Banking on Deforestation:
The Cost of Nonenforcement*

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Abstract

Despite surging environmental laws, how their enforcement influences banks' management of climate risks remains underexplored. Using Brazilian Amazon as a laboratory, we examine the impact of a shock to environmental law enforcement on bank management of risks arising from deforestation—a significant but understudied climate risk. After enforcement declined, Brazilian banks significantly altered their priorities to more short-term profitability over longer-term risk concerns. Banks greatly increased lending to agribusinesses engaged in deforestation and actively shifted resources to regions with higher deforestation potential. Results suggest that without rigorous enforcement, banks may fail to fully internalize deforestation risks, despite existing environmental laws.

JEL Classification Codes: D72, G11, G18, G21, Q50, Q54.

Keywords: environmental law enforcement, climate risk, deforestation risk, banking, financial institutions, bank credit, Brazilian Amazon, sustainable finance.

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"Enforcing laws and regulations is a necessary element to prevent impunity within society, to ensure the credibility and legitimacy of the institutions […] and to level the playing field among economic actors" (*OECD,* 2018).

"[…] Despite a 38-fold increase in environmental laws put in place since 1972, failure to fully implement and enforce these laws is one of the greatest challenges to mitigating climate change…" (*UN Environmental Programme,* 2019).

1. Introduction

In global policy debates on climate change, the financial sector's role is to allocate capital and manage risks efficiently –risks arising from environmental factors, their potential impact on financial stability, asset values, and long-term profitability. Banks and other financial institutions must manage these risks within context of changing environmental laws and the enforcement of these laws. It is well known many banks are integrating environmental, social, and governance (ESG) considerations into their broader risk management strategies (UNCTAD, 2021; BCBS, 2023; NGFS, 2019, 2021, 2023), but it is not known how much the intensity with which the environmental laws are enforced are considered.

An additional issue of uncertainty is how the risks of the deforestation of the rain forests specifically are managed. Deforestation is significant contributor to carbon emissions , but bank management of these risks has eluded much of the past research. Banks are exposed to deforestation risks through several channels including credit risk, regulatory compliance, reputational risk, and market volatility. This study investigates how deforestation-related risks are factored into banks' lending decisions, particularly in response to a sudden change in the intensity of environmental law enforcement.

More generally, amid a surge in environmental laws worldwide, both researchers and policymakers focus on how banks internalize carbon-related risks and the impact of these laws, but the intensity with which these laws are enforced remains a significant blind spot.[2,3] This paper tries to fill in these gaps and investigates whether a sudden relaxation of environmental law enforcement shifts banks' credit supply toward or away from "brown" deforesting industries in Brazil, highlighting the critical role of enforcement

[2] See Correa, He, Herpfer, and Lel, 2023; Degryse, Goncharenko, Theunisz, and Vadasz, 2023; Fuchs, Nguyen, Nguyen, and Schaeck, 2023; Giannetti, Jasova, Loumioti, and Mendicino, 2023; Ivanov, Kruttli, and Watugala, 2023. Increased attention to climate change is also paid by academics and investors see Hong, Karolyi, and Scheinkman, 2020; Choi, Gao, and Jiang, 2020; Engle, Giglio, Kelly, Lee, and Stroebel, 2020; Bolton and Kacperczyk, 2021.

[3] See UN Environment Programme (2014, 2019); https://www.unep.org/news-and-stories/press-release/dramatic-growth-laws-protect-environment-widespread-failure-enforce

in shaping financial decisions.

Brazil provides an ideal setting for this study. As home to the Amazon, the world's largest tropical forest, Brazil plays a key role in global climate stability. However, deforestation in the Amazon poses both physical and transition risks to various sectors, including finance, agriculture, and infrastructure.[4] Over the past five decades, deforestation driven by infrastructure development and agricultural expansion has contributed significantly to environmental degradation, with global implications – deforestation in this area is estimated to account for one-fifth to one-quarter of the global greenhouse effect (Fearnside, 2005, 2019; Pearce and Brown, 2023).

Brazil's evolving environmental laws further provide a valuable backdrop for our research, with a notable shift towards environmental protection in the early 21st century. However, the year 2019 marked a significant reversal in the intensity enforcement, as a new presidential administration introduced immediate cuts in personnel and resources for key agencies including the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA). Leveraging this sudden decline in IBAMA's forest oversight personnel as an exogenous shock to environmental law enforcement, we examine how the relaxation of environmental policy enforcement influences banks' supply of "brown" agribusiness credit in Brazil.

The agribusiness sector (including agriculture and agroindustry) is a major driver of large-scale deforestation risk in the Amazon (Peres, Campos-Silva, and Ritter, 2022, 2023). Banks face significant exposure to deforestation risk through multiple channels, including heightened credit risk, regulatory compliance challenges, reputational damage, and increased market volatility, all of which can undermine financial stability. For example, lending to businesses linked to deforestation can result in significant financial and reputational risks as those businesses may face operational disruptions, increased costs, or legal penalties, affecting their ability to repay loans, triggering defaults, and impairing the bank's financial stability. Analyzing how banks navigate deforestation risks, especially in response to the shift in policy, is

[4] Physical climate risks from deforestation, such as flooding and soil erosion, can erode asset values and collateral, increasing default risks; for instance, degraded land may reduce loan collateral value. Transition risks—regulatory, market, reputational, and legal—further disrupt financial stability, as stricter regulations raise compliance and legal costs and default risks, prompting banks to reassess lending strategies.

the objective of this study.

Specifically, we test whether banks primarily prioritize short-term profitability gains and existing lending relationships (Degryse, Roukny, and Tielens, 2022; De Haas and Popov, 2023; Giannetti, Jasova, Loumioti, and Mendicino, 2023) over long-term concerns, including prudential, regulatory, and reputational risks (Reghezza, Altunbas, Marques-Ibanez, Rodriguez d'Acri, and Spaggiari, 2022; Ehlers, Packer, and De Greiff, 2022; Correa, He, Herpfer, and Lel, 2023; Degryse, Goncharenko, Theunisz, and Vadasz, 2023; Ivanov, Kruttli, and Watugala, 2023). It remains unclear *ex ante* how weakening environmental law enforcement would impact "brown" credit allocation. Banks' responses to the shock hinge not only on the trade-off between risk and profitability but also on how they navigate the potential shifts in borrower risk, market dynamics, and expected agribusiness loan outcomes. On the one hand, if the shock leads to increased bank lending to agribusinesses, it may suggest that banks prioritize immediate financial gains, potentially downplaying deforestation risks. Alternatively, if banks continue lending despite recognizing these risks, it could reflect a strategic calculation that the anticipated profits outweigh the long-term environmental and reputational costs, illustrating the complexity of their climate risk management.

On the other hand, weakening environmental law enforcement may prompt banks to increase focus on deforestation-related climate risks, leading to a reduction in lending to agribusinesses engaged in deforestation. Banks exposed to deforestation risks—through credit, reputational, regulatory, and legal channels—could prioritize long-term risk management over short-term gains. By incorporating physical risks, such as land degradation and transition risks tied to evolving regulations and market preferences, banks may seek to mitigate potential defaults and reputational damage. This proactive approach would not only align with sound risk management practices but also enhance the bank's credibility, resilience, and long-term value (Freeman, 1984).

Our exploration is also called for because agribusiness credit is strongly associated with increases in deforestation risk (Andersen, 1996; Alvarez and Naughton-Treves, 2003; Hargrave and Kis-Katos, 2013; Assunção, Gandour, Rocha, and Rocha, 2020). The banking sector holds about two-thirds of the country's financial system assets and plays a crucial role in managing risks arising from unsustainable interactions with nature (Calice, Diaz Kalan, and Miguel, 2021).[5]

Brazil's role as a major emerging economy – ninth in global GDP in 2023 IMF rankings and largest in Latin America – provides a unique lens to observe policy implications and avoid confounding cross-country differences. In developing nations like Brazil, weak rule of law, often driven by corruption and influential group interests, creates a gap between regulation and enforcement that may undermine environmental regulations (OECD, 2018; UN Environment Programme, 2014, 2019). Enforcement is key if firms and banks recognize regulatory risks only when substantial consequences for noncompliance are anticipated. This highlights challenges in understanding how laws impact financial institutions in developing countries, where existence of laws does not guarantee effective implementation.

Prior research on effects of environmental law enforcement is scarce. Assunção, McMillan, Murphy, and Souza-Rodrigues (2023) explore how the design of environmental law enforcement may lead to different environmental outcomes using counterfactual analysis. However, to the best of our knowledge, we are the first to directly investigate whether banking activity reacts to changes in enforcement capacity.

Examining the consequences of actual changes in environmental law enforcement, rather than laws alone, is particularly crucial for developing nations like Brazil. These countries heavily rely on natural capital for economic development, exposing them to the risk of irreversible environmental degradation, subsequent crises, and social collapses in absence of adequate environmental governance (Combes, Delacote, Motel, and Yogo, 2018; Diamond, 2013). Moreover, weaknesses in legal frameworks can contribute to reduced accountability for environmental violations. In Brazil, IBAMA's vulnerability to political influence raises concerns about potential risks to financial resource management (Yee, Tang, and Lo, 2016; Abreu, Soares, and Silva, 2022). Given that BRICS nations contribute 40% of global greenhouse

[5] As recognized in Article 2.1(c) of the Paris Agreement, the financial sector could play a central role in shifting capital investments from fossil fuel-intensive industries towards climate-friendly initiatives to achieve a globally sustainable economy. Financial credit is a key tool to reallocate capital to more environmentally conscious alternatives ((UNFCCC, 2018; NGFS, 2019; Kacperczyk and Peydró, 2022).

gas emissions, exploring changes in their law enforcement is highly relevant (Liu, Zhang, and Bae, 2017).[6]

To identify effects of a relaxation in the environmental law enforcement on bank allocation of credit to deforesting industries, we exploit the sudden cuts in the environmental oversight personnel of the IBAMA across Brazilian federal states after the presidential election of Jair Bolsonaro in 2019. This constitutes an exogenous shock to environmental law enforcement stringency as demonstrated by the surprise and uncertainty expressed by many major press articles.[7] Such personnel cuts significantly undermined the ability of the environmental agencies to effectively monitor and enforce the laws.

For data, we rely on comprehensive administrative records from four distinct sources in Brazil, including granular bank branch financial data. To help identify the effects, we adopt a panel collapsed at the bank branch level into a single observation per branch covering the changes from the pre-shock (2018) to the post-shock (2019) period, akin to Khwaja and Mian (2008) and Schnabl (2012) and investigate the transmission of the environmental law enforcement shock to the banking sector. Specifically, we analyze the impact on each bank branch's allocation of credit to "brown" agribusiness (agricultural and agro-industrial) industries post the environmental law shock. To enhance identification, we conditionally examine this effect based on municipalities' *ex-ante* deforestation potential. Employing a *quasi*-difference-in-difference model with fixed-effects for banks and federal states, controlling for regional credit demand, we simultaneously conduct within-bank estimations using the branch-level credit data. This empirical strategy mitigates concerns related to demand shocks or unobserved bank characteristics influencing credit reallocation to deforestation-intensive industries.

Our empirical investigation reveals that after the sudden relaxation in the environmental law

[6] Policy makers in BRICS should not underestimate the long-term consequences of unsustainable growth. Choosing not to act could lead to higher costs arising from mitigating the effects of natural disasters, and could hinder economic growth, especially in developing countries (Hsiang and Jina, 2014; Strobl, 2011; Anttila-Hughes and Hsiang, 2013; Berger, Karakaplan, and Roman, 2023).

[7] E.g., https://edition.cnn.com/2022/09/20/americas/brazil-bolsonaro-deforestation-term-intl-latam/index.html; https://www.reuters.com/article/idUSKCN1VI13Q/; https://edition.cnn.com/2019/08/25/americas/brazil-bolsanaro-environmental-record-intl/index.html; https://www.greenpeace.org/international/story/52098/bolsonaro-president-brazil-amazon-environment/; https://www.economist.com/graphic-detail/2019/08/15/deforestation-in-the-amazon-may-soon-begin-to-feed-on-itself.

enforcement in Brazil in 2019, banks tend to prioritize short-term financial gains and existing "brown" relationships. They significantly increase their share of "brown" credit in order to accommodate credit demand from agribusinesses located in regions with a higher proportion of land suitable for deforestation. Our evidence is robust to a variety of tests, including alternative dependent variable, alternative estimation techniques, alternative sample composition, ruling out alternative explanations such as state and foreign bank ownership, and when including competing interaction terms with additional municipality characteristics. Placebo tests in which we assume the shock occurred three, two, or one year before the actual date yield no significant results. Placebo tests in which we replace bank agribusiness credit (linked to large scale deforestation) with credit to other sectors (not linked to large scale deforestation) do not show positive and significant increases in credit after the shock.

Our main effects are more pronounced in regions characterized by significant pre-existing concentration of agro-industrial activities, suggesting a potential shift in perceived returns for agribusiness firms in areas with weakened oversight. This implies a possible change in the anticipated profitability for agribusiness enterprises operating in regions with diminished environmental supervision. We also show that results are more pronounced for banks with a stronger *ex-ante* risk appetite, which are more prone to engage in "brown" loan supply following the weaking of IBAMA enforcement capacities. These results may signal an unexplored tendency among financial institutions to prioritize short-term gains and profitability and overlook long-term transition risks when the climate policy stringency is weakened.

Our findings point to an internal capital markets channel: we conjecture that banks may use internal capital markets to channel resources and accommodate the demand for agribusiness credit in regions affected by relaxed enforcement. This aligns with prior research by Houston, James, and Marcus (1997), Bustos, Caprettini, and Ponticelli (2016), Ben-David, Palvia, Spatt (2017), Coleman, Correa, Feler, and Goldrosen (2017), and Becker, Busch, and Tonzer (2021), indicating that Brazilian banks strategically employ internal capital markets to navigate external shocks or policy changes. Using proxies for changes of internal funds from the bank to its branches and branch profitability as dependent variables, our analysis shows that banks engaged in an internal reallocation of capital towards branches of the same bank located in regions with greater availability of forested areas. Thus, internal capital market reallocation to branches able to grasp profitability benefits emerges as a key channel for our results. The analysis underscores the crucial role of internal capital markets in understanding the observed increase in “brown” agribusiness credit following the enforcement reduction.

Another important channel to test is political connections, as prior research including for Brazil finds to be rewarding for firms and areas that provide financial support for winning officials (Fisman, 2001; Faccio, Masulis, and McConnell, 2006; Faccio and Parsley, 2009; Leuz and Oberholzer-Gee, 2006; Claessens, Feijen, and Laeven, 2008). We construct measures of campaign contributions and find that our main higher “brown” credit results are more pronounced for regions with higher political support for the president’s party and coalition. These results may suggest that “brown” agribusiness firms could derive notable benefits from political connections following the election.

Finally, to address skepticism regarding the link between agribusiness credit and deforestation in Brazil, we also conduct a real effects analysis. For this, we use a municipality-level sample (level at which deforestation data is available) as we collapse all data at the municipality-level panel into a single observation per municipality, in the spirit to Khwaja and Mian (2008) as above and use the change in natural forest area from before to after the shock as dependent variable. Using two different methodologies, we confirm that the change in the bank branch share of “brown” agribusiness credit after the shock and/or the weakening of environmental law enforcement are linked to substantial rise in deforestation. Overall, results of this study have important policy implications and underscore the important role of rigorous enforcement in ensuring banks internalize deforestation risks.

Our study adds a distinctive and important perspective to the evolving literature on climate risk, policy, and financial institutions. Previous research primarily focused on climate risks from hurricanes and wild fires (Correa, He, Herpfer, and Lel, 2023; Degryse, Goncharenko, Theunisz, and Vadasz, 2023; Fuchs, Nguyen, Nguyen, and Schaeck, 2023; Ivanov, Kruttli, and Watugala, 2023) has demonstrated how banks adjust lending decisions in response to environmental considerations through altering loan spreads, probabilities of default, or reallocating credit away from high carbon firms. Studies by Beyene, De Greiff, Delis, and Ongena (2021), Benincasa, Kabas, and Ongena (2022), Degryse, Roukny, and Tielens (2022), Kacperczyk and Peydro (2022), De Haas and Popov (2023), and Giannetti, Jasova, Loumioti, and Mendicino (2023) shed light on various aspects, from the impact of climate policies on banks' effectiveness to cross-border lending practices and the reluctance of banks to alter lending policies due to potential negative effects on existing relationships. Our work is the first, to our knowledge, to examine the immediate effects of a sudden shift in the enforcement of environmental laws on banks' "brown" credit allocation in Brazil, offering insights distinct from previous studies that focused on post-regulation adjustments or long-term policy effects. Moreover, our focus is on deforestation, another type of climate risk, which is less than fully explored in scholarly inquiries.

Our study also contributes to law and finance research, which highlights the critical role of legal frameworks in shaping economic and financial outcomes. Building on seminal works by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997, 1998), Levine (1999, 2005), Malmendier (2009) and others, we further explore the nexus between law and financial dynamics. Bae and Goyal (2009), Haselmann, Pistor, and Vig (2010), Rodano, Serrano-Velarde, and Tarantino (2016), and Ponticelli and Alencar (2016), Schiantarelli, Stacchini, and Strahan, (2020), Heitz and Narayanamoorthy (2021), and Fonseca and Van Doornik (2022) delved into the impact of legal enforceability on loan structures, bankruptcy laws, and court congestion, respectively. Extending this line of inquiry, we focus on repercussions of the changes in enforcement of environmental laws, rather than other laws, which are rarely considered. This offers a fresh perspective on the interplay between legal factors and financial and environmental consequences.

We also aim to enhance the exploration of financial sector and real economy dynamics in Brazil, integrating insights from Claessens, Feijen, and Laeven (2008), Behr, Norden, and de Freitas Oliveira (2020), Martins, Schiozer, and de Menezes Linardi (2023), Norden, Mesquita, and Wang (2021), Colonnelli, Lagaras, Ponticelli, Prem, and Tsoutsoura, (2022), and Martins, Schiozer, and de Menezes

Linardi (2023). Behr, Norden, and de Freitas Oliveira (2020) highlight the positive correlation between bank credit relationships and employment and wages in Brazilian firms, emphasizing the economic impact of bank credit availability. Martins, Schiozer, and de Menezes Linardi (2023) stress the importance of same-bank lending in supply chain dynamics. Claessens, Feijen, and Laeven (2008) uncover the influence of political connections on Brazilian firms, revealing higher stock returns and increased bank financing for those contributing to elected federal deputies. Colonnelli, Lagaras, Ponticelli, Prem, and Tsoutsoura, (2022) explore the impact of revealing corrupt practices on firms engaged in illegal dealings with the government, and find adaptive responses in firms' growth strategies, capital investment, and borrowing. Our unique contribution extends this research by investigating how changes in environmental law enforcement in Brazil shape bank credit allocation to deforesting industries and subsequent deforestation outcomes. It adds valuable insights to the understanding of the intricate relationships between financial dynamics and environmental policies in the Brazilian business landscape.

Finally, we add to findings on political connections and financial outcomes which used cross-country and country-specific political connections and finds that political connections increase firm value for the connected firms, including through preferential access to financing (Fisman, 2001; Johnson and Mitton, 2003; Ferguson and Voth, 2008; Faccio and Parsley, 2006; Leuz and Oberholzer-Gee, 2006; Claessens, Feijen, and Laeven, 2008) or have real economic outcomes, increasing job creation (Bertrand, Kramarz, Schoar, and Thesmar, 2004). We complement and add to this research by providing some evidence of the influence of political connections on "brown" credit supply in the Brazilian Amazon. Our political economy analysis underscores the enduring significance of political connections in influencing bank credit provision, even within the context of deforesting industries.

The remainder of the paper is organized as follows. Section 2 shows our hypothesis development. Section 3 offers an overview of the environmental law in Brazil and changes in the enforcement over our sample period. Section 4 describes our dataset and identification strategy. Section 5 explains our empirical results and Section 6 draws conclusions and provides policy implications.

2. Hypothesis development

It is unclear *ex ante* how a weakening in environmental law enforcement would impact “brown” credit allocation. Our empirical analysis tests which of the following views empirically dominates. On the one hand, according to **Hypothesis 1 (Short-Term Profitability Gains)**, a reduction in the staff responsible for deforestation control might result in an increased share of “brown” agribusiness credit allocated by banks. On the other hand, according to **Hypothesis 2 (Long-Term Value Gains)**, weakened environmental law enforcement may decrease banks’ “brown” credit allocation patterns. The effect of a weakening in environmental law enforcement on banks’ credit would depend on the trade-off banks face between the short-term profitability gains derived from the exploitation of credit opportunities to new agribusinesses and the preservation and/or enhancement of existing lending relationships with “brown” borrowers versus the longer-term value gains inclusive of prudential, regulatory, and reputational risks. Banks’ responses to this trade-off will hinge on their prioritization of immediate financial gains over the potential long-term impacts of deforestation-related risks on their resilience and stability.

To expand, **Hypothesis 1 (Short-Term Profitability Gains)** suggests that suggests that a weakening in environmental law enforcement may increase bank “brown” credit to deforesting firms due to lower compliance costs and higher perceived short-term profitability. In this context, banks' responses to the enforcement shock will hinge not only on the trade-off between risk and profitability but also on how the shock alters expected outcomes on loans to agribusinesses. Weakening environmental laws could reduce compliance costs for firms engaged in deforestation, making their operations more cost-effective and potentially leading to higher profit margins. If the shock leads to increased lending, it may suggest that banks downplay deforestation risks, prioritizing short-term gains. Some may also argue that industries linked to deforestation, when unhindered by strict environmental regulations, may experience growth, leading to job creation and overall economic development. This positive economic outlook could make these industries more attractive to investors and creditors. Banks may see an opportunity to extend credit to these firms, anticipating better financial gains from improved relationships. Investors and banks focused on short-term gains might be attracted to deforesting industries if they expect a rapid increase in profits due to reduced regulatory burdens. This perception of quick returns could lead to increased credit for deforesting firms as banks seek to capitalize on what appears to be lucrative opportunity.

Conversely, **Hypothesis 2 (Long-Term Value Gains)** suggests that a weakening of environmental law enforcement could lead banks to reduce "brown" credit to deforesting firms as they internalize deforestation risks and adopt broader climate risk management strategies. Banks exposed to both physical risks—such as land degradation and increased flooding—and transition risks—including reputational, regulatory, and legal liabilities—may reevaluate lending to industries linked to deforestation. Businesses involved in deforestation could face regulatory penalties, legal lawsuits, operational disruptions, and reputational damage, all of which impair their ability to repay loans, thereby undermining bank resilience and stability. Additionally, banks with heightened exposure to deforestation may experience increased market volatility, financial losses, and reputational damage from negative publicity, which can harm their brand and erode customer trust. As public demand for sustainable practices intensifies, banks must account for long-term financial and regulatory risks. Proactively managing these risks enhances banks' climate risk management credentials, strengthens their reputation, and supports long-term value creation, positioning them as reliable institutions in an increasingly sustainability-focused financial landscape.

3. Institutional details on environmental law and its enforcement in Brazil

The foundation of the Brazilian environmental law system is the Brazilian Forest Code (Lei 12.651/2012), governing landowners' responsibilities related to forest conservation, legal reserves, and environmental licensing. The initial effort to combat deforestation emerged in 1989 with the "Nossa Natureza (Our Nature)" program. Subsequently, the 2004 initiative, "Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm)," introduced additional legal procedures for the management and control of the Brazilian Amazon Forest. Its intended objective was to promote the sustainable use of the land for economic and infrastructure development; and dictated the legal procedures regarding monitoring and control of deforestation; environmental licensing and fining, and on-the-ground law enforcement. However, in 2012, the PPCDAm dictated a revision of Brazilian Forest Code to grant amnesty for all illegal deforestation before 2008 (West and Fearnside, 2021). This exemplifies the ease with which environmental laws can be dramatically altered depending on the influence of the Brazilian political regime, consequently contributing to the likely increased perception of impunity among land grabbers.[8] Nonetheless, in December 2015, Brazil signed the Paris Agreement at COP 21 of the UNFCCC under which the country committed to achieve zero illegal deforestation in the Amazon by 2030.[9]

One main strategy adopted to combat illegal deforestation in Brazil was the use of punitive power of the state and the imposition of administrative fines (Mendes, 2021). This was supported by an environmental enforcement structure, largely overseen by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA). Established in 1989, IBAMA is a federal agency responsible for enforcing environmental policies and regulations. It operates under the Ministry of the Environment and plays a crucial role in monitoring, licensing, and combating illegal activities that threaten the Amazon rainforest. The institute employs field agents, inspectors, and technical experts to carry out its mission. On-the-ground enforcement is carried out by armed IBAMA staff that physically oversee the land.

Prior to 2019, there was a significant emphasis on environmental protection and law enforcement in Brazil. However, following Jair Bolsonaro's election as president of Brazil in 2019, there were significant shifts in environmental policy with direct implications for environmental law enforcement. Specifically, the new administration made significant reductions in staff and resources allocated to environmental agencies, including IBAMA (Peres, Campos-Silva, and Ritter, 2022). Moreover, they openly questioned Brazil's commitment to the Paris Agreement and expressed a desire to expand regional infrastructure,

[8] As stated by Fearnside (2023): "Brazil is probably the only country in the world where one can invade government land, deforest, and expect to obtain a land title…Making illegal deforestation legal may fulfil Brazil's promise to end illegal deforestation by 2028".

[9] Regarding the Brazilian environmental laws that have directly affected the financial system, since 2008 Brazil has implemented some voluntary (the Green Protocol) and other mandatory guidelines for banks to deal with social and environmental risks. The Green Protocol fosters the provision of financial credit to promote the population's quality of life and sustainable use of the environment; and commit participating banks to consider the impacts and environmental costs in managing assets (Oyegunle and Weber, 2015). Moreover, the Central Bank of Brazil, under resolution N.4.327, requires banks to establish procedures for identification, classification, monitoring, and mitigation of socio-environmental risks.

agricultural activities, and mining operations with limited consideration for indigenous rights and existing environmental regulations (Escobar, 2018; Tollefson, 2018). This shift triggered international attention and raised questions about Brazil's commitment to addressing deforestation and climate risks. In summary, the changes in climate law enforcement in 2019 had severe consequences for the Brazilian Amazon Forest, leading to increased deforestation, threats to indigenous communities, and a negative impact on global climate efforts. Our study points to important consequences from the banking sector perspective.

4. Data and empirical approach

4.1 Data and sample

Our data are from four different sources of administrative records from Brazil, covering 2018 to 2019**.** First, we collect granular data on the universe of Brazilian bank branches at the municipal level from the ESTBAN (Estadistica Bancaria Mensal por Municipio) database published by the Central Bank of Brazil. Since we cannot distinguish among different offices of a bank within a municipality, a bank branch should be considered as the consolidated assets and liabilities held by a bank within a municipality. This approach has been previously used, for instance, to explore questions about the transmission of domestic and foreign liquidity shocks to Brazilian municipalities in different settings (Coleman and Feler, 2015; Bustos et al., 2016; Noth and Ossandon Busch, 2021). As of 2018, 3,364 of the 5,570 Brazil municipalities report hosting at least one bank branch and branches operate in all 27 federal states.

Second, we combine branch data with information on banks' call reports containing balance sheet and income statement at the bank group level from the Central Bank of Brazil. We manually construct an identifier to connect each branch to its corresponding bank. While 208 banks reported being active in Brazil as of 2018, most of them were concentrated in the investment banking sector, lacking a network of regional branches which are our main unit of interests. For example, only 56 banks reported more than one active branch as of 2018. We begin with a sample of 9,806 branches active as of 2018 and introduce three sample restrictions to align the sample with our identification strategy. First, we restrict the sample to branches active throughout 2018 and 2019, avoiding the results being influenced by branches entering or exiting the market. Second, we restrict the sample to branches that report active outstanding credit balances in the agricultural sector as of 2018. Finally, we drop the metropolitan areas of Sao Paolo and Rio de Janeiro from the sample, as these regions represent financial centers with little exposure to agriculture activity. Moreover, most banks are headquartered in these regions. With these restrictions, our final sample consists of 3,909 branches operating in 2,093 municipalities and belonging to 20 banking conglomerates. Each bank reports branches operating, on average, in 179 municipalities.

Third, we next merge the bank branch-level data with an administrative record of the staff employed by IBAMA in each federal state. These data are collected from yearly reports published by the Brazilian Ministry of Finance. We use this to construct our measure the IBAMA's personnel cuts from 2018 to 2019 under the new presidential administration, which constitutes the shock which weakened environmental law enforcement. Finally, we complete our data with an administrative record of each municipality's geographical area reported use (agriculture, forestry, or being kept as natural rainforest environment) from the Brazilian Annual Land Use and Land Cover Mapping Project (Mapbiomas). This source provides information on the yearly shares of land use per municipality each year. We use this information to compute the share of natural environment to total area per municipality as of 2018. As explained below, we use this variable to assess the municipal area available to be deforested per municipality, proxying for the extent to which the decrease in IBAMA's staff may have had an impact on firms' incentives to increase the areas intended for agriculture and related activities.

The final combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008) and Schnabl (2012). We collapse observations for each bank branch over the two periods of pre (2018) and post the environmental law shock (January 2019 when new presidential administration came into office) and use the change between periods in bank share of "brown" agribusiness credit and environmental oversight personnel as key variables for the analysis. We provide more details on our empirical approach below.

4.2 The IBAMA oversight personnel shock

We build an empirical setting aimed at identifying the effect of a weakened enforcement of environmental law in Brazil as proxied by the sudden reduction in IBAMA national agency's environmental oversight staff following the inauguration of a new administration in January 2019.

The sudden significant reduction in IBAMA's budget and environmental oversight personnel during the new administration became a matter of heated public debate in Brazil and abroad. Moreover, the local and international press presented this scenario as a sudden and unprecedented dismantling of environmental law enforcement capacities in Brazil, raising concerns about the consequences for the preservation of the Amazon ecosystems.

First, while IBAMA's approved budget for 2019 slightly increased compared to the electoral year of 2018, the main impact of the newly elected government came through a drastic cut in the budget's execution, which decreased in its payroll alone from 91 percent in 2018 to 56 percent in 2019. In 2019, the budget assigned to new investments in enforcement capacities had an execution of only 4 percent. Despite budget execution details being clearly important, data availability on this at granular level impedes us from using this as a shock in our analysis.

Second and what we exploit as the shock in our analysis is that IBAMA's oversight staff, the "boots on the ground" for environmental law enforcement, decreased significantly from January 2019. We calculate changes in IBAMA's oversight personnel between 2018 and 2019 based on data available at the federal state level. Figure 3 illustrates the percentage change in IBAMA's staff in each of the 27 federal states in Brazil. Between 2018 and 2019, 20 federal states reported significant decreases in IBAMA's oversight staff, with an average decrease across affected regions of 6.2 percent, and largest decreases being reported in the large federal states exposed to deforestation. Out of the five most affected federal states, four were within the so-called Legal Amazon, a region of nine federal states in the northwest of Brazil, shown in Figure 1. These regions reported an average decrease in IBAMA's staff of about 14 percent on a yearly basis, with even larger decreases for individual states. For instance, the staff decreased by 20 percent in the state of Amazonia and by 15 percent in the states of Mato Grosso do Sul and Tocantins.

Importantly, official records suggest that these drastic reductions in environmental budget execution and oversight personnel had material consequences for IBAMA's enforcement capacities. For instance, the number of sanctioning processes due to environmental law violations decreased by 50.6 percent between 2018 and 2019, while only 16 percent of the budget assigned to on-site inspections and fire-control measures was executed (Werneck, Angelo, and Araujo, 2022). Against this backdrop, the deforestation in the Amazon region increased by 49 percent, while the number of fires recorded in the Amazon – associated with deforestation practices - increased by 52 percent during the first year of the new administration compared to 2018 (INPE, 2023). Figure 2 plots the annual loss in natural forest area for each Federal State in the Legal Amazon from 2010 to 2021 and shows very significant increases in deforestation in the years after 2019 shock in environmental law enforcement.

4.2 Empirical framework and identification strategy

We estimate the effect of a sudden relaxation in environmental law enforcement in Brazil from 2019 – proxied by the change in IBAMA's oversight staff within federal states – on the change in bank branch "brown" agribusiness (agricultural and agro-industrial firms, sector associated with large-scale deforestation) credit.

Following prior *quasi*-experimental settings in the empirical banking literature (Khwaja and Mian, 2008; Schnabl, 2012), we use the plausibly exogeneous variation in enforcement capacity to estimate a *quasi*-difference-in-difference model in which we collapse the bank branch-level panel into a single observation per branch. Specifically, we collapse observations for each bank branch over the two periods of pre (2018) and post shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. We adopt this procedure to avoid concerns of biased standard errors due to autocorrelation (Bertrand, Duflo, and Mullainathan, 2004). Moreover, this approach better facilitates the interpretation of the effects since aggregated time trends and banks' unobserved time-invariant characteristics do not affect the results after having first differentiated the main variables of interest.

We use the following *quasi*-difference-in-difference (*quasi*-DID) empirical model for "extension of "brown" agribusiness credit by bank branch *i* in municipality *j*, from 2018 to 2019.:

$$\Delta\, AG\ Credit_{i,j,(18-19)} = \beta 1\big(\Delta\, IBAMA_{j,(18-19)} \times Av\ Forest_{\ j,\,2017}\big) + \mu_{uf} + \delta_i + \Omega_{ij} + \epsilon_{i,j} \quad (1)$$

Our key dependent variable is Δ*AGCredit*, the change in the bank branch share of agribusiness credit to total credit from 2018 to 2019 at branch-municipality level. The key explanatory variables are: the *quasi*-DID term, Δ *IBAMA* × *Natural Forest Area* , and the uninteracted terms Δ *IBAMA* and *Natural Forest Area*, where Δ *IBAMA* is the change in the environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 available at federal state level, and *Natural Forest Area*, which is the ex-ante percentage of area available to deforest (forest area in km^2/total area km^2) as of 2017, which is at municipality level. Importantly, the interaction with "*Natural Forest Area*" serves two purposes: it allows narrowing-down the estimation at the municipal level, and it sheds light on the mechanism in place as banks may take advantage of a weaker law enforcement mostly precisely in regions where there is more available area to deforest. The standalone term Δ *IBAMA* is redundant due to the inclusion of federal state fixed effects that we discuss below.

Then, μ_{uf}, represents federal-state fixed effects and allows us to control for demand factors; given the collapsed panel between the pre/post periods, they are like *quasi*-region-time fixed effects; δ_i represents bank fixed effects; given the collapsed pre/post periods, this is like *quasi*-bank-time fixed effects, allowing for a within-bank estimation. Therefore, we may be able to address whether the same bank could increase more its agribusiness credit in certain regions, depending on the pre/post changes in IBAMA staff levels. Ω_{ij} is a vector of control variables capturing branches' characteristics. While bank characteristics are subsumed within the bank fixed effects, branch characteristics such as their size, deposit base, or profitability, may further explain an expansion of credit to agribusiness firms. To address this, we include branch size (log assets), branch liquidity ratio (the ratio of liquid assets to total assets ratio), branch profitability (return on assets, ROA), and branch deposit ratio (the ratio of deposits to total liabilities) as controls across all specifications. These variables are computed as 2017 averages from the monthly underlying data. Finally, $\varepsilon_{i,t}$ represents a white-noise error term. We account for the fact that the standard errors could be correlated across branches of the same bank by clustering standard errors at the bank level.

The coefficient of interest is $\beta 1$ on the quasi-DID term, Δ *IBAMA* × *Natural Forest Area.* It captures whether that the sudden decrease in IBAMA's oversight staff combined with a higher percentage of area available to deforest, incentivized banks to increase or reduce credit to agribusiness firms (sector associated with large scale deforestation).

The coefficient on $\beta 1$ would be negative if **Hypothesis 1** dominates **Hypothesis 2**, that is banks pursue short-term growth and/or profitability gains instead of longer-term value gains inclusive of prudential, regulatory, and reputational risks. The intuition is that a weakening in environmental law enforcement stringency could lead to short-term profitability gains when banks expand credit to accommodate an increase in the demand for credit from agribusinesses that could benefit from a weakened enforcement capacity. Conversely, the coefficient on $\beta 1$ would be positive if **Hypothesis 2** dominates **Hypothesis 1**.

4.3 Further identification concerns

We next discuss two additional concerns for identification and how we address them.

First, the change in IBAMA's environmental oversight staff could depend on regional characteristics. For instance, the government may reduce law enforcement capacities in regions that are politically aligned, or where economic growth through forest exploitation is already a trend. Moreover, the potential increase in branches' exposure to the agribusiness sector could reflect banks' own business models or trends in local credit demand, that may be spuriously correlated with the change in IBAMA staff.

Our approach to addressing this concern is threefold. First, we exploit the fact that the change in IBAMA's environmental oversight staff was triggered by a new president inauguration in January 2019, an electoral result that is arguably exogeneous from each municipality's perspective. The sizable decrease in IBAMA's capacities was also not chosen at the municipality level, since IBAMA had only a few regional offices mostly concentrated in the federal states' capitals. Second, as mentioned above, we use the plausibly exogeneous change in enforcement capacity to estimate a *quasi*-difference-in-difference model in which we collapse the branch-level panel into a single observation per branch. Third, we are further tightening the identification by saturating the *quasi*-DID model with federal state and bank fixed effects. By introducing the interaction term with municipalities' share of area available to deforest in Eq. (1), we do not only shed light on an underlying plausible mechanism linking weak law enforcement and agribusiness credit, but also allow for the use of federal state fixed effect that capture unobserved variation across branches that could be attributed to varying credit demand trends between years 2018 and 2019.

Still, another concern may be that unobserved changes in banks' business models could affect the estimation, as banks that are more prone to expand in the agribusiness sector could also be more active in regions that face a stronger reduction in law enforcement. The introduction of bank fixed effects in Eq. (1) reduces this omitted variable concern. In fact, we estimate Eq. (1) as a within bank estimation, in which we compare branches of the same bank that share the same characteristics of their banking conglomerate including, for instance, changes in a bank's business model that are contemporaneous to the new presidential election. Finally, as mentioned above, we also control bank branches' characteristics in all regressions.

We further address more specific identification concerns in a series of robustness tests discussed in Section 5.8. For instance, we estimate placebo tests with alternative event time windows, and we test the validity of the findings when introducing in the regression competing interaction terms between the change in IBAMA's environmental oversight staff and other regional characteristics.

4.4 Parallel trends analysis

As it is conventional in standard DID applications, we also conduct a test for the validity of the parallel-trends assumption. Figure 5 plots the evolution over time of the simple average change in the share of agribusiness loan growth *(*Δ *AGCredit*) that we use in our baseline analysis for branches located in regions with a large vs. small "*Natural Forest Area"* (affected and not-affected, respectively) over 2018 to 2020.

Figure 5 shows that prior to 2019, before the shock in environmental law enforcement, bank branches provided on average slightly less agribusiness credit to affected areas in early 2018 and/or a roughly similar trend exists in bank branch agribusiness credit to large vs small "*Natural Forest Area*" in the last months of 2018, but this reverses after the law enforcement shock.

The aggregate movements in bank branch agribusiness credit growth for large vs. small "*Natural Forest Area*" area provide some preliminary evidence consistent with the empirical domination of a short-term profitability shift of banks that we alluded to above (**Hypothesis 1**) over internalization of deforestation risks and longer-term value gains (**Hypothesis 2**). The figure also suggests that the parallel trends assumptions are not violated for bank agribusiness loan growth. Of course, these aggregate trends are only mildly suggestive, can only show simple differences and neither show individual bank branch behavior nor include control variables. In the next section, we investigate our question more rigorously in our *quasi*-DID regression model, controlling for different demand and supply factors and addressing identification concerns.

5. Empirical results

5.1 Baseline results

Table 1 provides definitions and data sources as well as summary statistics such as means, standard deviations, minimum and maximum values, on all variables used in our analysis.

Our main regression analysis evidence is presented in Table 2. We report results for Eq (1) using four different specifications: Column (1) presents a simple univariate model without any controls or fixed effects; Column (2) includes federal state fixed effects; Column (3) includes both federal state and bank fixed effects; and Column (4) shows the most complete model with federal state and bank fixed effects as well as controls for key bank branch characteristics. We find a negative coefficient for the key *quasi*-DID term ($\Delta IBAMA_{j,(18-19)} \times Av\ Forest_{j,2017}$). The sign and the statistical significance remain stable across models when controlling for different fixed effects and adding branch controls. This suggests that after the shock, a decrease in the IBAMA environmental oversight staff – which relaxed environmental law enforcement in Brazil– coupled with a higher exposure to areas with higher percentage available to deforest, incentivized banks to increase their share of “brown” agribusiness credit. This is consistent with is consistent with the empirical dominance of **Hypothesis 1**, under which banks pursue higher short-term profitability gains.

Results are also economically significant. Figure 6 presents the marginal effects at a 95th percent confidence level of changes in the number of IBAMA’s oversight staff on the proportion of agrobusiness credit across the distribution of municipalities' share of area available for deforestation. These estimates are derived from our baseline model specified in Eq (1). They suggest that a one-standard deviation decrease in IBAMA's oversight personnel growth rate (5 percentage points) is associated with a 35 basis points increase in the share of agribusiness credit growth for branches located in municipalities with approximately 70% of *ex-ante* available area to be deforested. This effect represents approximately 35% of the average change in branches' share of agribusiness credit, which is economically meaningful.

5.2 Decomposition of bank agribusiness credit into subcomponents

In Table 3, we report how the sudden change in IBAMA oversight staff affects the composition of bank agribusiness credit, looking separately at its two key subcomponents: agricultural credit in columns (1)-(2) and agro-industrial credit in columns (3)-(4). The agricultural credit is the ratio of loans to finance crop cultivation to total loans; while the agro-industrial credit is the ratio of loans to enterprises involved in processing, manufacturing, and value addition within the agricultural sector, to total loans. The latter primarily encompasses activities that convert raw agricultural products into food products related to agriculture.

These results in Table 3 suggest that between the two subcomponents, agricultural credit appears to be the driving force behind the increase in agribusiness credit following the relaxation of environmental law enforcement. In contrast, we find no significant effects for agro-industrial credit. Thus, effects are concentrated in the agriculture sector (farming and crop cultivation) which directly involves deforestation during the growth process. These results provide additional supporting evidence for **Hypothesis 1**, suggesting that a reduction in the staff responsible for forest oversight is fostering increased "brown" credit for activities with a higher deforestation risk.

5.3 Ex-ante agro-industrial importance

In Table 4, we further conduct a heterogeneity analysis to assess to which extent the effects of a weakening in the environmental law enforcement on bank provision of "brown" agro-industrial credit differ across municipalities with high versus low *ex-ante* agro-industrial importance measured two ways: *ex-ante* agricultural physical area extension and *ex-ante* agricultural specialization. We rerun our baseline specification using sample splits.

Columns (2)-(3) show estimation results for sample splits based on *ex-ante* agricultural physical area extension (larger vs. lower than the median). Columns (4)-(5) show sample splits based on *ex-ante* agricultural specialization (larger vs. lower than the median). We find that after the decrease in IBAMA's oversight staff which significantly weakened climate law enforcement in Brazil, banks increase their share of "brown" agrobusiness credit particularly in regions with larger "*deforestable*" areas. The main effect is higher and significant only in regions with a strong *ex-ante* intensity of agro-industrial importance, both in amount of agricultural area and in agricultural output level.

5.4 Branch and bank traits

We expand our baseline model (Eq. 1) by introducing an additional factor related to branch or bank characteristics (*Branch*/*Bank Trait*) into our main *quasi*-DID interaction term, resulting in a triple interaction model ($\Delta IBAMA_{j,(18-19)} \times Av\,Forest_{j,2017} \times Branch/Bank\,Trait$). The branch traits considered in this analysis are: branch size (log assets), branch deposits to assets ratio, branch liquidity to assets ratio and branch profitability ratio (ROA), all measured as of 2017. The bank traits considered in this analysis are: bank size (log assets), bank high risk credit to total credit ratio, bank capital to assets ratio and bank government ownership status, all measured as of 2017 as well. Table 5 Panel A presents triple interaction models using bank branch traits, while Table 5 Panel B presents triple interaction models using bank traits.

The results in Table 5 Panel A suggest that bank branches that are larger and have less deposits to assets engage in higher extension of agribusiness credit following the weaking of the environmental enforcement capacities. In addition, the results in Table 5 Panel B suggest that larger banks and those with higher risk appetite experience a higher increase in agribusiness credit following the weaking of the environmental enforcement capacities. Overall, these results further support **Hypothesis 1**, which indicates that banks pursue higher short-term profitability gains.

5.5 Channel: Internal capital markets reallocation and profitability

This section explores a potential channel for our results: bank internal capital markets reallocation to exploit short-term profitability gains. Our main results suggest that within a bank, those branches located in regions where IBAMA's enforcement capacities decreased the most increase their exposure to agriculture to a larger extent. This finding could reflect an increase in expected returns – as perceived by banks – of agribusiness firms that can now expand their operations in previously environmentally protected areas.

Thus, a plausible conjecture is that banks may try to exploit the weaker enforcement to their advantage to increase their own short-term profitability. Thus, they may channel liquidity through internal capital markets to support the supply of credit by branches that are geographically closer to agribusiness firms in the newly weakly-enforced areas. This builds on the notion that branches are restricted from raising deposits – their main source of funding – within the municipalities where they operate. Given this friction, exploiting a sudden shift in the expected return of loans to agribusiness firms will arguably require mobilizing resources from other branches affiliated to the same banking conglomerate.

The possibility that banks in Brazil may seize the opportunity of productivity shocks by shifting liquidity across regions has been discussed in related literature. Bustos, Caprettini, and Ponticelli (2016) shows, for instance, that productivity gains in the soy-beans industry led by technological changes created incentives for banks to reallocate financial resources to agriculture-intensive regions. Moreover, Coleman, Correa, Feler, and Goldrosen (2017) and Becker, Busch, and Tonzer (2021) show that Brazilian banks actively use internal capital markets within the country to adjust to foreign financial shocks or domestic changes in the stance of macroprudential policies, respectively. In our setting, finding traces of shifts in internal capital markets because of the reduction in IBAMA's law enforcement capacities would further corroborate that banks' reaction to this changing policy is driving our results.

To shed light on the dynamics in internal capital markets following the decrease in IBAMA's law enforcement capacities, we adjust Eq. (1) by replacing the dependent variable with the log change in the average monthly balances of internal liabilities between 2018 and 2019. In this exercise, we use two definitions of internal liabilities. First, a narrow definition that considers only interbank liabilities vis-à-vis the same banking conglomerate to which a branch belongs; and second, a broad definition which considers the sum of interbank deposits and the former variable. While for the case of interbank deposits, we cannot distinguish whether their origin lies inside the same banking conglomerate of a given branch, we would expect a sizable share of those deposits to be internal considering that bank branches outside the financial centers of Rio de Janeiro and Sao Paulo arguably lack operational independence to conduct interbank business operations.

Table 6 Panel A reports the results of this estimation. The results confirm that internal capital markets reacted to the decrease in IBAMA's environmental enforcement capacities, with liquidity flowing into bank branches that were in a better position to grasp the benefits of an expansion in the agribusiness sector. Columns (1)-(2) of Table 6 Panel A report the results for the narrow definition of internal liabilities. Following a decrease in IBAMA's oversight personnel by 8 percentage points (a one standard deviation shift), branches located in municipalities at the 75th percentile of the distribution of natural forest area reported a 0.4 percentage points larger growth rate of internal liabilities compared to other branches of the same bank. This differential effect corresponds to 12 percent of a standard deviation in the growth rate of internal liabilities between 2018 and 2019.

The results are robust using our alternative broad definition of internal liabilities reported in Panel A Columns (3)-(4), in which case the effect reports a similar order of magnitude. We thus conclude that the documented increase in bank branch agribusiness credit following weaker environmental law enforcement policies was fueled by a sizable shift of liquidity through bank internal capital markets across Brazil. The fact that banks react by activating internal liquidity channels is reassuring about the interpretation of the main results as driven by a reallocation of bank activities across regions following weaker environmental enforcement policies.

Moreover, Table 6 Panel B further investigates whether the weakening in environmental law enforcement did indeed provide banks the ability to seize short-term profitability gains. We replace our dependent variable in Eq. (1) this time with change in bank branch ROA from 2018 to 2019 in Column (1) and from 2018 to 2020 in Column (2). Across both specifications, we uncover that post-shock in 2019, banks exposed to weakened environmental law enforcement and areas with higher percentage available to deforest significantly increased their profitability. This evidence strongly supports **Hypothesis 1**.

5.6 Political economy analysis

Previous research has shown that firms contributing to electoral campaigns can potentially benefit from policies implemented by newly elected governments, as discussed in the Introduction. For the case of Brazil, Claessens, Feijen, and Laeven (2008) provide evidence that firms contributing to winning political candidates report larger stock returns and expand their access to bank finance compared to other firms. This suggests that the market for campaign donations may influence the relationship between political alignment and financial outcomes. Even if the effect of weaker environmental law enforcement holds, the way this relaxation affects firms could depend on local authorities' decisions regarding the reallocation of limited enforcement resources, particularly in regions where politically aligned firms operate. We next explore this question by examining whether our baseline results hold across regions with varying degrees of political alignment with the new administration.

We use donation-level data from Brazil’s 2018 federal election to construct measures of regions’ political alignment with President Bolsonaro’s administration. Using administrative records from the Brazilian High Electoral Court (Tribunal Superior Eleitoral), we identify firms and individuals that, in the run-up to the 2018 election, donated funds to candidates from the Social Liberal Party (PSL), Bolsonaro’s party of affiliation. Additionally, we identify firms and individuals contributing to any of the parties that formed the new president's coalition. Armed with these data, we compute the share of total electoral contributions within each federal state that went to the PSL or any of the new president's allied parties. We then split the sample of federal states based on the median share of president-supporting contributions and estimate Eq. (1) separately for regions with high vs. low financial support for the candidate's coalition. We explore whether the reallocation of resources for environmental law enforcement may have had a more pronounced impact in politically aligned regions, where firms may anticipate favorable treatment as a result of their political support.

Table 7 presents the results of this analysis. When considering the share of donations directed to the PSL party, we find that the results hold primarily for the subsample of federal states with larger contributions to the president's party (Column 1), whereas federal states with relatively lower financial support to the president's campaign do not show a statistically significant increase in agribusiness credit following the weakening of environmental law enforcement. Interestingly, we observe a significant increase in the size of the estimated coefficient in Column (1) compared to our baseline specification. This finding may suggest that the reduction in law enforcement did not benefit all regions equally, potentially reflecting a political economy dynamic in which politically contributing firms could have taken greater advantage of a weakened enforcement capacity.

5.7 Real effects: Deforestation analysis

Several prior studies suggest that the agribusiness sector plays a significant role in large-scale deforestation in Brazilian Amazon (Peres, Campos-Silva, and Ritter, 2022, 2023). To address skepticism that such a link between agribusiness credit and deforestation may not be present during our sample period, we also conduct a real effects analysis that focuses on this link.

For this analysis, we use a municipality-level sample (level at which deforestation data is available) as we collapse all data at the municipality-level panel into a single observation per municipality, in the spirit to Khwaja and Mian (2008) as above and use the change in natural forest area from before to after the shock as dependent variable.

Table 8 reports regression estimates that explain real "deforestation" effects using two different empirical approaches. Column (1) shows regression estimates that explain the relation between the change in credit supply to agro-industrial firms (a sector associated with large-scale deforestation) from 2018 to 2019 and change in natural forest area from 2018 to 2019. Columns (2) and (3) show regression estimates that explain the relation between the sudden relaxation in environmental law enforcement in Brazil from the 2019 shock which increased bank credit supply to agro-industrial firms and the change in natural forest area from 2018 to 2019 for Brazil as a whole and for Brazilian Amazon only, respectively.

Using both methodologies, we find that the change in the bank branch share of "brown" agribusiness credit after the shock and/or the weakening of environmental law enforcement are both linked to substantial rise in deforestation, and such effects are very large for Amazonia.

5.8 Additional Robustness tests

5.8.1 Alternative dependent variables, controls, and fixed effects

To further mitigate identification concerns, we undertake several additional robustness checks. First, in Table 9 Panel A we show the estimates of our baseline model employing different specifications. Column (1) repeats our main specification for convenience. Then, in Columns (2)-(3), we employ a different functional form for the dependent variable and report regression estimates for the log change in agribusiness credit from 2018 to 2019, when conducting regressions without and with bank branch controls. In Column (4), we drop the metropolitan regions, including all capital municipalities per state, to check that our results are not driven by those. In Column (5) we replace the federal state fixed effects with micro-region fixed effects. These level of region aggregation group statistical units of approximately 3.5 municipalities on average with similar economic characteristics. All these specifications corroborate our main results.

5.8.2 Ruling out alternative explanations: State and foreign ownership

The Brazilian banking system is characterized by a large presence of state-owned banks. For example, by 2019, their combined assets represented over 50 percent of total bank assets in the country. The political influence on state banks in Brazil has been a matter of ample research (Carvalho, 2014), raising the question of whether our results could be driven by state-owned banks that are pushed by their boards to lend more to firms in regions that supported the Bolsonaro campaign. If so, our measure of changes in law enforcement could be inadvertently correlated with regions of interest for state-owned banks, where these banks may have sought to expand following the start of the Bolsonaro administration in 2019.

In Table 9 Panel B we address the role of state-owned banks in our analysis. We begin by replicating our main estimation by excluding state-owned banks from the sample (Column 2). While the results remain in place, the magnitude of the estimated coefficient for the interaction term increases from -0,207 to -0,566. Similarly, excluding foreign-owned banks (col. 3) does not alter the results. This finding provides reassurance that our results are not driven by a general retrenchment of foreign banks from deforesting industries, which could have artificially inflated other banks' exposures. Thus, we conclude that these ownership dimensions are unlikely to be the primary factors behind our findings.

Alternatively, we implement tests in which we extend Eq (1) with a triple interaction term between Δ*IBAMA*, *Av Forest*, and a dummy identifying either state- or foreign-owned banks (Columns 4 and 5, respectively). While the enforcement effect remains significant for both state and private banks, we do find that it is smaller in magnitude for the former group.[10] In contrast, the triple-differences coefficient for the foreign dummy (Column 5) is not statistically significant. These results suggest that our findings are not primarily driven by state or foreign ownership; if anything, private banks appear to be more responsive to changes in law enforcement capacities, which may reflect their higher operational flexibility and stronger focus on market conditions.

5.8.3 Falsification tests

Next, we perform two types of placebo experiments to address concerns about the potential influence of alternative factors other than the sudden weakening of the environmental enforcement capacities that may

[10] When interpreting the magnitude of these effects, we find that a one-standard deviation decrease in IBAMA's oversight personnel growth rate (5 percentage points) in municipalities with approximately 70% of *ex-ante* available area to be deforested is associated with increases in the share of agribusiness credit of 67 vs. 220 basis points for state- and foreign-owned bank branches, respectively.

explain the increase in bank agribusiness credit. Table 10 Panels A and B report the results. Specifically, Panel A shows placebo test results when we falsely assume that the environmental law enforcement change and the decline in IBAMA's environmental oversight personnel occurred 3, 2, or 1 year earlier than the actual shock in 2016, 2017, and 2018, respectively instead of the actual which is in 2019. Coefficients on the *quasi*-DID interaction terms with the placebo shocks are all insignificant.

Then, Panel B shows placebo test results when we consider the change in bank branch share of credit to sectors not associated with large-scale deforestation, such as the change in the bank branch share of credit to commercial, residential housing, and consumer sectors, instead of agribusiness. Coefficients on the *quasi*-DID interaction terms show insignificant effects for bank branch credit to commercial and residential housing sectors and no significant positive increases in bank branch credit to consumer sector, all these being sectors that are not associated with large-scale deforestation. Therefore, the empirical evidence in Table 10 confirms that our main results are not driven by spurious explanations.

5.8.4 Horse race with municipality traits

Lastly, we undertake a comprehensive horse-race test to assess the extent to which the observed increases in bank branch agribusiness credit can be attributed to factors beyond agribusiness. Specifically, our objective is to discern whether macroeconomic or bank business-related characteristics may contribute to increases in agribusiness credit. To test this, we introduce a competing interaction term between the change in IBAMA's environmental oversight staff and various municipality characteristics. These include key factors such as the log of the municipal GDP, population, total bank assets, GDP per capita, and the proportion of agribusiness activities relative to the total GDP in the municipality. Results are presented in Table 11 show that none of the afore-mentioned municipality characteristics explain the increases in bank branch "brown" agribusiness credit after the weakening in environmental law enforcement. Moreover, our main coefficient of interest for the *quasi*-DID term ($\Delta IBAMA_{j,(18-19)} \times Av\,Forest_{j,2017}$) remains statistically and economically significant in all cases even after controlling for additional municipality characteristics interacted with the change in IBAMA's environmental oversight staff.

6. Conclusions

We delve into the complex interplay between deforestation—an often-overlooked climate risk—and environmental law enforcement, examining its impact on banks' allocation of "brown" credit. Our findings underscore the critical role of environmental law enforcement in shaping banks' climate risk management strategies. Our identification strategy leverages an exogenous shock – a substantial reduction in environmental police staff following the 2019 Brazil presidential election. Our findings help unveil the impact of environmental law enforcement on bank credit to agribusinesses involved in deforestation in the Brazilian Amazon. Focusing on Brazil, we circumvent potential distortions from cross-country variations.

Using comprehensive data on bank branches and deforestation in Brazil and a *quasi*-difference-in-difference methodology, our study examines banks' trade-offs between short-term profitability and long-term risks, including prudential, regulatory, and reputational concerns. The results show that weakened environmental law enforcement is linked to a notable surge in banks' allocation of "brown" (agribusiness) credit, especially in regions more conducive to deforestation. Banks with a higher risk appetite appear more inclined to lend to deforesting industries, highlighting a potential blind spot in climate risk management. The influence of political connections is stronger in areas with greater support for the incumbent president's coalition. Additionally, internal capital market reallocation and real effects analysis suggest a link between increased "brown" credit and deforestation.

The findings may have future implications, highlighting the need for a more nuanced understanding of how banks manage their exposures to climate risks. Results suggest that even with robust environmental laws, banks may struggle to fully internalize deforestation risks in the absence of consistent and rigorous enforcement. This points to a potential gap between regulation and practice, where the true impact of environmental laws hinges on their enforcement. Future research and policy might consider exploring how enforcement capacity shapes the extent to which financial institutions incorporate long-term climate risks. The lessons from Brazil may also extend to other countries facing deforestation challenges, offering valuable insights into the global relevance of environmental law enforcement for climate risk management.

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FIGURE 1:
Geographical Area Distribution of Amazonia in Brazil, Largest Rainforest in the World

This figure presents the geographic area distribution of Amazonia in Brazil, the area that comprises largest tropical rainforest in the world (covering 67% of the world's tropical forests) in dark green, while the rest of Brazil is shown in light green. Amazonia is an area of over five million square kilometers in Brazil, home to 28 million people, that includes several federal states: Amazonas (AM), Acre (AC), Amapá (AP), Maranhão (MA), MatoGrosso (MT), MatoGrosso do Sul (MS), Pará (PA), Rondônia (RO), Roraima (RR), and Tocantins (TO).

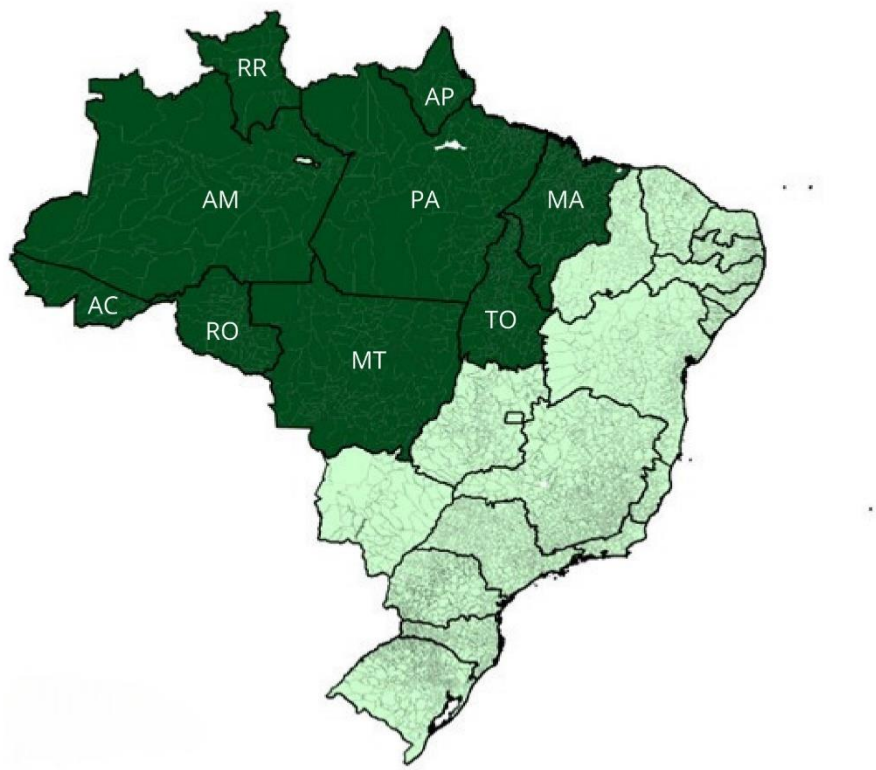

FIGURE 2:
Loss of Natural Forest Area (In km²)
for Brazilian Amazon

This figure shows the annual loss in natural forest area (in km²) for each Federal State in the Brazilian Legal Amazon: Amazonas (AM), Acre (AC), Amapá (AP), Maranhão (MA), MatoGrosso (MT), Pará (PA), Rondônia (RO), Roraima (RR), and Tocantins (TO). This figure draws data from TerraBrasilis, developed by the Brazilian Institute INPE (Instituto Nacional de Pesquisas Espaciais).

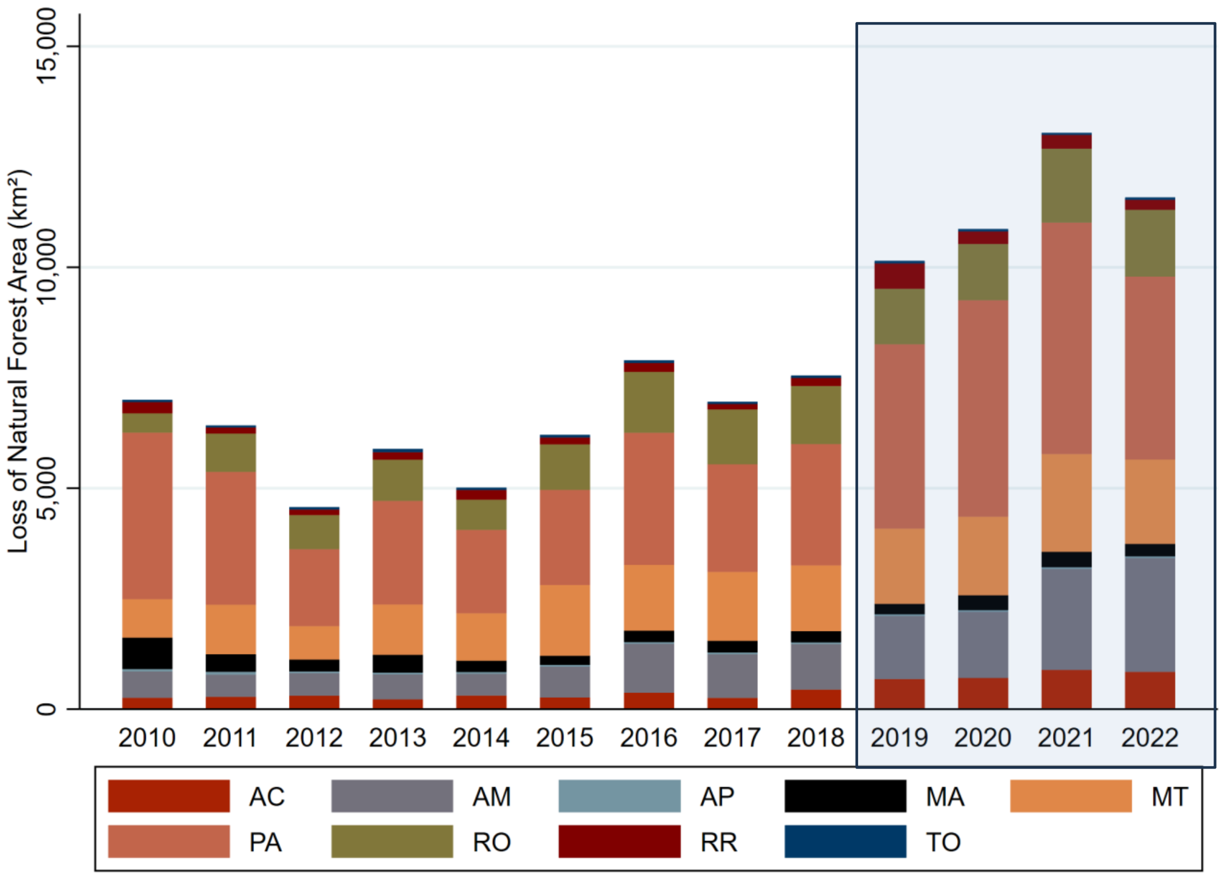

FIGURE 3:
Percentage Change in IBAMA Oversight Personnel (Δ *IBAMA)* from 2018 to 2019 across Brazil Federal States

This figure presents the percentage change in IBAMA oversight personnel from 2018 to 2019 across individual Brazil federal states which are shown with abbreviated letters and we show states in descending order from the states with the highest to those with the lowest decline in IBAMA oversight personnel. We pay special attention to federal states in Amazonia, the area that comprises largest tropical rainforest in the world (covering 67% of the world's tropical forests) which are: Amazonas (AM), Acre (AC), Amapá (AP), Maranhão (MA), MatoGrosso (MT), MatoGrosso do Sul (MS), Pará (PA), Rondônia (RO), Roraima (RR), and Tocantins (TO).

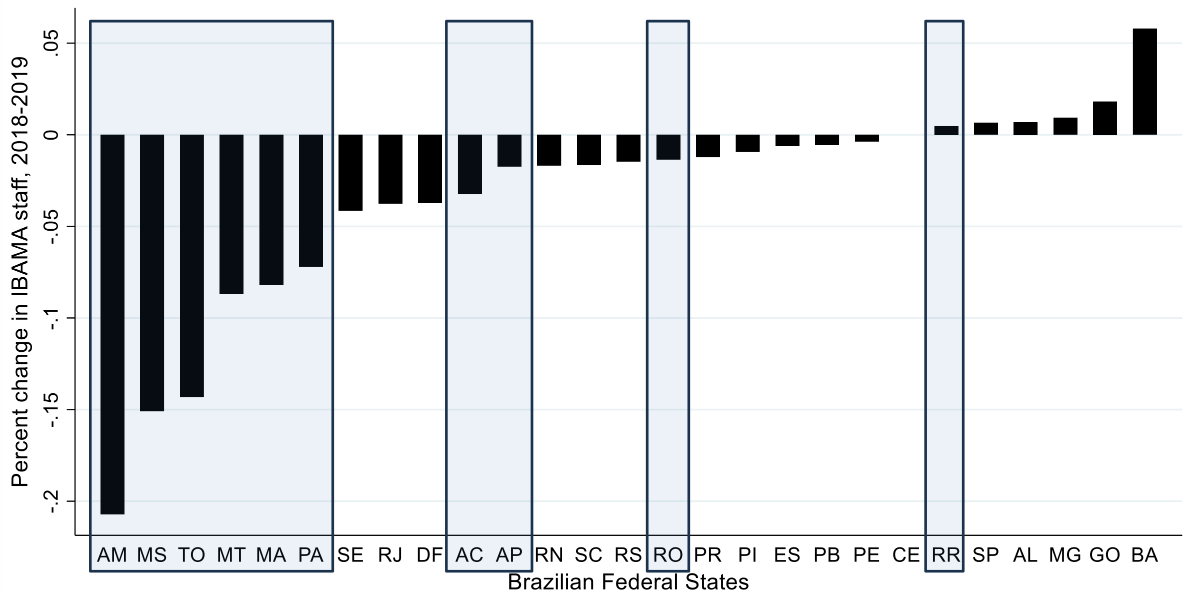

FIGURE 4:
Overall Percentage Budget Execution by IBAMA over 2015 to 2019

This figure presents the percentage change in Brazil IBAMA budget execution from 2015 to 2019.

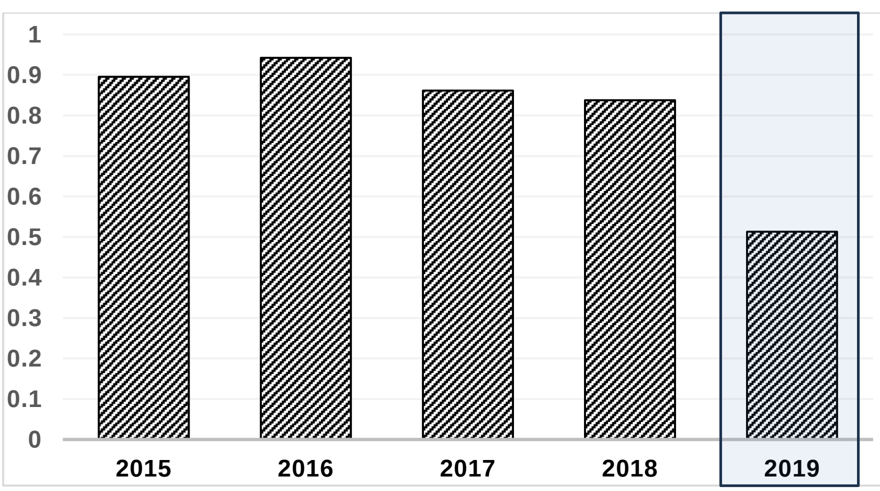

FIGURE 5:
Agribusiness Credit Growth *(Δ AGCredit)* in Large vs. Small "Natural Forest Area"

This figure presents the average change in the share of agribusiness loan growth *(Δ AGCredit)* for branches located in regions with a large vs. small "*Natural Forest Area"* (affected and not-affected, respectively) over 2018:M1-2020:M1.

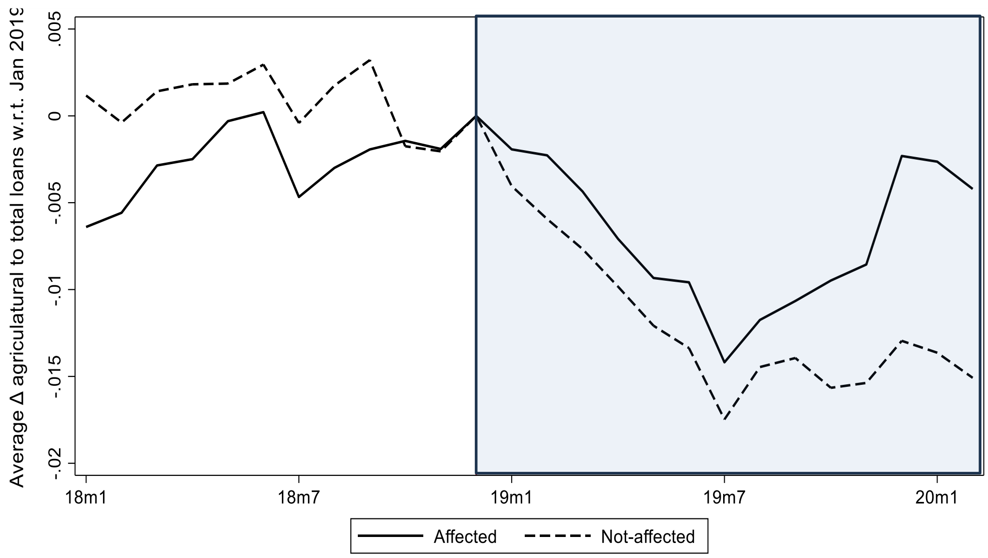

FIGURE 6:
Marginal Effects of Change in IBAMA Personnel (Δ *IBAMA)* on Agribusiness Credit Growth *(Δ AGCredit)* across the Distribution of "Natural Forest Area"

This figure illustrates the estimated marginal effects at a 95 percent confidence level of changes in IBAMA's personnel (Δ *IBAMA)* on the share of agribusiness credit *(Δ AGCredit)* across the distribution of municipalities' share of '*Natural Forest Area'* (forestry area, *x*-axis). The estimation is based on the preferred estimation in Eq. (1).

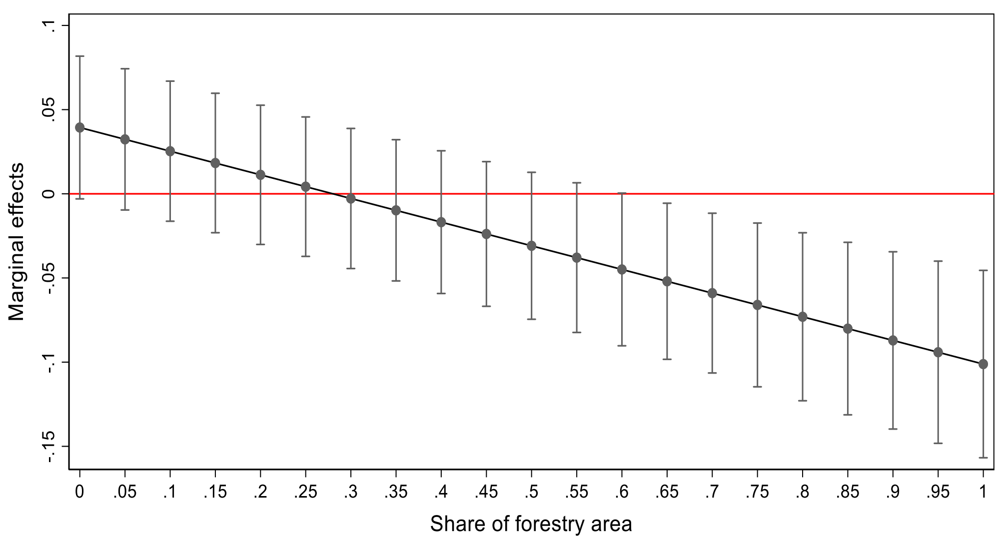

TABLE 1
Variable Definitions and Summary Statistics

This table provides definitions for the variables used in our analyses in Panel A, and summary statistics (mean, median, standard deviation (SD), as well as minimum and maximum) for each variable in Panel B We use combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities.

Panel A: Variable Definitions

Variable	Definition	Source
Key Dependent Variable		
Agribusiness Credit	The branch's share of agricultural credit (loans to finance mainly crop cultivation) and agro-industrial credit (loans to finance processing, manufacturing, and distribution of processed agricultural products) to total loans. Agricultural businesses are those involved in activities related to farming or agricultural production.	Authors' calculation based on Estatistica Bancaria Mensal por Municipio (ESTEBAN) database by the Central Bank of Brazil
Δ AG Credit	Change in the branch's share of agribusiness credit from 2018 to 2019.	
Main Independent Variables		
Δ IBAMA	Change in (%) in IBAMA's staff in each Federal State from 2018 to 2019.	Brazilian Ministry of Finance
Natural Forest Area	Percentage of forest available (forest area in km2/total area km2) in municipality (j) in 2017.	Brazilian Annual Land Use and Land Cover Mapping Project (Mapbiomas)
Control Variables		
Branch Size	The branch's natural log of total loans in 2017.	Authors' calculation based on Estatistica Bancaria Mensal por Municipio (ESTEBAN) database by the Central Bank of Brazil
Branch Liquidity Ratio	The branch's liquid-to-total assets ratio in 2017.	
Branch ROA	The branch's return on assets in 2017.	
Branch Deposit Ratio	The branch's ratio of deposits to total liabilities in 2017.	
Branch Share in Bank Assets	The ratio of branch assets to total bank assets in 2017.	Authors' calculation based on ESTEBAN database and Bank Call Reports by the Central Bank of Brazil
Bank Size	The bank's natural log of total assets in 2017.	Authors' calculation based on Bank Call Reports by the Central Bank of Brazil
Bank High Risk Credit Ratio	The bank's ratio of high-risk loans to total loans in 2017.	
Bank Capital Ratio	The bank's ratio of total equity capital to total assets in 2017.	
Bank Government Owned	Indicator for whether a bank is government owned (50% or more) or not.	

Panel B: Summary Statistics

Variable	**Mean**	**Median**	**SD**	**Min**	**Max**
Key Dependent Variable					
Agribusiness Credit	0.387	0.357	0.313	0.000	0.924
Δ AG Credit	-0.010	-0.005	0.055	-0.189	0.149
Main Independent Variables					
Δ IBAMA	-0.016	-0.012	0.046	-0.151	0.058
Natural Forest Area	0.321	0.254	0.223	0.027	0.921
Control Variables					
Branch Size	18.94	18.65	1.442	16.44	23.87
Branch Liquidity Ratio	0.013	0.008	0.014	0.000	0.067
Branch ROA	0.005	0.004	0.003	-0.001	0.015
Branch Deposit Ratio	0.330	0.310	0.191	0.011	0.768
Branch Share in Bank Assets	0.002	0.000	0.029	0.000	0.015
Bank Size	29.28	29.64	1.209	24.43	29.91
Banks Non-A Credit Ratio	0.557	0.520	0.090	0.446	0.937
Bank Capital Ratio	0.012	0.012	0.005	0.004	0.033

TABLE 2
Impact of Climate Law Enforcement Change on Bank Agribusiness Credit – Main Evidence

This table uses a bank branch-level sample and reports regression estimates from a quasi-difference-in-difference model (Eq. (1)) that explains the relation between a sudden relaxation in environmental law enforcement in Brazil from 2019 and the change in bank credit supply to agro-industrial firms (a sector associated with large-scale deforestation). Column (1) presents a model without any controls or fixed effects; Column (2) includes federal state fixed effects; Column (3) includes both federal state and bank fixed effects; and Column (4) shows a model with federal state and bank fixed effects as well as controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio).

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities. The dependent variable is *Δ AGCredit*, the change in the bank branch share of credit to agro-industrial firms from 2018 to 2019 which is at bank branch-municipality-month level. The key explanatory variables are *Δ IBAMA* × *Natural Forest Area* and the uninteracted terms *Δ IBAMA* and *Natural Forest Area*, where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area* , the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects (unless noted otherwise). Heteroskedasticity-robust *t*-statistics clustered at the bank level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)
Dependent Variable	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit
Independent Variables				
Natural Forest Area	0.006	0.002	0.001	0.002
	(0.008)	(0.006)	(0.007)	(0.007)
Δ IBAMA × Natural Forest Area	-0.111***	-0.199***	-0.209***	-0.207***
	(0.029)	(0.047)	(0.045)	(0.051)
Branch size				0.001
				(0.002)
Branch liquidity				-0.166**
				(0.045)
Branch profitability				0.368
				(0.864)
Branch deposit ratio				0.011
				(0.012)
FEs & Controls	No	Federal	Federal and Bank	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909	3,909	3,909
R-squared	0.002	0.014	0.031	0.033

TABLE 3
Decomposition of Bank Agribusiness Credit into Subcomponents

This table uses a bank branch-level sample and reports regression estimates from a quasi-difference-in-difference model Eq. (1) that explains the relation between a sudden relaxation in environmental law enforcement in Brazil and the change in bank credit supply to agro-industrial firms (a sector associated with large-scale deforestation), when decomposing agribusiness credit into agricultural credit (loans to finance crop cultivation) in Columns (1)-(2) and agro-industrial credit (loans to enterprises that convert raw agricultural products into food products related to agriculture, being involved in processing, manufacturing, and value addition within the agricultural sector) in Columns (3)-(4). Columns (1) and (3) present models with federal state and bank fixed effects only, while Columns (2) and (4) present models that additionally include controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio).

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities. The dependent variables are *Δ Agricultural Credit* and *Δ Agro-Industrial Credit*, the change in the bank branch share of credit to agricultural and agro-industrial firms, respectively, from 2018 to 2019, which is at bank branch-municipality-month level. The key explanatory variables are *Δ IBAMA × Natural Forest Area*and the uninteracted terms *Δ IBAMA* and *Natural Forest Area*, where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area*, the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects. Heteroskedasticity-robust *t*-statistics clustered at the bank level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)
Dependent Variable	Δ Agricultural Credit	Δ Agricultural Credit	Δ Agro-Industrial Credit	Δ Agro-Industrial Credit
Independent Variable				
Natural Forest Area	-0.168***	-0.154**	0.001	0.000
	(0.049)	(0.067)	(0.000)	(0.000)
Δ IBAMA × Natural Forest Area	-0.027*	-0.055**	0.002**	0.003
	(0.015)	(0.024)	(0.001)	(0.002)
FEs & Controls	Federal and Bank FEs	Federal and Bank FEs, Branch Controls	Federal and Bank FEs	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909	3,909	3,909
R-squared	0.032	0.073	0.021	0.041

TABLE 4
Impact of Climate Law Enforcement Change on Bank Agribusiness Credit – Splits by *Ex-Ante* Agro-Industrial Importance

This table uses a bank branch-level sample and reports regression estimates from a quasi-difference-in-difference model Eq. (1) that explains the relation between a sudden relaxation in environmental law enforcement in Brazil and the change in bank credit supply to agro-industrial firms (a sector associated with large-scale deforestation), and reports results for sample splits according to the median of municipalities' share of *ex-ante* agro-industrial importance proxied two ways. Column (1) repeats our baseline specification for convenience of comparison. Columns (2) and (3) show estimation results for sample splits using the *ex-ante* agricultural physical area extension (larger vs. lower than the median). Columns (4) and (5) show estimation results for sample splits using the *ex-ante* agricultural production/output (larger vs. lower than the median).

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities. The dependent variable is *Δ AGCredit*, the change in the bank branch share of credit to agro-industrial firms from 2018 to 2019 which is at bank branch-municipality-month level. The key explanatory variables are *Δ IBAMA* × Natural Forest Area and the uninteracted terms *Δ IBAMA* and *Natural Forest Area*, where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area*, the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects and controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio). Heteroskedasticity-robust *t*-statistics clustered at the bank level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)
	Baseline Full Sample (*repeated for convenience*)	*High Ex-Ante* Agricultural Physical Area Extension	*Low Ex-Ante* Agricultural Physical Area Extension	*High Ex-Ante* Agricultural Production	*Low Ex-Ante* Agricultural Production
Dependent Variable	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit
Natural Forest Area	0.002	-0.003	0.007	-0.003	0.004
	(0.007)	(0.006)	(0.010)	(0.008)	(0.008)
Δ IBAMA × Natural Forest Area	-0.207***	-0.314**	-0.0730	-0.458**	-0.0546
	(0.051)	(0.120)	(0.138)	(0.164)	(0.166)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls
Observations	3,909	2,727	1,176	2,139	1,769
R-squared	0.033	0.045	0.041	0.036	0.053
Controls	Yes	Yes	Yes	Yes	Yes

TABLE 5
Impact of Climate Law Enforcement Change on Bank Agribusiness Credit – Heterogeneity by *Branch* and *Bank* Traits

This table uses a bank branch-level sample and reports regression estimates from a quasi-difference-in-difference model Eq. (1) that explains the relation between a sudden relaxation in environmental law enforcement in Brazil and the change in bank credit supply to agro-industrial firms (a sector associated with large-scale deforestation), when conducting interactions with key branch traits in Panel A and bank traits in Panel B. Panel A reports results when conducting interactions with four different bank branch traits (*Branch Trait*), all as of 2017 (Columns 1-4): branch size (the natural log of branch total assets), branch deposit ratio (branch deposits to total liabilities ratio), branch liquidity (branch liquid assets to total assets ratio), and branch profitability (branch return on assets). Panel B reports results when conducting interactions with four different bank traits (*Bank Trait*), all as of 2017 (Columns 1-4): bank size (the natural log of bank total assets), high risk credit ratio (bank high risk credit to total credit ratio), capital (bank equity capital to total assets ratio), and government ownership (indicator for whether the bank is government owned); bank trait by themselves are absorbed due to inclusion of bank fixed effects.

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities. The dependent variable is *Δ AGCredit*, the change in the bank branch share of credit to agro-industrial firms from 2018 to 2019 which is at bank branch-municipality-month level. The key explanatory variables are *Δ IBAMA* × *Natural Forest Area* and the uninteracted terms *Δ IBAMA* and *Natural Forest Area* , where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area* , the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects and controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio). Heteroskedasticity-robust *t*-statistics clustered at the bank level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Panel A: Interactions with *Branch* Traits

	(1)	(2)	(3)	(4)
Branch Trait	*Branch* Size	*Branch* Deposit Ratio	*Branch* Liquidity Ratio	*Branch* ROA
Dependent Variable	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit
Independent Variables				
Natural Forest Area	0.007	-0.012	-0.005	0.003
	(0.012)	(0.008)	(0.007)	(0.012)
Branch Trait	0.004	-0.017***	-0.008	0.005
	(0.003)	(0.002)	(0.007)	(0.009)
Δ IBAMA × Natural Forest Area	-0.112	-0.336***	-0.171*	-0.119
	(0.104)	(0.071)	(0.082)	(0.206)
Δ IBAMA × Branch Trait	0.111	-0.097*	-0.026	0.030
	(0.093)	(0.052)	(0.073)	(0.087)
Natural Forest Area× Branch Trait	-0.012	0.025	0.015	-0.001
	(0.012)	(0.015)	(0.014)	(0.007)
Δ IBAMA × Natural Forest Area × Branch Trait	-0.209**	0.190***	-0.051	-0.127
	(0.083)	(0.038)	(0.152)	(0.273)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909	3,909	3,909
R-squared	0.034	0.037	0.035	0.034

Panel B: Interactions with *Bank* Traits

	(1)	(2)	(3)	(4)
Bank Trait	*Bank* Size	*Bank* High-Risk Credit Ratio	*Bank* Capitalization Ratio	*Bank* Government-Owned
Dependent Variable	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit
Independent Variables				
Natural Forest Area	0.00679	-0.00822*	-0.0151**	0.0527***
	(0.0116)	(0.00455)	(0.00653)	(0.00676)
ΔIBAMA × Natural Forest Area	-0.119	-0.0290	-0.118	-0.447**
	(0.107)	(0.0703)	(0.100)	(0.153)
ΔIBAMA × Bank Trait	0.110	-0.0120	-0.0361	0.0321
	(0.0979)	(0.0321)	(0.0336)	(0.0509)
Natural Forest Area× Bank Trait	-0.0123	0.0110	0.0204	-0.0633***
	(0.0124)	(0.0118)	(0.0118)	(0.00646)
Δ IBAMA × Natural Forest Area× Bank Trait	-0.191*	-0.202**	-0.101	0.274
	(0.111)	(0.0710)	(0.0882)	(0.165)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls
Observations	3,915	3,915	3,915	3,909
R-squared	0.001	0.002	0.014	0.031

TABLE 6
Internal Capital Markets Reallocation and *Profitability* Analyses

This table uses a bank branch-level sample and reports regression estimates from a quasi-difference-in-difference model Eq. (1) that explains the relation between a sudden relaxation in environmental law enforcement in Brazil and the change in bank internal capital markets reallocation from the bank to the branches, which is proxied two ways: change in the share of internal liabilities to assets (vis-à-vis the branch) using a narrow definition in Columns (1)-(2) and an extended definition in Columns (3)-(4), where the narrow definition considers only intra-bank credits in the numerator, whereas the extended definition adds intra-bank deposits in the numerator. Columns (1) and (3) present models with federal state and bank fixed effects only, while Columns (2) and (4) present models that additionally include controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio).

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities. The dependent variable is *Δ AGCredit*, the change in the bank branch share of credit to agro-industrial firms from 2018 to 2019 which is at bank branch-municipality-month level. The key explanatory variables are *Δ IBAMA × Natural Forest Area* and the uninteracted terms *Δ IBAMA* and *Natural Forest Area*, where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area* the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects and controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio). Heteroskedasticity-robust *t*-statistics clustered at the bank level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Panel A: *Internal Capital Markets* Reallocation from Bank to Branches

	(1)	(2)	(3)	(4)
Intra-bank capital movements	*Narrow* ICM	*Narrow* ICM	*Extended* ICM	*Extended* ICM
Dependent Variable	Δ ICM Reallocation	Δ ICM Reallocation	Δ ICM Reallocation	Δ ICM Reallocation
Independent Variables				
Natural Forest Area	-0.003	-0.005	0.001	-0.001
	(0.003)	(0.004)	(0.002)	(0.003)
Δ IBAMA × Natural Forest Area	-0.107*	-0.116**	-0.107**	-0.107**
	(0.053)	(0.051)	(0.046)	(0.046)
FEs & Controls	Federal and Bank FEs	Federal and Bank FEs, Branch Controls	Federal and Bank FEs	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909	3,909	3,909
R-squared	0.125	0.141	0.129	0.136

Panel B: Bank Branch *Profitability*

	(1)	(2)
Dependent Variable	Δ ROA 2018-2019	Δ ROA 2018-2020
Independent Variables		
Natural Forest Area	0.00004	-0.0001
	(0.0001)	(0.0001)
Δ IBAMA × Natural Forest Area	-0.004**	-0.002**
	(0.001)	(0.001)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909
R-squared	0.199	0.328

TABLE 7
Political Economy Analysis

This table uses a bank branch-level sample and reports regression estimates from a quasi-difference-in-difference model Eq. (1) that explains the relation between a sudden relaxation in environmental law enforcement in Brazil and the change in bank credit supply to agro-industrial firms (a sector associated with large-scale deforestation), when considering sample splits according to the median of federal state' political alignment with the Bolsonaro administration (share of Bolsonaro-supporting political contributions in the Brazil's federal election in 2018) proxied two ways. Columns (1) and (2) show estimation results for sample splits using the share of political contributions for Bolsonaro's party (PSL or Social-Liberal Party) (larger vs. lower than the median). Columns (4) and (5) show estimation results for sample splits using the share of political contributions for Bolsonaro's coalition consisting of the parties PSL, PRTB, PRB, PSC, PTB, PL, PATRI, and PP (larger vs. lower than the median).

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities. The dependent variable is *Δ AGCredit*, the change in the bank branch share of credit to agro-industrial firms from 2018 to 2019 which is at bank branch-municipality-month level. The key explanatory variables are *Δ IBAMA × Natural Forest Area* and the uninteracted terms *Δ IBAMA* and *Natural Forest Area*, where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area*, the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects and controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio). Heteroskedasticity-robust *t*-statistics clustered at the bank level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)
Political alignment to Bolsonaro	Federal States with a *Large* Share of PSL to Total Donations	Federal States with a *Low* Share of PSL to Total Donations	Federal States with a *Large* Share of Bolsonaro's Coalition to Total Donations	Federal States with a *Low* Share of Bolsonaro's Coalition to Total Donations
Dependent Variable	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit
Independent Variables				
Natural Forest Area	0.004	0.004	0.002	0.004
	(0.01)	(0.006)	(0.006)	(0.012)
Δ IBAMA × Natural Forest Area	-0.320***	0.0479	-0.368**	-0.0505
	(0.0769)	(0.150)	(0.133)	(0.147)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909	3,909	3,909
R-squared	0.033	0.056	0.056	0.016

TABLE 8
Real Effects: *Deforestation* Analysis

This table uses a municipality-level sample and reports regression estimates that explain real "deforestation" effects using two different empirical approaches. Column (1) shows regression estimates that explain the relation between the change in credit supply to agro-industrial firms (a sector associated with large-scale deforestation) from 2018 to 2019 and change in natural forest area from 2018 to 2019. Columns (2) and (3) show regression estimates that explain the relation between the sudden relaxation in environmental law enforcement in Brazil in 2019 which increased bank credit supply to agro-industrial firms and the change in natural forest area from 2018 to 2019 for Brazil as a whole and for Brazilian Amazon only, respectively.

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the municipality-level panel into a single observation per municipality, in the spirit to Khwaja and Mian (2008). We collapse observations for each municipality over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in natural forest area, bank share of agribusiness credit, and environmental oversight personnel as key variables for the analysis. The sample covers 2,085 Brazilian municipalities for the full sample and 318 Brazilian municipalities for Brazilian Amazon only. The dependent variable is *Δ Natural Forest Area*, the change in natural forest area from 2018 to 2019, which is at municipality-year level. The key independent variables are *Δ AGCredit*, the change in the bank branch share of credit to agro-industrial firms from 2018 to 2019 which is collapsed at municipality-year level. or *Δ IBAMA × Natural Forest Area* and the uninteracted terms *Δ IBAMA* and *Natural Forest Area* , where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area* , the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects and controls for key bank branch characteristics collapsed at municipality level, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio). Heteroskedasticity-robust *t*-statistics clustered at the municipality level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)
Sample	*Full Sample*	*Full Sample*	*Only Amazonia*
Dependent Variable	Δ Natural Forest Area 2018-2019	Δ Natural Forest Area 2018-2019	Δ Natural Forest Area 2018-2019
Independent Variables			
Natural Forest Area		-0.008	0.008
		(0.007)	(0.007)
Δ IBAMA × Natural Forest Area		0.097**	0.210**
		(0.046)	(0.078)
Δ AG Credit	-0.018**		
	(0.008)		
FEs & Controls	Federal State FEs, Branch Controls	Federal State FEs, Branch Controls	Federal State FEs, Branch Controls
Observations	2,085	2,085	318
R-squared	0.150	0.162	0.173

TABLE 9
Robustness Tests

This table uses a bank branch-level sample and reports regression estimates from a quasi-difference-in-difference model Eq. (1) that explains the relation between a sudden relaxation in environmental law enforcement in Brazil and the change in bank credit supply to agro-industrial firms (a sector associated with large-scale deforestation), when considering several robustness tests. Panel A: Column (1) repeats our baseline specification for convenience of comparison. Columns (2) and (3) show estimation results when the dependent variable is the log change in agribusiness credit without and with controls included, respectively. In Column (4), we drop the metropolitan regions, including all capital municipalities per state. In Column (5), we replace the federal state fixed effects with micro-region fixed effects, where micro-regions are statistical units of approximately 3.5 municipalities on average. Panel B: Column (1) repeats our baseline specification for convenience of comparison. Columns (2) and (3) show estimation results when excluding state-owned and foreign-owned banks, respectively. Columns (4) and (5) show estimation results when including interactions terms with indicators for state- and foreign-ownership, respectively.

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities. Unless noted otherwise, the dependent variable is *Δ AGCredit*, the change in the bank branch share of credit to agro-industrial firms from 2018 to 2019 which is at bank branch-municipality-month level. The key explanatory variables are *Δ IBAMA × Natural Forest Area* and the uninteracted terms *Δ IBAMA* and *Natural Forest Area* , where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area* , the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects and controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio). Heteroskedasticity-robust *t*-statistics clustered at the bank level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Panel A: Alternative Dependent Variables, Different Controls and FEs

	(1)	(2)	(3)	(4)	(5)
	Baseline Specification *(Repeated for Convenience)*	Log Change Growth Rate - No controls	Log Change Growth Rate - With controls	Drop Metropolitan Regions	Micro-Region FEs
Dependent Variable	Δ AGCredit	Δ Ln AGCredit	Δ Ln AGCredit	Δ AGCredit	Δ AGCredit
Natural Forest Area	0.002	0.023	0.009	0.002	-0.004
	(0.007)	(0.024)	(0.022)	(0.007)	(0.008)
Δ IBAMA × Natural Forest Area	-0.207***	-0.745**	-0.798**	-0.189**	-0.420**
	(0.051)	(0.282)	(0.336)	(0.073)	(0.197)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Micro-Regional FEs, Branch Controls
Observations	3,909	3,909	3,909	3,339	3,881
R-squared	0.033	0.087	0.098	0.031	0.126

Panel B: State and Foreign Bank Ownership

	(1)	(2)	(3)	(4)	(5)
	Baseline Specification *(Repeated for Convenience)*	Excluding State Banks	Excluding Foreign Banks	Ownership = State	Ownership = Foreign
Dependent Variable	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit
Natural Forest Area	0.002	0.047**	-0.001	0.053***	0.0002
	(0.007)	(0.016)	(0.006)	(0.007)	(0.006)
Δ IBAMA × Natural Forest Area	-0.207***	-0.566**	-0.248***	-0.631***	-0.237***
	(0.051)	(0.170)	(0.040)	(0.143)	(0.045)
Ownership					
Ownership × Natural Forest Area				-0.062***	0.062***
				(0.007)	(0.008)
Ownership × Δ IBAMA				-0.001	0.202
				(0.050)	(0.233)
Δ IBAMA × Natural Forest Area × Ownership				0.439**	-0.733
				(0.158)	(1.278)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls
Observations	3,909	922	3,670	3,851	3,851
R-squared	0.033	0.061	0.030	0.045	0.036

TABLE 10
Placebo Tests

This table uses a bank branch-level sample and reports regression estimates from a quasi-difference-in-difference model Eq. (1) that explains the relation between a sudden relaxation in environmental law enforcement in Brazil and the change in bank credit supply to agro-industrial firms (a sector associated with large-scale deforestation), when considering several falsification tests. Panel A shows placebo test results when we falsely assume that the environmental law enforcement change and the decline in IBAMA oversight personnel occurred 3, 2, or 1 year earlier than the actual shock in 2016, 2017, and 2018, respectively instead of the actual which is 2019. Panel B shows placebo test results when we consider the change in bank branch share of credit to sectors not associated with large-scale deforestation, such as the change in the bank branch share of credit to consumers, commercial, and residential housing sectors, instead of agribusiness.

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities. Unless noted otherwise, the dependent variable is *Δ AGCredit*, the change in the bank branch share of credit to agro-industrial firms from 2018 to 2019 which is at bank branch-municipality-month level. The key explanatory variables are *Δ IBAMA × Natural Forest Area* and the uninteracted terms *Δ IBAMA* and *Natural Forest Area*, where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area*, the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects and controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio). Heteroskedasticity-robust *t*-statistics clustered at the bank level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Panel A: Placebo Tests: Assume Shock Occurred 3 Years, 2 Years, or 1 Year Earlier

	(1)	(2)	(3)	(4)
Test	Baseline Specification (Actual Sample: 2018-2019) *(Repeated for Convenience)*	Placebo 1: Assume Shock Occurred 3 Years Ago (Placebo Sample: 2015-2016)	Placebo 2: Assume Shock Occurred 2 Years Ago (Placebo Sample: 2016-2017)	Placebo 3: Assume Shock Occurred 1 Year Ago (Placebo Sample: 2017-2018)
Dependent Variable	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit
Independent Variables				
Natural Forest Area	0.002	-0.00	0.004	-0.0037
	(0.007)	(0.005)	(0.005)	(0.007)
Δ IBAMA × Natural Forest Area	-0.207***	-0.009	0.066	0.168**
	(0.051)	(0.017)	(0.040)	(0.06)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909	3,909	3,909
R-squared	0.033	0.132	0.140	0.087

Panel B: Placebo Tests: Credit to Sectors *Not* Associated with Large-Scale Deforestation

Industrial Sector	Baseline Specification *(Repeated for Convenience):* AgriBusiness	Placebo 1: Consumer	Placebo 2: Commercial	Placebo 3: Residential Housing
Dependent Variable	Δ AGCredit	Δ Commercial Credit	Δ Residential Mortgage	Δ Consumer Credit
Independent Variables				
Natural Forest Area	0.002	-0.015	0.053	-0.010
	(0.007)	(0.006)	(0.010)	(0.005)
Δ IBAMA × Natural Forest Area	-0.207***	0.008	-0.044	0.157***
	(0.051)	(0.027)	(0.028)	(0.030)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909	3,909	3,909
R-squared	0.033	0.271	0.031	0.077

TABLE 11
Impact of Climate Law Enforcement Change on Bank Agribusiness Credit – Robustness: Horse Race with *Municipality* Traits

This table uses a bank branch-level sample and reports regression estimates from a quasi-difference-in-difference model Eq. (1) that explains the relation between a sudden relaxation in environmental law enforcement in Brazil and the change in bank credit supply to agro-industrial firms (a sector associated with large-scale deforestation), when including a competing interaction term with municipality characteristics (*Mun Var*), all as of 2017. Municipality characteristics considered are as follows: municipality log of their GDP, municipality log population, municipality log total bank assets, municipality GDP per capita, and municipality share of agribusiness product to total GDP.

The table uses combined data from four main sources of administrative records from Brazil covering the period 2017 to 2019: i) granular bank branch balance sheet data at branch municipality-month level; ii) consolidated bank call report data at bank-month level ; iii) records of geographical areas dedicated to agriculture, forestry, or to natural environments, including areas available for deforestation at the municipality-year level; and iv) administrative data of IBAMA's personnel at the federal state-year level. The combined data is collapsed at the bank branch-level panel into a single observation per branch, in the spirit to Khwaja and Mian (2008). We collapse observations for each bank branch over the two periods of pre-shock (2018) and post-shock (2019) and use the change between periods in bank share of agribusiness credit and environmental oversight personnel as key variables for the analysis. The final sample covers 3,909 branches belonging to 20 banking conglomerates, operating in 2,093 Brazilian municipalities. The dependent variable is *Δ AGCredit*, the change in the bank branch share of credit to agro-industrial firms from 2018 to 2019 which is at bank branch-municipality-month level. The key explanatory variables are *Δ IBAMA × Natural Forest Area* and the uninteracted terms *Δ IBAMA* and *Natural Forest Area*, where *Δ IBAMA* is the change in environmental oversight personnel of the Brazil national agency IBAMA from 2018 to 2019 across federal states which is at federal state-year level and *Natural Forest Area*, the *ex-ante* area available to deforest as of 2017 which is at municipality-year level. The standalone term *Δ IBAMA* is redundant due to the inclusion of federal state fixed effects. Variable definitions are in Table 1. All regressions include *Federal State* fixed effects and *Bank* fixed effects and controls for key bank branch characteristics, all as of 2017: size (the natural log of branch total assets), liquidity (branch liquid assets to total assets ratio), profitability (branch return on assets), and deposit ratio (branch deposits to total liabilities ratio). Heteroskedasticity-robust *t*-statistics clustered at the bank level are reported in parentheses below the coefficient estimates. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)
Municipality Trait	*Municipality*Log GDP	*Municipality* Log Pop	*Municipality* Log Bank Assets	*Municipality* GDP per Capita	*Municipality* Share of Agribusiness to Total GDP
Dependent Variable	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit	Δ AGCredit
Independent Variables					
Natural Forest Area	0.001	0.002	0.001	0.002	0.002
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
Δ IBAMA × Natural Forest Area	-0.221***	-0.212***	-0.203**	-0.195***	-0.212***
	(0.062)	(0.059)	(0.071)	(0.057)	(0.047)
Δ IBAMA × Mun Var	0.005	0.001	-0.001	0.000	0.165
	(0.017)	(0.017)	(0.010)	(0.000)	(0.151)
Mun Var	-0.004	-0.00282*	-0.002	0.000	0.001
	(0.002)	(0.002)	(0.002)	(0.000)	(0.013)
FEs & Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909	3,909	3,909	3,909
R-squared	0.036	0.034	0.034	0.037	0.034