NZ banks. We then sum this measure across all non-brown companies within a group.	Orbis & DealScan & NZBA

Appendix C - Matching DealScan Lender with Orbis Financials Bank

To construct time-varying bank-level controls, we match DealScan lenders to entities in Orbis Bank Financials, which provides standardized financial statement data for both public and private institutions at the commercial bank, parent, or bank holding company (BHC) level. We extract the *lender_parent_name* from DealScan and implement a multi-step matching procedure:

1. Restrict to Parent Entities: Since our analysis is conducted at the parent/BHC level, we restrict the Orbis sample to banks where the firm's Bureau van Dijk ID (BvD ID) matches its global ultimate owner ID (GUO BvD ID), ensuring that we capture consolidated financial. We first limit the Orbis Bank Financials sample to institutions whose BvD ID equals their GUO BvD ID, identifying ultimate parent firms and BHCs.
2. Cleaned Exact Matching: We standardize both DealScan and Orbis bank names by removing punctuation, legal suffixes, and special characters. We then perform exact matches on the cleaned names. This step yields the majority of our matches.
3. Semantic Similarity Matching: For remaining unmatched names, we generate 1,536-dimensional embeddings of the cleaned DealScan and Orbis names using OpenAI's text-embedding-ada-002 model. We compute cosine similarities across all candidate pairs and retain those with similarity scores above 0.8. Each match is manually validated to ensure correctness.
4. Fuzzy String Matching: For any remaining unmatched lenders, we apply fuzz.token_set_ratio from the *fuzzywuzzy* library to compute name similarity scores. We retain matches with a score above 85 and manually inspect each match for accuracy.
5. Relaxed Parent Constraint: Some lenders in DealScan are commercial banks without a listed parent in Orbis or are owned by non-bank entities. In these cases, we relax the restriction that BvD ID equals GUO BvD ID and repeat the above matching steps to identify the closest plausible match. Manual Completion: Finally, we manually check unmatched or ambiguous cases using contextual and institutional knowledge to complete the coverage.
6. Finally, we manually check any unmatched or ambiguous names to complete the process. This matching allows us to merge financial statement data from Orbis onto our DealScan-based bank-year panel.

Appendix D - Matching DealScan Borrowers with Orbis

To ensure accurate and point-in-time borrower ownership information, we match borrowers in DealScan with firms in Orbis Historical, a dataset that provides time-stamped ownership and firm-level characteristics for both public and private entities. The matching process is carried out in several stages to address the scale and complexity of both datasets and to minimize false positives.

We begin by extracting all borrower names and associated countries from DealScan between January 1, 2017, and December 31, 2024, yielding 48,905 unique borrower-country pairs. Given that Orbis contains hundreds of millions of firm-level records globally—many of which are noisy, inactive, or irrelevant—automated matching across the full universe is computationally impractical and error-prone. To constrain the search space, we query each borrower-country pair individually using the Orbis interface and retain the first match returned, resulting in 38,149 candidate firm-level matches with unique Bureau van Dijk identifiers (BvD IDs). To improve the precision of matches, we perform the following verification steps:

1. Exact Name Matching: We clean borrower names from both DealScan and Orbis by removing punctuation, whitespace, special characters, and standard legal suffixes (e.g., "Inc.", "LLC", "Ltd"). We then compare cleaned strings for exact equality. This procedure yields 28,506 high-confidence matches.
2. Industry Code Matching: For the unmatched firms, we retrieve both 4-digit U.S. SIC codes and 6-digit NAICS codes from Orbis and compare them with the primary SIC or NAICS listed in DealScan. If either code matches exactly, we retain the match. This adds an additional 2,192 firms.
3. Two-Digit Sector + Semantic Similarity: Recognizing that exact codes may differ due to differences in classification across databases, we further relax the industry code requirement to allow for 2-digit SIC or NAICS sector-level alignment. For this subset, we evaluate semantic similarity between DealScan and Orbis firm names using OpenAI's text-embedding-ada-002 model. Both names are embedded into 1,536-dimensional vectors, and we compute cosine similarity between the vectors. We retain matches with 2-digit code alignment and a cosine similarity above 0.6, subject to manual review to eliminate false positives. This step contributes 2,894 additional verified matches.
4. Manual Validation of High-Similarity Matches: For pairs with cosine similarity above 0.6 but without 2-digit code alignment, we conduct manual validation to confirm firm identity and include valid matches. This recovers several hundred additional matches that would otherwise be discarded by algorithmic criteria.

After all steps, we obtain 35,043 borrower-country pairs matched to 34,132 unique Orbis entities. The discrepancy arises from spelling variations across years in DealScan for the same underlying firm (e.g., "BP PLC" vs. "BP Plc"). Finally, we retrieve the global ultimate owner (GUO) for each matched firm using Orbis's ownership structure. We retain only those whose GUO is a registered firm (i.e., not individuals or families) with a valid SIC or NAICS classification. This yields a final set of 29,500 matched borrowers and 24,693 distinct GUOs prior to further sample refinements (e.g., excluding commercial banks or government entities).

Appendix E - Identifying Brown Firms

We identify brown firms based on SIC codes, following a combined classification from Trinks (2018) and de Ferro (2025). A firm is classified as brown if its SIC code—as listed in either DealScan or Orbis—falls within the list provided below.

Major Group	SIC 2/3	Industry	SIC 4
Coal mining	12	Bituminous coal and lignite-surface mining	1221
		Bituminous coal-underground mining	1222
		Anthracite mining	1231
		Coal mining services	1241
Oil and Gas Extraction	13	Crude petroleum and natural gas	1311
		Natural gas liquids	1321
		Drilling oil and gas wells	1381
		Oil and gas exploration services	1382
		Oil and gas field services, nec	1389
Petroleum Refining	291	Petroleum refining	2911
		Petroleum and coal products, nec	2999
		Mining machinery	3532
		Oil and gas field machinery	3533
Pipelines	46	Crude petroleum pipelines	4612
		Refined petroleum pipelines	4613
		Pipelines, nec	4619
Gas Production and Distribution	492	Natural gas transmission	4922
		Gas transmission and distribution	4923
		Natural gas distribution	4924
		Gas production and/or distribution	4925
		Gas and other services combined	4932
		Coal and other minerals and ores	5052
Petroleum and Petroleum Products	517	Petroleum bulk stations and terminals	5171
		Petroleum products, nec	5172
Gasoline Service Stations	554	Gasoline service stations	5541
		Fuel oil dealers	5983
		Liquefied petroleum gas dealers	5984
		Fuel dealers, nec	5989

Figure 1a Trends of *Brown Group%* around NZBA Membership

This figure plots point estimates and their 90% confidence intervals for the effect of *NZ Signed* on *Brown Group%* surrounding NZBA membership. The specification follows Table 3 Panel B Column (1). However, *NZ Signed* is replaced with interactions for each event year (omitting t-4) and NZ Bank.

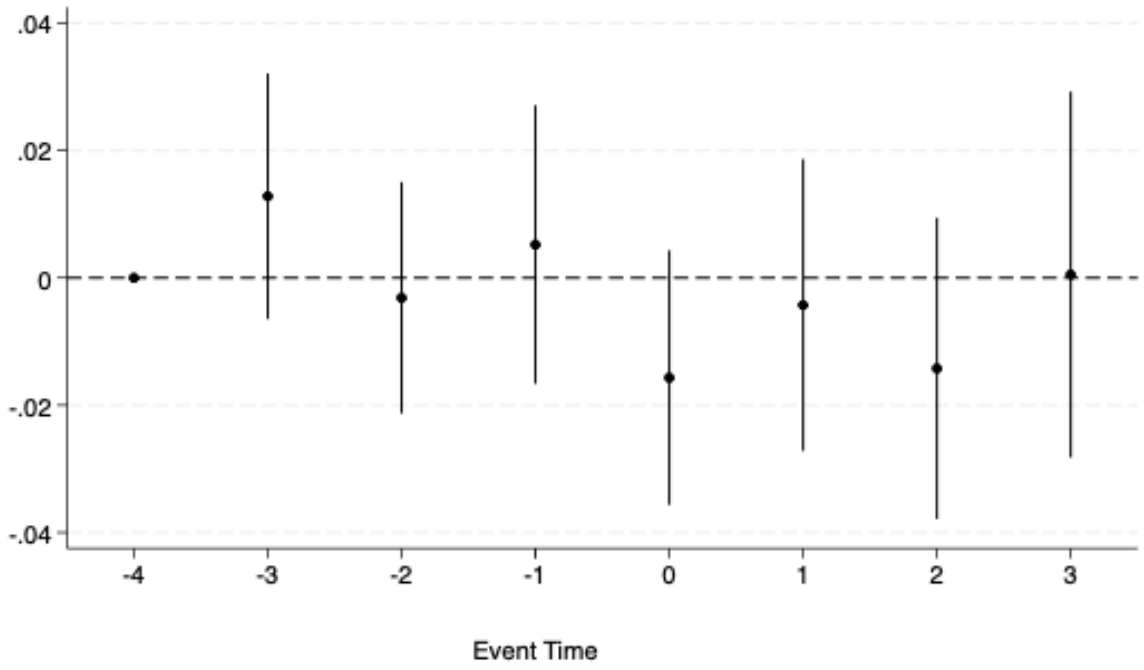

Figure 1b Trends of *Brown Borr in Brown Group%* around NZBA Membership

This figure plots point estimates and their 90% confidence intervals for the effect of *NZ Signed* on *Brown Borr in Brown Group%* surrounding NZBA membership. The specification follows Table 3 Panel B Column (2). However, *NZ Signed* is replaced with interactions for each event year (omitting t-4) and NZ Bank.

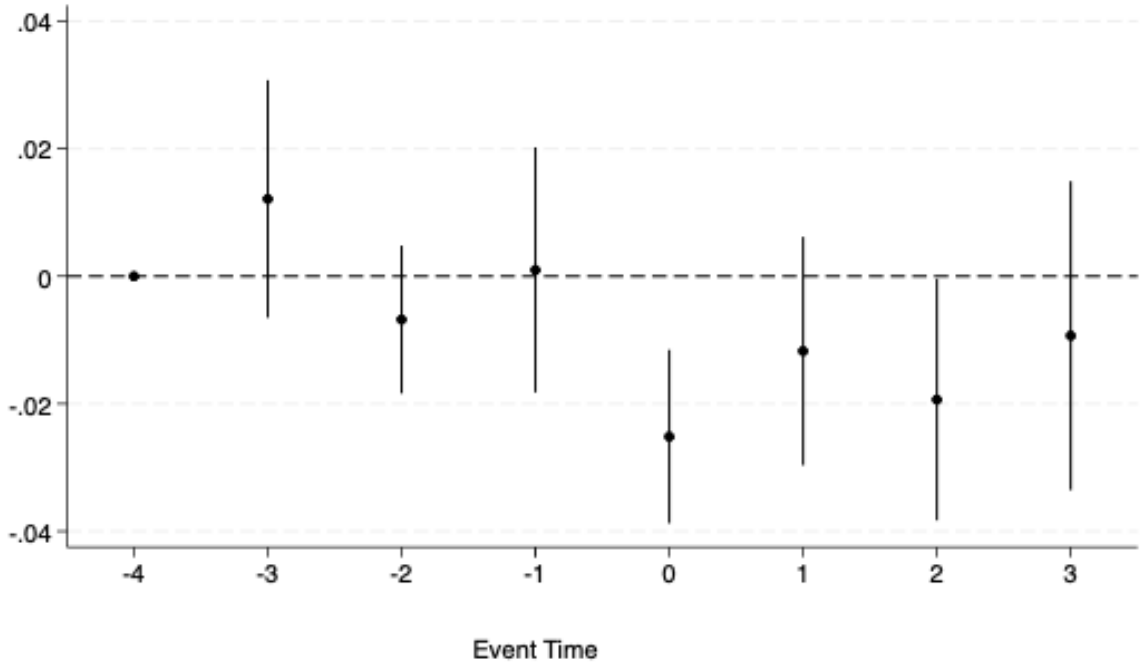

Figure 1c Trends of *Brown Borr%* around NZBA Membership

This figure plots point estimates and their 90% confidence intervals for the effect of *NZ Signed* on *Brown Borr%* surrounding NZBA membership. The specification follows Table 3 Panel B Column (3). However, *NZ Signed* is replaced with interactions for each event year (omitting t-4) and NZ Bank.

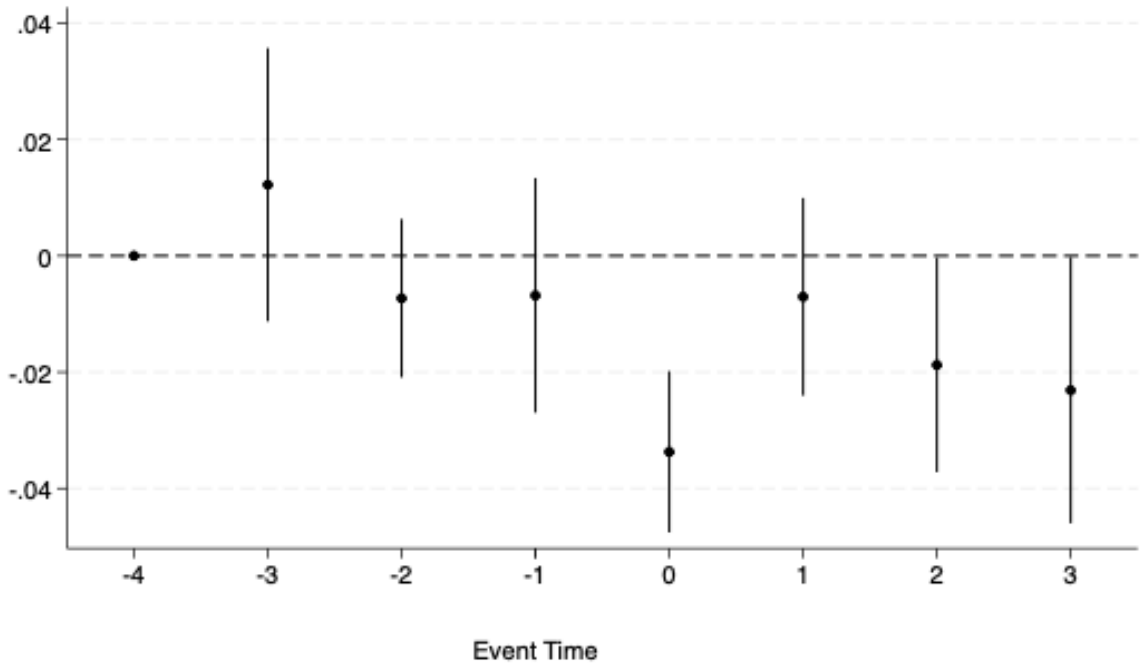

Table 1 Sample Construction

Data steps	Remaining #Obs
DealScan raw data (2017–2024).	903,949
Merge in matched Orbis (valid BvD ID).	726,749
Drop observations where the GUO lacks an SIC code.	628,175
Keep only lead arrangers and sole lenders.	407,305
Drop non-commercial banks.	383,894
Drop government borrowers.	382,972
Bank Year	
Aggregate to the bank–year level.	3,692
Expand the panel and fill empty years.	5,122
Merge in NZ lenders.	5,122
Merge in controls; drop unmatched lenders.	4,788
Construct stacked DiD sample; keep 4 pre-treatment years and up to 4 post-treatment years.	8,311
Drop non-public banks.	4,927
Drop observations with missing controls.	4,468
Drop observations without weights due to no pre-treatment.	4,299
Drop singletons under the fixed-effects structure.	3,874
Final regression sample	3,874

Table 2 Sample Distribution

This table presents the composition of our sample. Panel A reports the distribution of syndicated loans by year, where "#" denotes the number of loans. Each unique tranche is counted as a separate loan. The sample covers the period from 2017 to 2024. Panel B lists the top 20 lead arranger banks based on the number of syndicated loans extended to brown business groups. For each bank, we report the number of loans made to brown parent companies, brown subsidiaries, clean subsidiaries, and finance subsidiaries within brown business groups. We also indicate whether the bank is a signatory of the NZBA and the year of commitment.

Panel A Distribution by Year

Year	#Loan to brown group	#Loan to brown group parent	#Loan to brown sub in brown group	#Loan to clean sub in brown group	#Loan to finance sub in brown group	#Loan to brown company (w & w/o brown parent)	#Loan	#Lead banks	#Lead banks signed NZBA
2017	758	526	173	43	16	829	12,149	196	
2018	804	597	153	33	21	857	12,422	220	
2019	725	526	140	30	29	787	12,402	218	
2020	583	412	100	63	8	598	11,889	227	
2021	734	549	102	60	23	784	14,051	248	43
2022	681	485	144	41	11	765	12,096	232	7
2023	622	483	80	54	5	687	11,048	240	3
2024	634	523	64	36	11	701	13,077	234	

Panel B: Top 20 Banks

Bank	#Loan to brown group	#Loan to brown group parent	#Loan to brown sub in brown group	#Loan to clean sub in brown group	#Loan to finance sub in brown group	#Loan to brown firm (w/ & w/o brown parent)	#Loan	NZBA signed year
Wells Fargo & Co	1,292	948	306	35	3	1,390	11,926	2021
JP Morgan	1,184	877	254	40	13	1,267	17,758	2021
MUFG	907	682	142	63	20	986	15,004	2021
BofA Securities	884	667	170	41	6	966	18,279	2021
Citi	837	631	162	31	13	930	9,964	2021
RBC Capital Markets	778	544	197	32	5	799	7,485	2021
Mizuho Financial Group	774	557	127	70	20	826	11,072	2021
Sumitomo Mitsui	657	467	96	70	24	743	11,271	2021
Scotiabank	593	410	145	11	27	602	3,820	2021
CIBC	588	394	151	41	2	618	4,665	
Toronto Dominion Bank	537	334	159	23	21	541	4,136	2021
BMO Capital Markets	529	395	128	5	1	579	8,211	2021
BNP Paribas SA	453	302	67	73	11	474	8,570	2021
HSBC Banking Group	420	264	79	61	16	435	8,196	2021
Societe Generale SA	398	244	42	99	13	387	4,412	2021
Barclays	393	312	56	25		448	8,437	2021
National Bank of Canada	387	310	67	8	2	417	1,840	2021
Truist Financial	347	257	84	6		398	6,189	
Citizens Financial Group	307	259	37	5	6	299	4,448	
US Bancorp	284	244	34	6		331	4,797	

Table 3 Bank-Year

This table presents the results of the bank–year level analysis examining the share of brown-related lending—measured by the number of loans—as a percentage of each bank's total lending in a given year surrounding the adoption of the NZBA. Panel A reports summary statistics for the stacked difference-in-differences regression sample after applying entropy balancing. The sample is entropy balanced on pre-treatment covariates—including *Ln Assets, Total Loan, ROA, Non-performing Loan, Capital Ratio, Non-Performing Loan, Syn Loans*—within each cohort. Panel B presents the regression results from estimating equation (1). Columns (1) report estimates using *Brown Group%* as the dependent variable, which captures the share of loans extended to brown groups—defined as business groups whose parent company operates in fossil fuel–related sectors. Column (2) report the estimates using *Brown Borr in Brown Group%* as the dependent variable, which captures the share of loans extended to brown subsidiaries within brown groups. Column (3) replace the dependent variable with *Brown Borr%*, which captures the share of loans extended to brown borrowers regardless of parent industry classifications. All specifications include bank × cohort and country x year × cohort fixed effects. All variables are defined in Appendix B. All continuous variables are winsorized at the 1st and 99th percentiles. Numbers below the coefficient estimates in parentheses are *p*-values. Standard errors are clustered by bank-cohort. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Summary Statistics

VARIABLES	N	Mean	SD	25%	Median	75%
Brown Group%	3,874	0.057	0.062	0.018	0.045	0.080
Brown Borr in Brown Group%	3,874	0.052	0.057	0.014	0.038	0.073
Brown Borr%	3,874	0.075	0.088	0.023	0.057	0.098
NZ Signed	3,874	0.234	0.424	0.000	0.000	0.000
Ln Assets	3,874	26.914	1.185	26.240	27.052	27.879
Total Loan	3,874	0.514	0.157	0.435	0.545	0.612
Capital Ratio	3,874	17.285	10.234	14.276	16.036	17.939
ROA	3,874	0.722	0.475	0.470	0.750	1.000
Non-Performing Loans	3,874	2.800	3.159	0.920	1.550	3.470
Syn Loans	3,874	5.154	1.582	4.357	5.475	6.422
Net Interest Margin	3,874	1.992	1.127	1.210	1.810	2.546

Panel B: Bank-Year

VARIABLES	*Brown Group%*	*Brown Borr in Brown Group%*	*Brown Borr%*
	(1)	(2)	(3)
NZ Signed	-0.012	-0.018**	-0.021**
	(0.199)	(0.027)	(0.030)
Ln Assets	0.009	-0.002	0.007
	(0.634)	(0.884)	(0.733)
Total Loan	0.053	0.075	-0.008
	(0.495)	(0.322)	(0.951)
ROA	-0.005	0.002	-0.006
	(0.548)	(0.795)	(0.527)
Capital Ratio	0.003	-0.000	-0.001
	(0.399)	(0.777)	(0.796)
Non-Performing Loans	-0.001	0.001	0.003
	(0.885)	(0.854)	(0.465)
Net Interest Margin	-0.034	-0.034	-0.033
	(0.150)	(0.115)	(0.123)
Syn Loans	-0.005	-0.008	-0.016
	(0.546)	(0.324)	(0.141)
Observations	3,874	3,874	3,874
R-squared	0.692	0.714	0.755
Bank×Cohort FE	YES	YES	YES
Country×Year×Cohort FE	YES	YES	YES

Table 4 Bank-Group-Year Unconditional

This table presents results from the unconditional bank–borrower group–level analysis. Panel A outlines the sample construction process, Panel B reports summary statistics, and Panel C presents the results from estimating equation (2). We examine the effect of NZBA adoption on the likelihood that a bank extends a loan to clean subsidiaries (non-brown, non-finance subsidiaries) within brown business groups. The sample is entropy balanced on pre-treatment covariates—including *Ln Assets, Total Loan, ROA, Non-performing Loan, Capital Ratio, Non-Performing Loan, and Syn Loans*—within each cohort. Column (1) reports results for the full sample of all possible bank–group pairs, where the dependent variable is an indicator equal to one if the bank extended a loan to a clean subsidiary. Columns (2) and (3) examine the role of relationships, with column (2) restricting the sample to bank–group pairs with a 5-year lead-agent relationship and column (3) excluding such relationships. Columns (4) and (5) repeat this analysis using a 10-year definition of lead-agent relationship, with column (4) including and column (5) excluding such relationships. All specifications include bank × cohort and group × year× cohort fixed effects, and all continuous variables are winsorized at the 1st and 99th percentiles. Numbers below the coefficient estimates in parentheses are *p*-values. Standard errors are clustered by bank-cohort. All variables are defined in Appendix B. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Sample Construction

Data steps	**Remaining #Obs**
Unconditional Bank Group Year Sample	
Start with bank–tranche-level data	382,972
Aggregate to the bank–group–year level	159,114
Expand the panel to include all possible bank–subsidiary relationships	21,210,840
Keep only brown groups	1,316,912
Merge in NZ lenders	1,316,912
Merge in controls	1,269,763
Merge in relationship indicators	1,269,763
Construct stacked DiD sample; keep 4 pre-treatment years and up to 4 post-treatment years	2,901,077
Drop observations with missing controls	2,411,871
Drop non-public banks	1,556,165
Drop singletons under the fixed-effects structure	1,556,165
Drop observations without weights due to no pre-treatment	1,499,485
Final regression sample	1,499,485

Panel B: Summary Statistics

VARIABLES	N	Mean	SD	25%	Median	75%
Clean Sub Loan	1,499,485	0.009	0.094	0.000	0.000	0.000
NZ Signed	1,499,485	0.243	0.429	0.000	0.000	0.000
Ln Assets	1,499,485	26.752	1.241	26.305	26.978	27.560
Total Loan	1,499,485	0.517	0.161	0.434	0.546	0.622
ROA	1,499,485	0.007	0.005	0.005	0.008	0.009
Capital Ratio	1,499,485	17.373	9.185	14.900	16.100	18.070
Non-Performing Loans	1,499,485	2.917	3.572	0.570	1.500	3.720
Net Interest Margin	1,499,485	2.088	1.373	1.390	1.790	2.400
Syn Loans	1,499,485	33.810	37.584	2.000	19.000	60.000

Panel C: Bank-Group-Year Unconditional

VARIABLES	*Clean Sub Loan*				
	Full Sample	Relationship (5 years)	Non-Relationship (5 years)	Relationship (10 years)	Non-Relationship (10 years)
	(1)	(2)	(3)	(4)	(5)
NZ Signed	-0.002	0.038**	-0.003	0.039**	-0.003
	(0.485)	(0.033)	(0.143)	(0.040)	(0.178)
Syn Loans	0.000***	0.001*	0.000***	0.001*	0.000***
	(0.000)	(0.055)	(0.002)	(0.064)	(0.002)
Ln Assets	-0.001	0.044	-0.002	0.030	-0.002
	(0.899)	(0.533)	(0.607)	(0.684)	(0.640)
Total Loan	-0.023	0.323	-0.026	0.318	-0.025
	(0.353)	(0.192)	(0.180)	(0.223)	(0.190)
ROA	-0.036	-3.402	-0.008	-3.728	0.005
	(0.815)	(0.197)	(0.933)	(0.158)	(0.962)
Capital Ratio	0.000	0.008	0.000	0.009	0.000
	(0.466)	(0.150)	(0.717)	(0.140)	(0.819)
Non-Performing Loans	-0.000	-0.006*	-0.000	-0.006*	-0.000
	(0.439)	(0.065)	(0.165)	(0.089)	(0.206)
Net Interest Margin	0.000	-0.031	0.002*	-0.038	0.002
	(0.886)	(0.192)	(0.082)	(0.147)	(0.104)
p-value of difference between *NZ signed*			.011		.015
Observations	1,499,485	2,346	1,496,724	2,420	1,496,643
R-squared	0.262	0.871	0.238	0.867	0.239
Bank×Cohort FE	YES	YES	YES	YES	YES
Group×Year×Cohort FE	YES	YES	YES	YES	YES

Table 5 Bank-Group-Year Conditional

This table presents the results of the conditional bank–borrower group–year analysis of lending allocation within brown business groups. Panel A documents sample construction, and Panel B reports summary statistics. Panel C presents the results of estimating equation (3), where the dependent variable—*Clean Sub%* measures, by number of loans, the share of bank *i*'s syndicated lending to group *k*'s clean subsidiaries (non-brown, non-finance) in year *t*, relative to the total loans bank *i* extends to group *k* in year t. The sample is entropy balanced on pre-treatment covariates—including *Ln Assets, Total Loan, ROA, Non-performing Loan, Capital Ratio, Non-Performing Loan, and Syn Loans*—within each cohort. Column (1) includes bank x cohort, group x cohort, and county x year x cohort fixed effects. Column (2) includes bank x group x cohort and country x year x cohort fixed effects. All variables are defined in Appendix B; continuous variables are winsorized at the 1st and 99th percentiles. Numbers below the coefficient estimates in parentheses are *p*-values. Standard errors are clustered by bank-cohort. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Sample Construction

Data steps	**Remaining #Obs**
Keep only brown groups; require the parent to be a brown firm; drop stand-alone entities.	14,947
Aggregate to the bank–brown-group–year level.	7,548
Merge in NZ lenders.	7,548
Merge in controls; drop unmatched lenders.	7,516
Construct stacked DiD sample; keep 4 pre-treatment years and up to 4 post-treatment years.	11,310
Drop observations with missing controls.	10,533
Drop non-public banks.	9,011
Drop singletons under the fixed-effects structure.	6,587
Drop observations without weights due to insufficient pre-treatment observations.	6,575
Final regression sample.	6,575

Panel B: Summary Statistics

VARIABLES	N	Mean	SD	25%	Median	75%
Clean Sub %	6,575	0.101	0.293	0.000	0.000	0.000
NZ Signed	6,575	0.295	0.457	0.000	0.000	1.000
Ln Assets	6,575	27.338	0.959	26.809	27.515	28.251
Total Loan	6,575	0.501	0.142	0.412	0.533	0.583
ROA	6,575	0.701	0.352	0.450	0.750	0.940
Capital Ratio	6,575	18.488	11.147	15.270	17.000	19.100
Non-Performing Loans	6,575	2.052	1.672	0.900	1.490	2.670
Net Interest Margin	6,575	1.718	0.728	1.150	1.660	2.250
Syn Loans	6,575	2.445	1.852	1.000	2.000	3.000

Panel C: Bank-Group-Year Conditional

VARIABLES	*Clean Sub %* (in Brown Group)	
	(1)	(2)
NZ Signed	0.088**	0.096***
	(0.013)	(0.010)
Ln Assets	0.104	0.172
	(0.281)	(0.222)
Total Loan	-0.114	0.021
	(0.571)	(0.923)
ROA	-0.092***	-0.088**
	(0.007)	(0.015)
Capital Ratio	0.009	0.005
	(0.111)	(0.464)
Non-Performing Loans	-0.004	0.003
	(0.712)	(0.859)
Net Interest Margin	0.036	-0.009
	(0.374)	(0.864)
Syn Loans	0.017***	0.013***
	(0.000)	(0.004)
Observations	6,575	6,572
R-squared	0.832	0.887
Bank×Cohort FE	YES	NO
Group×Cohort FE	YES	NO
Bank×Group×Cohort FE	NO	YES
Country×Year*Cohort FE	YES	YES

Table 6 Group Capital Allocation

This table presents our analysis of internal capital allocation within corporate groups. Panel A reports summary statistics. Panel B replicates our unconditional bank-group-year analysis in Table 4 but replaces the dependent variable with *Finance Sub Loan* in Brown Group, an indicator equal to one if a finance subsidiary in a brown group received a loan from bank *i* in year *t*. Panel C replicates our conditional bank-group-year analysis in Table 5 but replaces the dependent variable with *Finance Sub%* in Brown Group, which measures, by number of loans, the share of bank *i*'s syndicated lending to group *k*'s finance subsidiaries in year *t*, relative to the total loans bank *i* extends to group *k* in year *t*. Panel B and Panel C follow the specifications in Tables 3 and 4, respectively. Panel D presents results from regressions examining whether a subsidiary's investment (*NetInv*) responds to financing received by other subsidiaries within the same group. All specifications in panel D include either group or subsidiary fixed effects, and country × industry × year fixed effects. The key variable of interest is a triple interaction term: *Num Other NonBrown Sub Loans* × *NZ* × *Post*, which captures whether investment in a given subsidiary responds to financing directed toward other clean subsidiaries within the group following NZBA adoption. All variables are defined in Appendix B. All continuous variables are winsorized at the 1st and 99th percentiles. Numbers below the coefficient estimates in parentheses are *p*-values. Standard errors are clustered by bank-cohort in panels B & C and company-cohort in panel D. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Summary Statistics

VARIABLES	N	Mean	SD	25%	Median	75%
Finance Sub Loan	1,499,485	0.001	0.027	0.000	0.000	0.000
Finance Sub%	6,575	0.019	0.131	0.000	0.000	0.000
Net Inv	4,869	0.047	0.430	-0.033	-0.001	0.030
Loan	4,869	0.113	0.317	0.000	0.000	0.000
ROA	4,869	0.031	0.144	-0.008	0.033	0.083
Num Other Group Loans	4,869	0.762	1.093	0.000	0.000	5.000
Num Other NonBrown Loans	4,869	0.387	0.790	0.000	0.000	0.000
*Num Other NonBrown Loans*NZ*	4,869	0.303	0.681	0.000	0.000	0.000
*Num Other NonBrown Loans*NZ*Post*	4,869	0.120	0.456	0.000	0.000	0.000
Ln Assets	4,869	13.213	2.442	11.504	13.394	14.970
Ln Age	4,869	2.939	0.982	2.398	3.045	3.611
Lev	4,869	0.592	0.325	0.378	0.593	0.766

Panel B: Finance Sub-Unconditional

VARIABLES	*Finance Sub Loan*				
	Full Sample	Relationship (5 years)	No-Relationship (5 years)	Relationship (10 years)	No-Relationship (10 years
	(1)	(2)	(3)	(4)	(5)
NZ Signed	-0.000	0.014	-0.000	0.014	-0.000
	(0.660)	(0.453)	(0.338)	(0.471)	(0.401)
Syn Loans	0.000*	-0.000*	0.000**	-0.000*	0.000*
	(0.069)	(0.062)	(0.036)	(0.081)	(0.052)
Ln Assets	0.001	-0.020	0.001	-0.021	0.001
	(0.340)	(0.226)	(0.108)	(0.199)	(0.135)
Total Loan	0.007*	0.106	0.006*	0.115	0.006
	(0.089)	(0.185)	(0.099)	(0.150)	(0.126)
ROA	-0.017	-0.404	-0.019	-0.445	-0.014
	(0.533)	(0.622)	(0.497)	(0.591)	(0.565)
Capital Ratio	0.000	0.002	0.000	0.001	0.000
	(0.448)	(0.274)	(0.467)	(0.319)	(0.511)
Non-Performing Loans	-0.000	0.000	-0.000	0.000	-0.000
	(0.291)	(0.740)	(0.171)	(0.939)	(0.193)
Net Interest Margin	-0.000	-0.004	-0.000	-0.009	-0.000
	(0.422)	(0.751)	(0.632)	(0.557)	(0.540)
Observations	1,499,485	2,346	1,496,724	2,420	1,496,643
R-squared	0.097	0.625	0.104	0.695	0.093
Bank×Cohort FE	YES	YES	YES	YES	YES
Group×Year×Cohort FE	YES	YES	YES	YES	YES

Panel C: Finance Sub-Conditional

VARIABLES	*Finance Sub%*	
	(1)	(2)
NZ Signed	-0.004	-0.016**
	(0.701)	(0.044)
Ln Assets	0.041***	-0.011
	(0.005)	(0.466)
Total Loan	0.072	0.105
	(0.299)	(0.152)
ROA	-0.004	-0.002
	(0.551)	(0.765)
Capital Ratio	0.000	-0.000
	(0.606)	(0.770)
Non-Performing Loans	-0.001	0.002
	(0.856)	(0.442)
Net Interest Margin	-0.025**	-0.006
	(0.020)	(0.461)
Syn Loans	0.001	0.001
	(0.378)	(0.401)
Observations	6,575	6,572
R-squared	0.847	0.906
Bank×Cohort FE	YES	NO
Group×Cohort FE	YES	NO
Bank×Group×Cohort FE	NO	YES
Country×Year×Cohort FE	YES	YES

Panel D: Group Capital Allocation

VARIABLES	*NetInv*			
	(1)	(2)	(3)	(4)
Loan	0.040**	0.042**	0.034*	0.034*
	(0.022)	(0.019)	(0.077)	(0.073)
ROA	-0.082	-0.081	0.173**	0.172**
	(0.211)	(0.210)	(0.044)	(0.045)
Num Other Group Loans	-0.007		0.004	
	(0.407)		(0.495)	
Num Other NonBrown Sub Loans		-0.027		-0.024
		(0.450)		(0.350)
*Num Other NonBrown Sub Loans*NZ*		0.025		0.039
		(0.580)		(0.230)
*Num Other NonBrown Sub Loans*NZ*Post*		-0.009		-0.009
		(0.649)		(0.626)
Ln Assets	-0.039***	-0.039***	-0.409***	-0.409***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln Age	-0.039**	-0.039**	-0.041	-0.044
	(0.021)	(0.022)	(0.437)	(0.413)
Lev	0.042	0.042	-0.011	-0.013
	(0.259)	(0.257)	(0.882)	(0.871)
Observations	4,868	4,868	4,783	4,783
R-squared	0.271	0.271	0.582	0.582
Group FE	YES	YES	NO	NO
Firm FE	NO	NO	YES	YES
Country×Industry×Year FE	YES	YES	YES	YES

Table 7 Interest Rate

This table presents the results of our interest rate analysis. Panel A reports summary statistics. Panel B presents regression estimates of the interest rate spread as a function of whether the lending bank has signed the NZBA (*NZ Signed*). The sample is entropy balanced on pre-treatment covariates—including *Ln Assets, Total Loan, ROA, Non-performing Loan, Capital Ratio, Non-Performing Loan, Syn Loans*—within each cohort. Column (1) presents the results for all loans originated to brown groups using bank x cohort, group x cohort and country × year × cohort fixed effects. Columns (2) and (3) are subsamples of Column (1) based on whether the loan is to a clean or brown company, respectively. Columns (4) – (6) repeat this analysis using bank x group x cohort and country × year × cohort fixed effects. All variables are defined in Appendix B. All continuous variables are winsorized at the 1st and 99th percentiles. Numbers below the coefficient estimates in parentheses are *p*-values. Standard errors are clustered by bank-cohort. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Summary Statistics

	N	Mean	SD	25%	Median	75%
Spread	7,807	5.173	0.512	4.836	5.081	5.525
NZ Signed	7,807	0.209	0.407	0.000	0.000	0.000
Ln Assets	7,807	27.199	0.869	26.553	27.279	27.997
Total Loan	7,807	0.480	0.175	0.352	0.536	0.629
ROA	7,807	0.781	0.380	0.520	0.820	1.020
Capital Ratio	7,807	18.739	11.894	15.130	17.390	20.000
Net Interest Margin	7,807	1.928	1.371	1.040	1.690	2.360
Non-Performing Loans	7,807	1.964	1.356	0.980	1.490	2.440
Syn Loans	7,807	13.835	16.873	5.000	9.000	15.000
Size	7,807	6.914	0.906	6.295	6.908	7.601
Maturity	7,807	51.681	21.561	36.000	58.000	60.000
Covenants	7,807	0.271	0.445	0.000	0.000	1.000

Panel B: Interest Rate Spreads

VARIABLES	*Spread*					
	Brown Group	Clean	Brown	Brown Group	Clean	Brown
	(1)	(2)	(3)	(4)	(5)	(6)
NZ Signed	0.115	-0.686***	0.126	-0.019	-0.727***	-0.006
	(0.386)	(0.002)	(0.390)	(0.832)	(0.001)	(0.947)
Nun Syn Loan	0.008***	0.004	0.008***	0.003	0.001	0.003
	(0.004)	(0.410)	(0.006)	(0.114)	(0.893)	(0.104)
Ln Assets	-0.817***	-0.706	-0.718***	-0.514***	-1.203***	-0.491***
	(0.000)	(0.195)	(0.000)	(0.000)	(0.009)	(0.000)
Total Loan	-2.256	-0.744	-2.492	-3.292***	-0.993	-3.325***
	(0.161)	(0.732)	(0.135)	(0.002)	(0.708)	(0.003)
ROA	-0.143***	-0.177	-0.122***	-0.127*	-0.280***	-0.115
	(0.002)	(0.196)	(0.009)	(0.066)	(0.003)	(0.123)
Capital Ratio	0.015	0.006	0.016	0.024**	0.004	0.026**
	(0.280)	(0.744)	(0.269)	(0.044)	(0.875)	(0.043)
Non-Performing Loans	-0.107*	0.243**	-0.090	-0.057	0.137	-0.086
	(0.069)	(0.047)	(0.140)	(0.295)	(0.218)	(0.167)
Net Interest Margin	0.268	0.356	0.259	0.309**	0.430*	0.269**
	(0.230)	(0.119)	(0.285)	(0.017)	(0.060)	(0.044)
Size	-0.183***	-0.262*	-0.146**	-0.038	-0.174	-0.030
	(0.002)	(0.089)	(0.016)	(0.500)	(0.122)	(0.582)
Maturity	-0.001	0.009*	-0.001	-0.001	0.014*	-0.001
	(0.615)	(0.069)	(0.255)	(0.585)	(0.089)	(0.364)
Covenants	-0.067	-0.214*	-0.055	-0.059	-0.140*	-0.048
	(0.244)	(0.052)	(0.373)	(0.385)	(0.075)	(0.497)
p-value of difference between *NZ signed*			.001			.001
Observations	7,807	369	7,287	7,799	347	7,260
R-squared	0.806	0.948	0.81	0.889	0.889	0.889
Bank×Cohort FE	YES	YES	YES	NO	NO	NO
Group×Cohort FE	YES	YES	YES	NO	NO	NO
Country×Year×Cohort FE	YES	YES	YES	YES	YES	YES
Bank×Group×Cohort FE	NO	NO	NO	YES	YES	YES