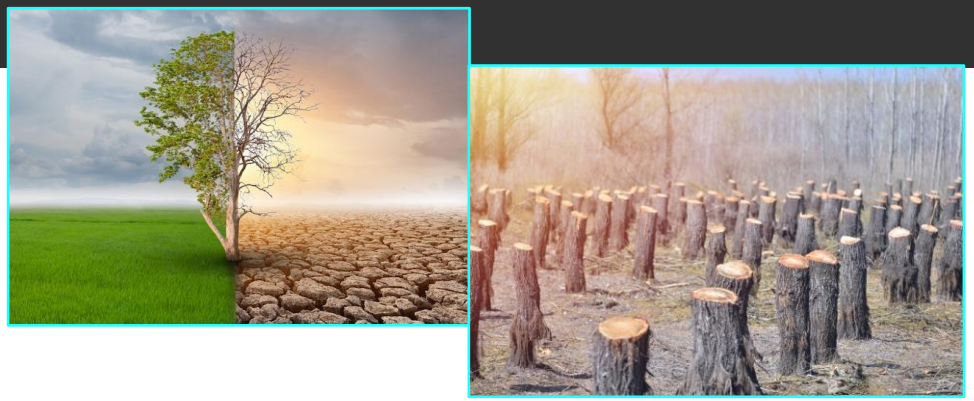
Banking on Deforestation: The Cost of Nonenforcement



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Motivation & RQ

- **Banks' Role**: Channel funds and manage climate-related risks effectively.
  - Risks impact financial stability, asset values, and long-term profitability.
- **Gaps in Understanding**:
  - Enforcement: Unclear how enforcement intensity of environmental laws affects risk assessment.
  - Deforestation Risks: Limited research on how banks manage risks tied to deforestation.
- **Deforestation & Banks**:
  - Major contributor to carbon emissions.
  - Banks exposed through credit risk, compliance, reputation, and market volatility.
- **Key Question**: How do banks factor in their lending decisions deforestation-related risks when law enforcement intensity suddenly shifts?

Motivation (cont.)

"[…] 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).

- **Surge in Environmental Laws:**
  - Global efforts to combat climate change have resulted in a proliferation of environmental regulations and laws.
  - Researchers and policymakers are now focused on how financial institutions, particularly banks, internalize climate-related risks such as carbon emissions.
- **The Blind Spot in Enforcement:**
  - While laws have increased, the intensity of enforcement is understudied.
  - This paper's focus: Examining whether banks respond to changes in environmental law enforcement by shifting their lending to high deforestation risk ("brown") vs low deforestation risk industries.

Why Brazil? A Natural Case Study

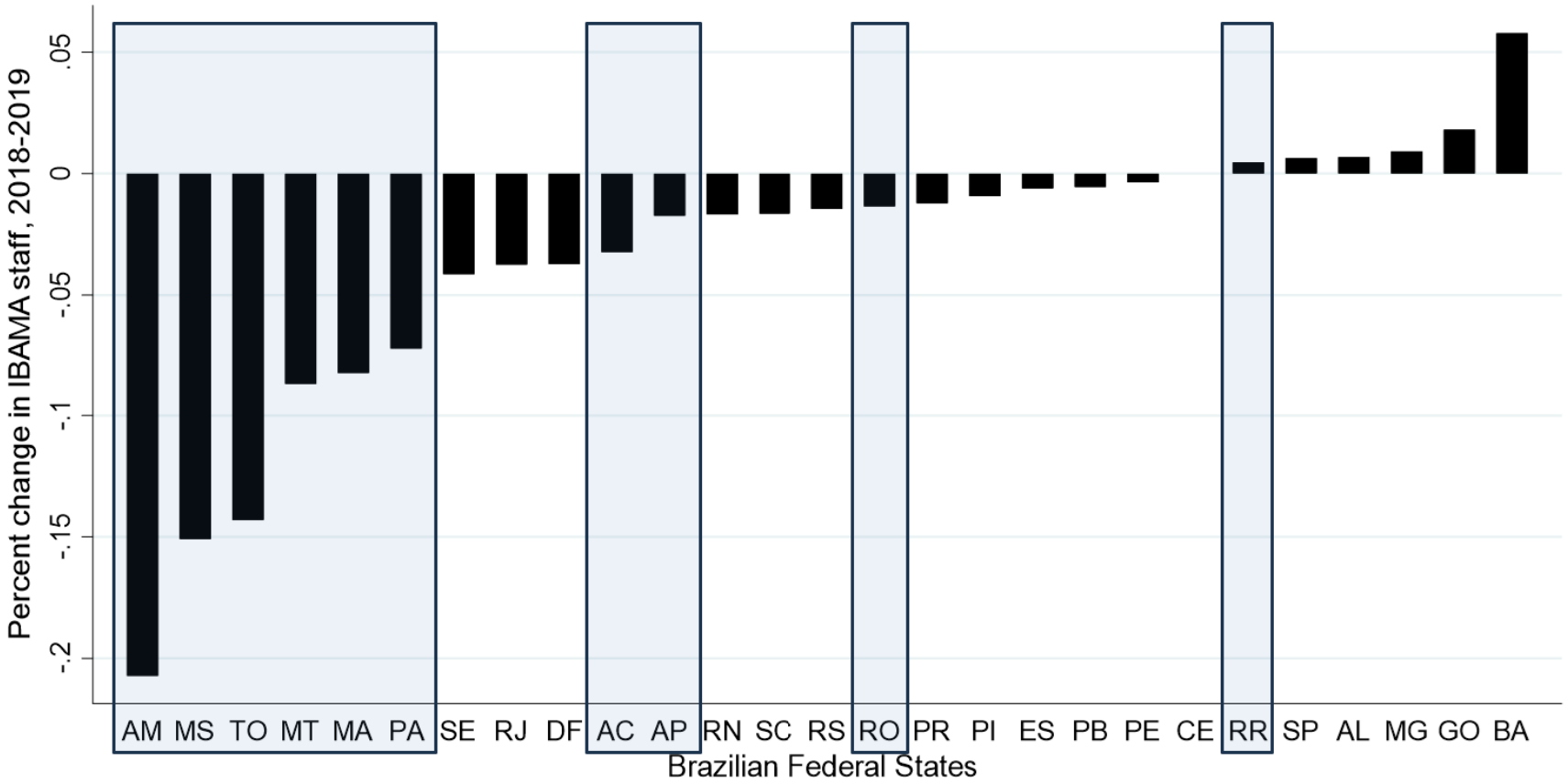
- **Brazil's Global Importance:**
  - Amazon Rainforest: The world's largest tropical forest, critical to global climate stability, acting as a carbon sink.
  - Deforestation contributes significantly to the global greenhouse effect (up to 25% of global emissions) (Fearnside, 2005, 2019).
- **Sectoral Impact of Deforestation:**
  - Impacts extend across various sectors, including:
  - Finance: Banks are exposed to both physical and transition risks.
  - Agriculture & Infrastructure: Deforestation often driven by infrastructure expansion and agribusiness activities.
- **Brazil as an Ideal Setting:**
  - The paper leverages Brazil's changing environmental laws to examine the link between enforcement intensity and banks' credit supply to high-deforestation-risk industries.

Geographical Area Distribution of Amazonia in Brazil
The Largest Rainforest in the World

Climate Law Enforcement Shock

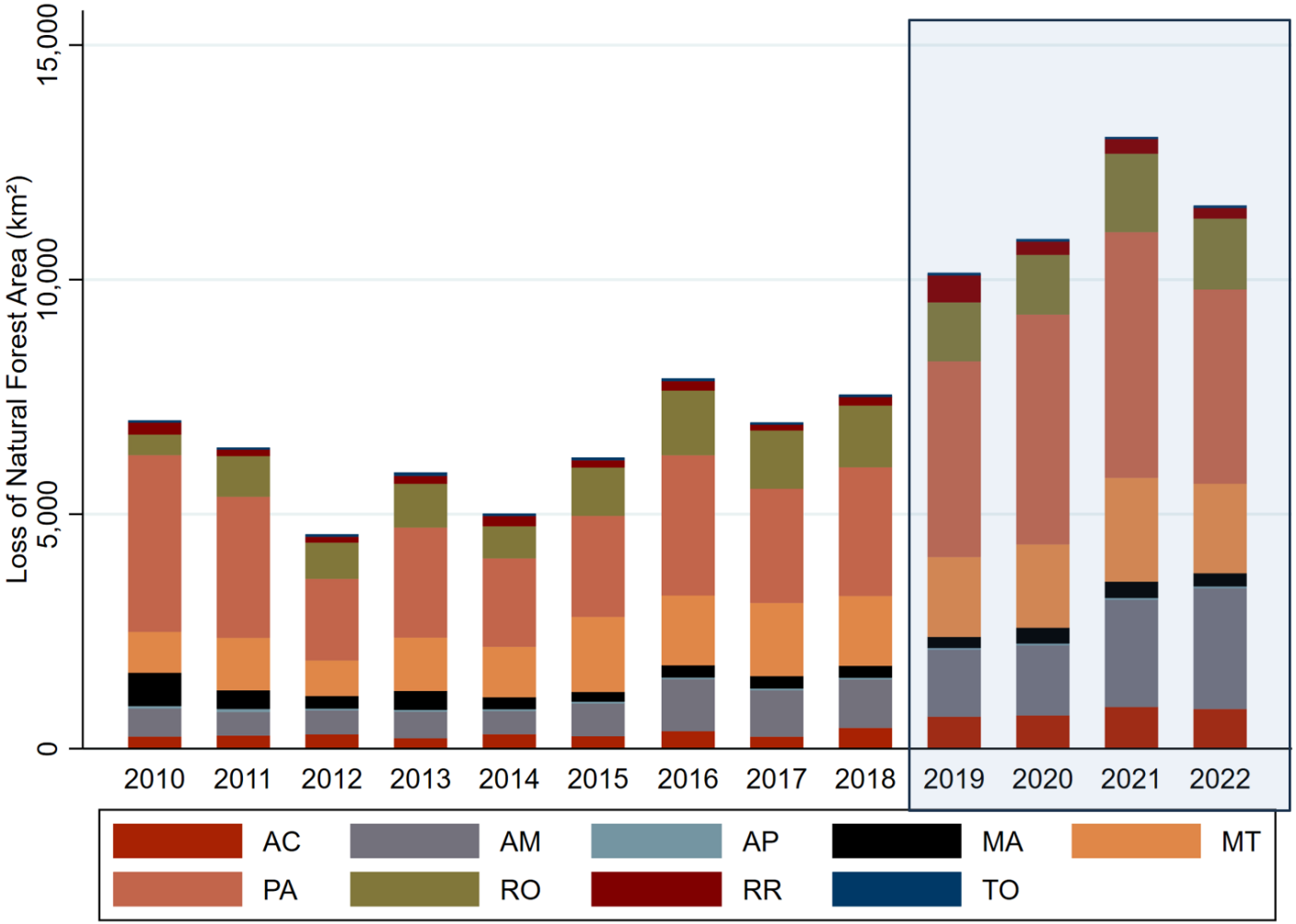
- **IBAMA Oversight Personnel Shock:** In 2019 Brazil experienced a sudden reduction in environmental law enforcement capacity, specifically through the reduction of personnel and resources at IBAMA (Brazilian Institute of Environment and Renewable Natural Resources).
  - IBAMA's payroll budget execution dropped from **91% to 56%** despite a slight overall budget increase.
  - Between 2018 and 2019, 20 federal states, especially the Legal Amazon, faced an average 6.2% reduction in staff, with some regions like Amazonia seeing declines of up to 20%.
  - This IBAMA oversight personnel reduction serves as an exogenous shock to analyze how banks respond to a significant decrease in environmental enforcement.
  - This drastic reduction in climate enforcement sparked widespread domestic and international debate, portrayed as an unprecedented dismantling of environmental law enforcement in Brazil.
- **Objective of the Study:** Investigate how the relaxation of environmental policy enforcement influences banks' supply of credit, particularly to high-risk sectors such as agribusiness.
- **Agribusiness as a Key Driver of Deforestation:** Brazil's agribusiness sector is a major contributor to deforestation, spurred by demand for land expansion.
  - **In 2019, deforestation in the Amazon increased by 49%, with fires linked to deforestation rising by 52%.**

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



- Percentage Change in IBAMA Staff (2018-2019): 20 out of 27 federal states reported significant decreases in IBAMA oversight personnel; Average decrease across affected regions: 6.2%.
- Largest Decreases in Deforestation-Prone States: Average decrease in Legal Amazon: 14%.
  - Amazonia: 20% reduction in IBAMA staff. Mato Grosso do Sul and Tocantins: 15% reduction in each state.

Loss of Natural Forest Area (in km²) for Brazilian Amazon



- Very significant increases in deforestation in years after 2019 environmental enforcement shock.

Deforestation and Financial Risks for Banks

- **Multiple Channels of Bank Exposure:**
  - Banks are exposed to **deforestation-related risks** through several key channels:
    - **Credit Risk**: Lending to businesses that could default due to environmental degradation or regulatory penalties.
    - **Regulatory Compliance Risk**: Banks may face increased scrutiny if linked to financing deforestation-related activities.
    - **Reputational Risk**: Public and investor backlash against banks financing industries contributing to deforestation.
    - **Market Volatility**: Shocks in agricultural commodity prices linked to deforestation can increase financial instability.
- **Research Focus:**
  - How do banks navigate these risks in light of weakened environmental law enforcement?
  - The study examines whether banks prioritize **short-term profitability** at the expense of **long-term risks**.

Two Competing Hypotheses – Bank Behavior Post-Enforcement Relaxation

Hypothesis 1: Increased Lending to High-Risk Deforestation Industries

- **Relaxation of Constraints:**
  - When constraints such as environmental law enforcement are weakened, economic theory suggests that constrained activities are likely to increase.
  - In this case, **lending to deforesting industries** is expected to rise as the **compliance burden decreases**.
- **Rationale:**
  - **Lower Compliance Costs**: Reduced enforcement leads to lower costs for industries tied to deforestation, increasing their attractiveness to creditors.
  - **Higher Short-Term Profitability**: Banks may see lending to agribusiness and deforestation-linked industries as highly profitable in the short term, especially without the threat of regulatory penalties.
  - **Growth Potential**: Reduced regulatory burdens may boost growth prospects for deforesting industries, making them more appealing to banks focused on short-term gains.
  - **Job Creation and Economic Growth**: Banks might also be motivated by potential local economic growth and job creation, further incentivizing lending to these industries.

Two Competing Hypotheses – Bank Behavior Post-Enforcement Relaxation

Hypothesis 2: Reduced Lending to High-Risk Deforestation Industries

- **Reputational and Long-Term Risk Considerations:**
  - Even with weakened enforcement, banks may still recognize the long-term risks associated with deforestation-related lending.
  - **Reputational Damage**: Banks may self-regulate to protect their reputations, avoiding ties to environmentally harmful sectors to safeguard long-term value (Boot, Greenbaum, and Thakor, 1993).
  - **Misalignment of Risks**: Banks may perceive a misalignment between regulatory enforcement and the real, long-term climate risks of deforestation, prompting conservative lending.
- **Rationale:**
  - **Physical and Transition Risks**: Banks with a deeper understanding of environmental risks may choose to reduce their exposure to deforesting industries to avoid potential long-term liabilities, including land degradation, market volatility, and future regulatory shifts.
  - **Self-Regulation**: Banks may adopt stricter internal policies to mitigate risks that could lead to operational disruptions, defaults, or future legal penalties, despite relaxed regulatory constraints.
  - **Sustainable Risk Management**: Focusing on long-term resilience and protecting institutional credibility, some banks may choose to prioritize sustainable lending practices over short-term profitability gains.

Data and Sample

Four Comprehensive Data Sources (2018–2019):

- **Bank Branch Data (ESTBAN):**
  - Source: Central Bank of Brazil, covering the universe of bank branches at the municipal level.
  - Sample: 9,806 branches across 3,364 municipalities, collapsed to represent consolidated branch-level assets and liabilities.
- **Bank Call Reports:**
  - Source: Balance sheets and income statements at the bank group level.
  - Sample: 56 banks with more than one active branch (of 208 total active banks).
- **IBAMA Staff Data:**
  - Source: Brazilian Ministry of Finance reports.
  - Used to measure: Personnel cuts in 2019 as the exogenous shock in environmental enforcement.
- **Land Use Data (Mapbiomas):**
  - Source: Annual Land Use Mapping Project.
  - Used to measure: Municipal-level natural environment share, indicating land available for deforestation.

Data and Sample

- **Sample Restrictions for Clean Sample**
  - Focus on bank branches active over 2018–2019.
  - Only include branches with active agricultural lending.
  - Exclude metro areas like São Paulo and Rio de Janeiro, due to limited agribusiness exposure.
  - Final Sample: 3,909 branches.
- **Panel Data Structure**
  - Final combined data is collapsed at the bank branch level into a single observation per branch for pre- and post-shock periods.
  - Two periods: 2018 (pre-shock) vs. 2019 (post-shock).
  - *Follows methodology of Khwaja and Mian (2008) and Schnabl (2012).*
- **Key Variables:**
  - *Dependent variable*: Change in the bank share of "brown" agribusiness credit.
  - *Independent variable*: Change in environmental oversight personnel (IBAMA cuts).

Regression Framework

- **To test our hypotheses**, we employ **a *quasi*-difference-in-difference (*quasi*-DID) approach**, collapsing panel data into pre- (2018) and post-shock (2019) periods.
- The main regression model is as follows:

$$\Delta AG\ Credit_{i,j,(18-19)} = \beta_1(\Delta IBAMA_{j,(18-19)} \times Av\ Forest_{j,2017}) + \mu_{uf} + \delta_i + \Omega_{ij} + \epsilon_{i,j}$$

- $\Delta AGCredit$: Change in agribusiness credit at branch level (2018–2019).
- $\Delta IBAMA \times Av\ Forest\ Area$: Interaction of personnel reduction and available forest area.
  - $\Delta IBAMA$: Change in IBAMA personnel, proxy for relaxation of environmental enforcement.
  - *Av Forest Area*: Percentage of available land for deforestation at the municipality level.
- *Fixed Effects*: State & Bank FEs.
- *Bank Branch Controls*: size, liquidity, profitability, deposit ratio.
- *Errors* are clustered at the bank level.

Regression Framework (cont.)

- The main regression model is as follows:

$$\Delta AG\ Credit_{i,j,(18-19)} = \beta_1(\Delta IBAMA_{j,(18-19)} \times Av\ Forest_{j,2017}) + \mu_{uf} + \delta_i + \Omega_{ij} + \epsilon_{i,j}$$

- **$\beta_1 < 0$ (Hypothesis 1):**
  - Banks prioritize **short-term gains**.
  - Lower IBAMA oversight + larger natural forest areas → Increased credit to agribusiness (deforestation-linked firms).
  - Banks capitalize on weakened enforcement for short-term profitability gains.
- **$\beta_1 > 0$ (Hypothesis 2):**
  - Banks focus on **long-term value** and **reputational risk management**.
  - Despite weaker enforcement, banks reduce exposure to deforestation risk, accounting for regulatory and reputational risks in their credit decisions.

Main Results

Main Results

	(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

- We find a negative coefficient for the key quasi-DID term.
- The sign and the statistical significance remain stable across models when controlling for different fixed effects and adding branch controls.

Main Results (cont.)

	(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)
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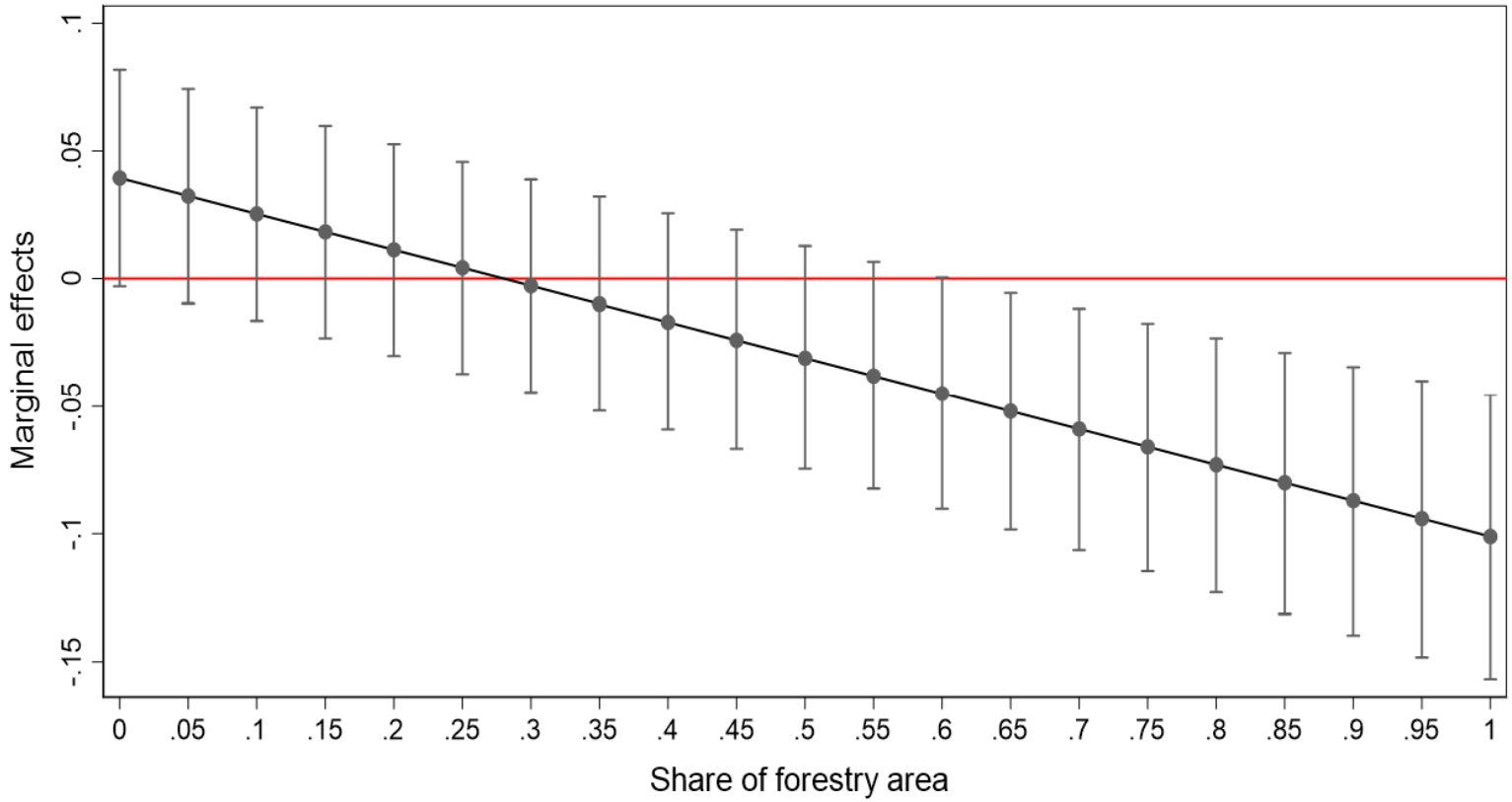
FEs & Controls	No	Federal	Federal and Bank	Federal and Bank FEs, Branch Controls
Observations	3,909	3,909	3,909	3,909
R-squared	0.002	0.014	0.031	0.033

- Results suggest that after the enforcement decline in 2019 (a decrease in the IBAMA staff), banks increased their share of "brown" agribusiness credit, especially in areas with higher deforestation potential.
  - This is consistent with is consistent with the empirical dominance of Hypothesis 1, under which banks may pursue higher short-term profitability gains.

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



- **Economically Significant Results**: A 1 stdv decrease in IBAMA staff (5%) correlates with a 35 bps increase in "brown" agribusiness credit growth.
- **Focus on Deforestation Areas**: This effect is strongest in municipalities with 70% of available land for deforestation.

Summary of Results Thus Far

- **Key Findings:** The weaker environmental law enforcement (reduction in IBAMA personnel in 2019) led to a **significant increase in bank lending to agribusinesses** linked to large-scale deforestation.
  - Banks increased credit to deforesting industries particularly in **municipalities with a higher percentage of land available for deforestation**, suggesting banks capitalized on weaker enforcement.
- **Hypothesis H1 Supported:** The results confirm Hypothesis 1, where banks pursue **short-term profitability gains**, even at the cost of long-term regulatory and reputational risks.
- **Novel Contribution: First-of-its-kind analysis** examining how environmental enforcement capacity shapes bank lending decisions related to deforestation risk.
- **Implications:** Highlights the role of enforcement, suggest that inconsistent enforcement weakens the effectiveness of environmental laws, leading to greater deforestation risks.

Identification and Other Robustness Tests

- The results are also robust to:
  - *Parallel trends analysis*
  - *Alternative dependent variables, controls, and fixed effects*
  - *Ruling out alternative explanations: State and foreign ownership*
  - *Falsification tests*
  - *Horse race with municipality traits*

Additional Robustness Tests

	(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

- The main result remains robust.

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

- Results are not driven by state or foreign bank ownership.

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

Test	(1) Baseline Specification (Actual Sample: 2018-2019) *(Repeated for Convenience)*	(2) Placebo 1: Assume Shock Occurred 3 Years Ago (Placebo Sample: 2015-2016)	(3) Placebo 2: Assume Shock Occurred 2 Years Ago (Placebo Sample: 2016-2017)	(4) 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

- Results do not hold when falsely assuming that shock occurred at different times.

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

- Results do not hold for sectors not associated with large-scale deforestation.

Horse Race with Municipality Traits

	(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

- Municipality characteristics cannot explain the increases in bank branch agribusiness credit after the weakening in environmental law enforcement.

Additional Analyses

Splits by Ex-Ante Agro-Industrial Importance

	(1) Baseline Full Sample (*repeated for convenience*)	(2) *High Ex-Ante* Agricultural Physical Area Extension	(3) *Low Ex-Ante* Agricultural Physical Area Extension	(4) *High Ex-Ante* Agricultural Production	(5) *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

- The main effect of IBAMA staff reduction on agribusiness credit 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.

Heterogeneity by 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

- 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

Heterogeneity by 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

- Larger banks and those with higher risk appetite experience a higher increase in agribusiness credit following the weaking of the environmental enforcement capacities.
  - These results further support Hypothesis 1, which indicates that banks pursue higher short-term profitability gains.

Internal Capital Markets Redistribution from Bank to Branches

	(1)	(2)	(3)	(4)
Intra-bank capital movements	*Narrow* ICM	*Narrow* ICM	*Extended* ICM	*Extended* ICM
Dependent Variable	Δ ICM Redistribution	Δ ICM Redistribution	Δ ICM Redistribution	Δ ICM Redistribution
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

- Internal capital markets responded to the decrease in IBAMA's environmental enforcement, with liquidity flowing into branches positioned to capitalize on agribusiness sector growth.

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

- 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.

Political Economy Analysis

	(1)	(2)	(3)	(4)
Political alignment	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 President's Coalition to Total Donations	Federal States with a *Low* Share of President'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

- The results hold primarily for the subsample of federal states with higher political connections.
  - Politically contributing firms could have taken greater advantage of a weakened enforcement capacity.

Real Effects Deforestation Analysis

	(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

- 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.

Summary of Findings

- **Deforestation & Banking:**
  - Explored the interactions among deforestation risks, environmental law enforcement, and bank lending.
  - Focused on Brazil's agribusiness sector (high deforestation risk) vs. other industries (low risk).
  - Quasi-difference-in-difference approach using comprehensive data from Brazilian bank branches and deforestation trends.
- **Key Findings for the Impact of Weaker Enforcement:**
  - Exogenous reduction in Brazil's environmental enforcement in 2019 led to a notable increase in lending to agribusinesses (deforestation-linked industries) in regions conducive to deforestation.
  - Banks with higher risk tolerance were more inclined to finance deforesting industries, emphasizing gaps in climate risk management.
  - Internal capital markets emerges as an important channel: Banks reallocated resources internally to branches in regions with high deforestation risk, allowing them to capitalize on weakened enforcement, enhancing short-term profitability in regions with high deforestation risk.
  - The real effects analysis shows a direct link between increased "brown" credit and deforestation, showing that credit expansion in agribusiness may contributes to deforestation.

Contributions to Literature

- **Climate Risk & Financial Institutions:**
  - Distinct perspective by extending research on climate risks, focusing on deforestation as an underexplored area in bank lending decisions.
  - First to examine the immediate effects of weakened environmental law enforcement on "brown" credit extension (Correa et al., 2023; Ivanov et al., 2023; De Haas and Popov, 2023).
- **Law & Finance:**
  - We contribute to the nexus between law enforcement and financial dynamics by analyzing the effects of reduced enforcement on bank lending (La Porta et al., 1997; Haselmann et al., 2010).
  - Explore how environmental laws, unlike other laws, shape economic consequences.
- **Brazil's Financial Sector & Real Economy:**
  - Focus on bank credit & deforestation and demonstrate how environmental law enforcement affects bank credit provision and deforestation outcomes (Claessens et al., 2008; Martins et al., 2023).
  - Highlight the impact of political connections on "brown" credit supply in the Brazilian Amazon (Fisman, 2001; Johnson and Mitton, 2003).

Implications for Policy and Future Research

- **Gap Between Law & Practice:**
  - Even with robust environmental laws, banks struggle to internalize deforestation risks without consistent enforcement.
- **Global Relevance:**
  - The results from Brazil highlight a broader issue that could apply to other countries facing deforestation challenges.
- **Future Directions:**
  - Research should explore how **enforcement capacity** shapes financial institutions' ability to manage **long-term climate risks.**