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Green Mandates and the Politics in the Jungle: Do Leftist Mayors Curb Amazon Deforestation?

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Green Mandates and the Politics in the Jungle: Do Leftist Mayors Curb Amazon Deforestation?*

Abstract

This paper investigates whether left-leaning politicians are more effective than their right-leaning counterparts in reducing deforestation in the Legal Amazon in Brazil. Using data from 760 Amazon municipalities and a regression discontinuity approach based on close elections, it finds that leftist mayors tend to increase environmental spending always and may reduce deforestation, though the latter effect is uneven and do not extend to reforestation outcomes. Their impact is stronger in contexts with fewer coalition constraints, greater fiscal autonomy, and certain geographic or political conditions. While electoral dynamics often bring environmentally focused candidates to power in high-risk areas, structural and economic pressures limit mayoral ability to achieve sustained reductions in forest loss. Overall, the findings highlight both the potential and the constraints of decentralised governance in advancing environmental protection and carry implications for subnational environmental policy not only in Brazil, but also beyond its border.

JEL classification

H77, Q56, R14, P44

Keywords

political ideology, leftist mayors, deforestation, reforestation, close elections, regression discontinuity design, local democracy, Brazil

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1. Introduction

Forest loss accounts for between 12% and 20% of global greenhouse gas emissions, making deforestation one of the most consequential drivers of climate change. Nowhere is this more acute than the Amazon, where legal and illegal activities - farming, ranching, mining, and logging - continue to erode the world's largest tropical rainforest at alarming rates. Brazil, which holds 60% of the Amazon, sits at the centre of this crisis. How Brazil governs its forests therefore matters not only for its own citizens but for the global climate.

A growing body of evidence establishes that political leadership shapes deforestation outcomes at the federal level (Burgess et al. 2012; Boucher et al. 2013). Yet at the municipal level - where land use decisions are made, environmental budgets are set, and enforcement is carried out - these issues remain rather understudied with recent exceptions of Pailler (2018), Cisneros, and Kis-Katos (2024). Pailler (2018) found that deforestation rates increase by 8–10% during election years when an incumbent mayor runs for re-election while Cisneros et al. (2024) found that random government audits triggered forest loss, especially during election years, in municipalities governed by first-term mayors who managed to win re-elections afterwards, and in places with a high share of cattle ranching, indicating potential collusion between local politicians and the agricultural sector. We depart from this tradition to raise a precise question on leader's ideology: does electing a left-wing mayor, compared to a right-wing one, lead to better environmental outcomes in Brazil's Legal Amazon? Why? Why not?

The question is consequential for several reasons. Since the 2006 Forest Management Law, Brazil has progressively decentralised forest governance, granting mayors significant authority over land use regulation, environmental spending, and local enforcement. This decentralisation created both an opportunity and a risk: local leaders can mobilise resources for conservation, but they also face powerful economic incentives to accommodate agribusiness, mining, and ranching interests. The tension between these forces is sharpest in the Amazon, where municipal executives operate at the intersection of national environmental goals and local political economies. President Bolsonaro's dismantling of federal environmental protections between 2019 and 2022 further elevated the stakes of local governance, making the ideology of municipal leaders a potentially critical determinant of forest outcomes during periods of federal retrenchment.

We contend that left-wing mayors - typically aligned with various labour, environmental, and indigenous movements - are more likely to prioritise environmental protection, even when doing so conflicts with local business interests. This ideological disposition translates most directly into environmental spending, a budgetary instrument that falls squarely within mayoral control. However, deforestation in the Amazon is driven largely by powerful external actors that lie beyond the reach of municipal authority. Coalition politics further complicate matters: leftist mayors governing in coalition with pro-extraction partners may find their environmental ambitions diluted, producing symbolic increases in spending without meaningful reductions in forest loss. Leftist mayors may contribute more to local revenue and local employment/income generation to cater to their electorates. Electoral dynamics add another layer. Voters in heavily deforested municipalities too may actively select left-wing candidates as environmental champions, creating a feedback loop between deforestation exposure and political representation that our analysis explicitly accounts for.

To identify the causal effect of mayoral ideology on environmental outcomes, we exploit close electoral contests between leftist and right wing mayoral candidates across 760 municipalities in the Brazilian Legal Amazon between 2000 and 2021, using a regression discontinuity design. This approach compares municipalities where a left-wing candidate narrowly won against those where a right-wing candidate narrowly prevailed, ensuring that the two groups are otherwise comparable. Because local elections in Brazil - particularly in remote Amazon municipalities - are susceptible to vote buying and clientelism especially near the zero-margin threshold, we implement a donut regression discontinuity that excludes observations within a 0.01 winning-margin band, addressing concerns about vote manipulation around zero threshold while preserving identification.

We measure outcomes across three dimensions: area deforested, reforested area, and annual environmental spending, drawing on satellite data from PRODES and Terra Class and official municipal finance records, among others. Our findings reveal a nuanced picture. Left-wing mayors consistently and significantly increase environmental spending - the instrument most directly under their administrative control. Their effect on deforestation is real but conditional: reductions in forest loss are observed primarily among left-only mayors governing without coalition constraints, in municipalities distant from the Transamazônica Highway, and when mayors are politically non-aligned with the federal government. These contextual dependencies reveal the structural limits that constrain even ideologically committed leftist local leaders. Reforestation, which requires sustained long-term investment and coordination beyond the municipal mandate, shows no significant response to mayoral ideology. We explore

several mechanisms. Leftist vote share is positively associated with indigenous population share; in turn, leftist mayors tend to significantly boost local revenue and local employment/income to cater to their electorates. More interestingly, we document that rising deforestation in a municipality predicts higher subsequent vote shares for left-wing candidates, suggesting that voters respond to environmental deterioration by demanding stronger local protection - a dynamic that reinforces the link between ecological pressure and leftist political representation.

This study sits at the intersection of three bodies of work: the economics of deforestation and forest governance, the literature on indigenous land governance and the political economy of representation and ideology. We discuss each in turn, identifying where our findings extend and challenge existing knowledge.

Amazonian deforestation is canonically understood as a tragedy of the commons - the product of uncoordinated exploitation for private profit through mining, logging, agriculture, ranching, and land speculation, in the absence of effective collective governance (Stavins, 2011; Van der Ploeg, 2011; Brollo et al., 2013). The theoretical foundations for thinking about sustainable management of such resources draw on a long tradition in optimal resource economics (Dasgupta and Heal, 1974; Samuelson, 1976; Dasgupta, 1982; Brown, 2000), which establishes conditions under which forests can be managed efficiently over time but which largely abstracts from the political economy of who governs and with what priorities.

More recent empirical work has begun to fill this gap by showing that political leadership materially shapes deforestation outcomes. A central theme across this literature is the collusion between municipal governments and local agribusiness interests. High agricultural profits motivate politicians to collude with local elites and ignore illegal conversion of natural forests. Ferreira and Rocha (2020) and Burgess et al. (2019) demonstrate that pro-agribusiness governments are associated with significantly higher rates of forest loss, establishing ideology as a relevant determinant of environmental outcomes at the federal level. Our paper extends this insight to the municipal level, where governance authority over land use, environmental enforcement, and spending is substantial but has received comparatively little systematic attention (exceptions being Pailler (2018) and Cisneros et al. (2024)). By doing so, we show that the political economy of forest protection operates not only through national policy but through the political ideology of hundreds of local executives.

A related literature examines how indigenous territorial rights and governance structures shape deforestation. The central finding is that formal recognition of indigenous territories significantly reduces forest loss by strengthening local monitoring and enforcement

capacity, though effectiveness varies with governance quality and institutional strength (Nepstad et al., 2006; Baragwanath and Bayi, 2020; Blackman et al., 2017). This literature has increasingly moved beyond aggregate findings to document heterogeneity within indigenous communities. Preferences over conservation, resource extraction, and market engagement differ across and within communities, shaped by market integration, leadership structures, and demographic composition (Yashar, 2005). Studies of consultation mechanisms such as Free, Prior and Informed Consent (FPIC) show that these processes often fail to capture internal diversity, typically reflecting the views of dominant community leaders rather than the full range of preferences (Arellano-Yanguas, 2011). Gender and generational variation are particularly consequential: women and younger community members tend to express stronger conservation preferences but remain systematically underrepresented in governance structures (Agarwal, 2009; Reyes-García et al., 2014). Our study connects to this literature through the electoral channel. We document that municipalities with larger indigenous populations are more likely to elect left-wing mayors who prioritise environmental protection, suggesting that indigenous communities exercise political influence not only through land governance institutions but through the ballot box. In this way, descriptive representation of indigenous interests at the municipal level may be an underappreciated mechanism for conservation outcomes.

The third strand of literature we engage concerns the relationship between political representation, ideology, and policy outcomes. The foundational distinction between descriptive and substantive representation - that electing diverse officials is expected to produce policies that reflect the interests of previously underrepresented groups (Bratton and Ray, 2002) - frames our core hypothesis: that electing left-wing mayors should translate into more pro-environment policy through both ideological commitment and constituency accountability.

Class-based theories of political behaviour provide further grounding. A consistent finding in comparative politics is that class position shapes political preferences, with workers and lower-income groups favouring state-led redistributive and regulatory policies while elites tend toward market-oriented alternatives (Korpi, 1983; Brooks, 1994; Manza et al., 1995; Evans, 2000; Lupus et al., 2009; Carnes and Lupu, 2015). In the Amazon context, where the costs of deforestation fall disproportionately on poorer and indigenous communities while the benefits accrue largely to agribusiness and extractive industries, this class logic maps directly onto environmental preferences. Left-wing parties in Brazil are structurally more likely to

represent the communities that bear the costs of forest loss, creating both ideological and electoral incentives for environmental action.

Campaign dynamics reinforce this alignment. Candidates strategically emphasise issues on which they hold a comparative advantage with their voter base (Page, 1976; Campbell, 1992, 1996; Demange and Van der Straeten, 2020), and growing evidence documents rising voter concern for environmental issues across democratic contexts (Papp, 2022; Cotofan et al., 2024). Our finding that municipalities with higher deforestation burdens are more likely to subsequently elect left-wing mayors is consistent with this electoral logic: environmental deterioration activates demand for protection, which left-wing candidates are better positioned to supply credibly.

Overall these strands of the literature converge on a common implication - that local political economy, ideology, and representation matter for forest outcomes - but leave the municipal level in the Brazilian Amazon largely unexamined in this context. In particular, our findings make four contributions. First, we provide the first systematic causal evidence on the effect of municipal political ideology on Amazonian deforestation, extending a literature that has focused almost exclusively on federal-level. Second, we show that the capacity of local leaders to deliver on environmental commitments depends critically on coalition structure, fiscal autonomy, geography, and federal alignment - findings that have direct implications for the design of decentralised environmental governance. Third, we document an electoral feedback mechanism linking deforestation exposure to leftist vote shares, contributing to the growing literature on environmental voting and descriptive representation. Fourth, our results speak directly to the debate on subnational conservation policy in federal developing economies, where environmental outcomes depend as much on local political economy as on national legislation.

The policy implications are equally clear. Strengthening environmental outcomes in the Amazon requires more than electing pro-environment mayors - it requires giving them the tools to act. Greater fiscal autonomy, reduced coalition dependency, stronger institutional protection from agribusiness pressure, and sustained federal-municipal alignment are the conditions under which left-wing governance translates into measurable forest protection. These findings carry lessons well beyond Brazil, for any federal system where environmental authority is decentralised but local leaders face structural constraints that limit their ability to act on their stated preferences.

The paper proceeds as follows. Section 2 develops the institutional background and theoretical hypotheses. Section 3 describes the data and empirical strategy. Section 4 presents the results. Section 5 concludes.

2. Background

Brazil consists of 26 states, a federal district, and over 5,590 municipalities. The study focuses on 760 municipalities in the Legal Amazon region, which spans nine states and contains 60% of the Amazon rainforest. Although indigenous issues are federally legislated, strong indigenous land rights and protections only began with the 1988 Constitution. This Constitution formally defined protected indigenous lands, enabling legal land demarcation and granting Indigenous peoples legal representation and autonomy - rights not afforded under previous constitutions.

The 1988 Constitution also marked a shift toward decentralised governance, giving municipalities and states greater political, fiscal, and administrative roles, while the federal government remained responsible for national policy planning. Municipalities were tasked with executing these policies, supported financially by the federal and state governments.

Because Brazil's federal system grants municipalities significant autonomy over land-use planning and budget execution, local executives operate at the intersection of national environmental policy and the political economy of rural development. In the Brazilian Amazon, mayors play a central role as intermediaries translating national environmental commitments into local outcomes, owing to the substantial autonomy municipalities hold over land use planning, budget allocation, and regulatory enforcement. Their influence operates through multiple channels. First, municipal administrative capacity shapes the effectiveness of land use enforcement, including zoning, licensing, and environmental monitoring. Second, mayors face strong political economy trade-offs: while agribusiness interests and electoral incentives often favour short-term resource exploitation, external pressures - such as federal deforestation blacklists or NGO engagement - can incentivise conservation. Empirical evidence shows that political turnover at the municipal level significantly affects deforestation, with pro-agribusiness leadership associated with increased forest loss (Ferreira and Rocha, 2020; Burgess et al., 2019). Third, fiscal tools such as discretionary environmental spending and incentives like the ICMS Ecológico can support conservation, although these are often outweighed by revenues from extractive activities. Mayors can also influence the protection of indigenous rights through service provision, infrastructure planning, and local conflict

mediation, with outcomes varying depending on their political alignment. Overall, decentralised governance creates both opportunities and risks: while local autonomy enables context-specific solutions, it also exposes environmental protection to political cycles and clientelism. While local municipalities are primarily dependent on transfers from the federal and provincial governments, they also have some autonomy of generating local revenue through taxes on local property and services. Strengthening environmental outcomes therefore requires better alignment of fiscal incentives, stronger oversight, and greater integration of local governments with indigenous institutions (Chiplunkar and Das, 2025).

2.1. Recent interventions for the protection of the Amazon

The Amazon faces unique property rights challenges, often perceived as "no man's land," which has led to widespread deforestation and land grabbing. Past government land reform initiatives encouraged migration to the region by offering land to settlers, further complicating land ownership and environmental governance.

In 2006, Brazil introduced a law requiring the legal registration of forested land, prompting rural property registrations across the country, including in the Amazon. However, this process exposed the lack of formal recognition for Indigenous Territories - about 63% remain unlegalized, with 821 out of 1,290 territories lacking official demarcation.

Successive governments have shown declining commitment to indigenous land approvals:

- Fernando Henrique Cardoso (1995–2002): 145 approvals
- Luiz Inácio Lula da Silva (2003–2010): 79 approvals
- Dilma Rousseff (2011–2016): 21 approvals
- Michel Temer (2016): 1 approval
- Jair Bolsonaro (2019–2022): 0 approvals

This trend reflects increasing marginalization of indigenous peoples, especially under Bolsonaro's pro-business, anti-indigenous policies. Much of the Legal Amazon still lacks clear land ownership, making it susceptible to illegal occupation. Research shows that fully recognized indigenous land rights can reduce deforestation by up to two-thirds.

The 2012 Forest Code introduced tools like the Rural Environmental Register (CAR) and the Environmental Regularization Program (PRA) to manage land use and promote sustainable agriculture. These initiatives aim to monitor deforestation, enforce environmental compliance, and incentivize sustainable practices. However, implementation has been slow, with many properties still pending verification and resolution.

2.2. Political representation of the left in Brazil

In Brazil, mayoral elections take place every four years, alternating with state and presidential elections that happen in between. Voting is mandatory for individuals aged 18 to 70, while illiterate, incapable persons, 16 and 17-year-olds, and those over 70 can choose to vote or not. In most municipalities with a population under 200,000, mayors are elected using a single-round voting system where the candidate receiving the most votes wins the election. However, in municipalities with populations exceeding 200,000, a candidate must secure an absolute majority to win. If no candidate achieves this in first round, a second-round runoff election determines the winner. Over 99% of municipalities in the Legal Amazon area elected a Mayor in the first round. Only a minority of municipalities had gone to the second round of election to elect its Mayor.

There are various methods for measuring the ideology of political parties, such as analysing their party programs, observing the behaviour of party representatives, examining their electoral behaviour, considering the public perception of party representatives, and consulting experts in the field. To classify party ideology, we consulted BBC Brasil, and Bolognesi et al. (2023)². The latter relied on expert opinions to classify party ideology, while BBC Brasil analysed the results of ten recent and relevant votes in the Chamber of Deputies. Appendix 2 Table 2.1 details these two sources of party ideology classifications, which are generally consistent when classification exists for both. Based on these classifications, we classified the parties of elected municipal Mayors and runner-up candidates into broader categories as follows:

<u>Ideology</u>	<u>Parties</u>
<u>Left</u>	PCB, PC do B, PCO, PDT, PMN, PSB, PSOL, PSTU, PT, PV
<u>Centre-Left</u>	AVANTE, CIDADANIA, PPS, PROS, REDE, SOLIDARIEDADE
<u>Centre</u>	PMDB
<u>Centre-Right</u>	DC, MDB, PMB, PRP, PSD, PSDB
<u>Right</u>	DEM, PL, PTB PATRIOTA, PODE, PP, PRTB, PSC, PTC, Republicanos, PPB, PR, PRB, PSC, PSL.

The study finds that leftist parties in Brazil are closely linked to labor unions and often promote socialism and anti-capitalism to address poverty. Key left-leaning parties include:

² We also consulted the EU Manifesto project, however, we were unable to use the Manifesto project extensively due to its limited coverage of Brazilian parties.

- **PT (Workers' Party)**, founded by labor unions, ruled Brazil from 2002 to 2016, and was a central player in national politics alongside **PSDB**.
- Other socialist or leftist parties include **PSTU, PSOL, PMN, PCO, PSB, and PV**, many advocating for reforms like shorter work hours, agrarian reform, public investment, and breaking ties with the IMF.
- **PV (Green Party)** emphasizes social equity and sustainability.
- **Rede** is an environmentalist party, while **AVANTE** is a centrist party formed by labor party dissidents.
- Many of these parties often formed coalitions with PT and shared socialist or anti-capitalist ideals.

These parties collectively promote policies favouring workers, environmental protection, and opposition to neoliberal economic models.

In contrast, centre and centre-right Brazilian parties are more allied with the businesses. Among them, PMDB and MDB are parties without a clear ideological program and have often allied themselves with the ruling executive to extract advantages through clientelist networks. PSB too has aligned with both the left and the right in recent years. PMB is the Brazilian Women's Party Known for its non-feminist and anti-abortion stance, while DC (Christian Democracy) is a small party supporting traditional Christian values.

Using this party ideology classification, we create several proxies for left-wing Mayors: (a) Mayors from the Left and Centre-Left parties taken together; (b) Mayors from the left parties only; (c) Further, we construct an index to identify the parties that best represent the workers' (as against business) interests. Most parties cite workers' rights as one of the key objectives. Thus, to disentangle the most prominent parties that defend workers' interests, we consider the ones that have "workers" (trabalhadores, colaboradores or operários in Portuguese) as one of the words in the party's acronym. (a)-(c) are the parties, who are generally pro-workers, pro-poor and often pro-environment too. (d) Since the 2016 municipal elections, we have also been able to identify if the local government has any elected indigenous members. The latter provides an additional way to assess the role of leftist Mayors (a)-(c) in sample municipalities with elected indigenous members. We find a high degree of correlation between the election of an indigenous member and that of the leftist Mayors.

*** Insert Figure 1 ***

Figure 1 displays the trend in the average share of leftist mayors in the sampled municipalities. Panel a depicts the trend for left and centre-left mayors taken together, while

panel b focuses specifically on left-only mayors. These two panels show a rising share of leftist mayors in Amazonian municipalities from 2000 to 2012. However, this share started declining somewhat after 2012, reaching a low point by 2015, and then stabilized, though it remained below the 2010 peak. This decline aligns with the gradual downfall of the PT government under President Lula, which was increasingly burdened by corruption scandals and economic crises. A similar downward trend is observed for mayors from workers' parties after 2010 in panel c.

*** Insert Table 1 here ***

Table 1 reports the likelihood of having a leftist mayor- columns (1)-(2) show the estimates of left party (left plus centre-left), columns (3)-(4) those of left only party mayors and columns (5)-(6) those of mayors from workers' parties. Row (1) shows the estimate of indigenous population (as a share of 10000 population), while row (2) shows that of Indigenous population as share of the municipality population. Evidently, there is a positive and significant association between the indigenous population shares in a municipality and the likelihood of having a leftist Mayor. Consequently, election of a leftist mayor can be taken as indicative of the indigenous population's representation in that municipality.

In view of the local election data from 2016 onwards, we also consider the likelihood of a municipality with elected indigenous members. Note that this information is not available for prior elections. Our analysis shows that the likelihood of having an indigenous person elected into a municipality is significantly higher (0.12 as against 0.066 with a t-statistic of 6.3830) when the mayor is from a left-leaning parties (left or centre-left in our classification). This positive association is also confirmed in Table 2 where we regress the number of elected indigenous members on the likelihood of having a mayor from left only, left and centre-left or workers' parties. This evidence further strengthens the significant association between political representation of the indigenous people and election of leftist Mayors in our sample.

Coalition governments are very common in Brazilian municipalities due to the great number of parties in the country. The likelihood of having a coalition government is about 0.36 in our sample when the mayor represents the left or a centre-left party. We also note that many mayors are aligned with the President in terms of their party affiliation and this likelihood (0.26 as against 0.06 for others with a t-stat of 35.5624 for testing the mean difference) is significantly higher among left-led municipalities in Brazil. The latter can probably be attributed to the fact that the centre-left Workers' Party (PT), under the Presidents Lula and Dilma Rousseff, had ruled for much of the sample period (2003-16).

2.3. Are leftist Mayors necessarily pro-environment?

Indigenous communities in the Amazon have historically lived in harmony with nature, acting as effective stewards of the forest. In the Bolivian Amazon, indigenous land ownership is strongly linked to forest conservation, while private settler and bushman holdings are associated with old-growth forest loss (Webb 2019).

Earlier waves of deforestation (1960s–2000s) were driven by government-led development through road construction, land incentives, and agricultural settlement programs. In Brazil, political shifts have, however, significantly influenced Amazon conservation. The centre-left Workers' Party (PT), in power from 2003 to 2016, introduced impactful environmental regulations like the 2006 land registration law and the 2012 New Forest Code. These policies reduced deforestation through measures such as protected areas, monitoring systems, and incentives for municipalities. However, under far-right President Jair Bolsonaro (elected in 2018), many of these protections were rolled back, thus promoting deforestation, weakening environmental enforcement and supporting illegal activities like mining and logging, and dismissing indigenous concerns. His presidency ended with deforestation levels 66% higher than in previous years (Lima et al., 2020).

Given Brazil's decentralised governance, we consider the role of leftist mayors on environmental spending and deforestation at the municipality level. We argue that left-leaning mayors are more inclined than their right-wing counterparts to implement environmentally protective policies. This tendency stems from three key factors: environmental protection often requires state intervention; leftist parties in Brazil, largely supported by the working class, generally favour government actions over market solutions (Carnes & Lupo, 2015); and such interventions typically benefit indigenous communities, who are poor and disproportionately affected by environmental degradation (Dunlap et al., 2001; Neumayer, 2004). As a result, left-wing mayors are more likely to pursue environmental regulations, even when these may conflict with local business interests, in order to support their core constituents- workers and the poor.

However, evidence also shows that local politicians can exploit natural resources for electoral gain. For instance, during Brazil's 2018 presidential election, deforestation spiked amid promises to weaken environmental protections (Abessa et al., 2019). Similarly, U.S. governors adjust environmental policies based on voter preferences- tightening in environmentally conscious ("green") states and loosening in industrial ("brown") states (List & Sturm, 2006). While there's no definitive evidence of an anti-environment agenda within Brazil's left, factions within Lula's Workers' Party have varied in their stance. Nonetheless,

Lula's recent return to office is seen as a positive development for Amazon preservation, with a pledge to achieve zero deforestation and halt further agricultural expansion by 2030.

Taken together, we contend that environmental spending is performable - it lies within mayoral discretion and satisfies coalition partners symbolically. As such, we expect most pronounced and positive effect of leftist mayors on environmental spending. Reducing deforestation, however, requires structural power over land, enforcement, and markets that Brazilian municipalities simply do not possess. The upshot is that the impact of leftist mayors on deforestation reduction would more muted relative to environmental expenses. The gap between these two sets of outcomes, environmental spending vs deforestation outcomes, reflects the mismatch between local political competition and the multi-level governance of Amazonian forests.

We use our data to explore the role of leftist mayors on environmental spending as well as different indices of deforestation and reforestation (levels and shares). Some further considerations are in order here. Left-leaning mayors may struggle to implement environmental policies if their governing coalitions include parties with opposing interests, or if economic incentives tied to business interests in the rainforest dominate local priorities. The study also investigates the varied impact of leftist mayors based on: (a) proximity to the Transamazônica Highway, which can facilitate illegal logging; (b) election years, when environmental issues are often deprioritized in favor of economic concerns; and (c) political alignment with the President, which can affect policy implementation. These factors are empirically tested using available data.

3. Data and Empirical Strategy

3.1. Data Description

We compile a unique municipality level data covering 760 Legal Amazon municipalities over 2000-2021 from various official main sources. Deforestation data primarily comes from satellite monitoring from PRODES, a project of the National Institute for Space Research (INPE) with the goal of monitoring and controlling deforestation, among others. Prodes has better spatial resolution than other monitoring systems, e.g., DETER and can identify areas of size 6.25 ha or above annually. Since the mask is a blind spot for both PRODES and DETER, any changes to secondary vegetation in the Amazon remain invisible to both systems, and

consequently, to Brazilian environmental authorities. The Terra Class project (Almeida et. al. 2016), a joint effort between INPE and EMBRAPA, maps land use categories (pasture, agriculture, secondary vegetation) but relies on PRODES deforestation masks as its baseline, making it derivative rather than primary. It partially addressed the problem of the invisibility of secondary vegetation in the Amazon by creating biennial maps of land use and cover within the PRODES deforestation mask, with secondary vegetation as one of the categories monitored.

Taken together PRODES provides Brazil's official deforestation statistics used in national policy, international climate commitments, and scientific publications. DETER explicitly states it is not designed for quantification - only for directing enforcement resources. PRODES uses consistent methodology across 35+ years, enabling reliable trend analysis. Each deforestation increment is manually verified, reducing commission errors (false positives). As such, PRODES remains the gold standard due to its precision, validation protocols, and consistent historical record. We, therefore, use Prodes deforestation data for our analysis.

In addition, we collect data on Legal Amazon over 2000-2021 from a variety of official sources: IBGE- Brazilian Institute of Geography and Statistics, Water Agency, DNIT - Infrastructure, MMA – Ministry of Environment, TSE – Superior Electoral Court, IPEA- Institute of Applied Economic Research, SUS- National Health Service, CPT- Pastoral Land Commission, Tesouro Transparente - Transparency National Treasure. This is summarised in Appendix ` Table A1 for key variables used in our analysis.

The key outcome variables of our interest are: (i) area deforested (PRODES); (ii) change in area deforested in square km (PRODES); (iii) area reforested (From Terra Class available only until 2015); (iv) expenditure on environment management. All areas are measured in square kilometers. For robustness, we also consider the area deforested and reforested as share of total municipality area, as well as area deforested and reforested as a share of total forested area, annual changes in area deforested as share of total deforested area as well as total expenditure on environmental management as share of total municipality expenditure. In general, mechanical clearance using bulldozers and other heavy equipment is estimated to cost 44%-70% more than using fire (Simorangkir, 2007). MODIS satellite data for detecting all fires across the world for the period 2003-2018 suggests that the incidence of fires is concentrated heavily in forested low-income countries and is about four times higher than that in forested high-income countries. Appendix 1 Table A2 summarises the means and standard deviations of all regression variables.

We use this compiled data to explore if leftist mayors exert a stronger impact on environmental spending rather than deforestation outcomes, especially when in coalition.

***Insert Figure 2 ***

Panels a-b of Figure 2 show the trends in deforested areas, the levels and annual changes in our sample. Between 2000-2004, there was a high degree of deforestation in Brazil (see panel a); however, deforestation started falling sharply (see panel b) from 2005 onwards as the Lula government initiated several policies to conserve the Amazon. However, there was a reversal of the policies to tackle deforestation as the country entered a period of economic crisis after 2014, which was further bolstered by the election of Bolsonaro in 2018 to govern between 2019-2022. This is further corroborated in the panel c of Figure 2, which shows the trend in local government expenses on environmental management: it grew steadily until about 2014 and then started falling.

3.2. Empirical Strategy and Identification

The main empirical challenge has been that the election of a leftist mayor in a municipality is unlikely to be random. It is likely to depend on the same municipal characteristics that also influence the deforestation or reforestation outcomes of interest. To address this issue, we employ close elections between left-wing (left and centre-left) and right-wing mayoral candidates within a regression discontinuity (RD) framework, see Appendix Table 2 for basic statistics of variables in the regressions. The underlying assumption is that close elections effectively randomise the selection of a leftist versus a right-wing mayor, thereby allowing us to estimate the causal effect of electing left-wing mayors in local municipal elections on various outcomes related to environmental spending and deforestation.

The RD design is one of the most credible non-experimental identification strategies used in the recent literature. It relies on weak and easy-to-interpret nonparametric identifying assumptions, which permit flexible and robust estimation and inference for local treatment effects. The key feature of the design in our case relies on the winning margin of a left-wing candidate against a right-wing one, which is used as the key running variable for each Amazon municipality in the sample. This determines the treatment assignment via hard-thresholding around the cut-off winning margin of 0 to characterise a close election. Close elections are defined as those in which the winner and the runner-up are of opposite ideologies and the margin of victory is so small (very close to the cut-off threshold of 0) that the ideological

identity of the winner of a close election turns out to be quasi-random. All municipalities that elect a left-wing candidate against a right-wing one with a winning margin above the cut-off 0 are offered the treatment, while all municipalities whose score is below this cut-off 0 (i.e., where a left-wing candidate loses against a right-wing one) are treated as the control units. Identification is then done by comparing the responses of treated units just above the cut-off of 0 winning margin with those below (control group) as counterfactuals.

The probability of a leftist mayor being elected is a function of the vote difference between the winner and the runner-up and this function has a discontinuity at zero. As the vote difference approaches discontinuity, constituencies in which a left candidate wins by a small vote margin are increasingly similar to constituencies in which a right-wing individual wins by a small margin (Lee 2001; Pettersson-Lidbom 2001), making the experimental framework quasi-random.

3.2.1. Identification

Before proceeding with the RD robust estimates of the selected outcomes, we first test that the RD identifying assumptions hold in our sample.

3.2.1.1. McCrary (2008) test

First, we check whether the running variable, i.e., the winning margin, is continuous at the cut-off point 0. To do this, use McCrary test (McCrary 2008) for all three possible left winning margins, named *wmw*, *wmw_leftonly* and *wmw_workers*, in our full sample using a cut-off value 0. The McCrary test was, however, statistically significant ($p=0.0000$), suggesting possible manipulation of the running variable at the cut-off. The binomial test does not show a significant imbalance in observations near the threshold, so the issue may not be due to sample imbalance but rather the distribution's shape. Accordingly, we inferred that this RDD may be compromised due to potential manipulation at the threshold value 0. If individual units can manipulate the forcing variable winning margin to end up just above or below the threshold, the key RD assumption of local random assignment fails. This is possible because of the strategic voting, especially if the voting goes to the second round.

Brazil's electoral system is widely viewed as institutionally strong, yet research consistently highlights the persistence of vote buying and clientelism at the municipal level (Schaffer, 2007; Simpser, 2013). More generally, weaknesses in electoral integrity are closely associated with vote-buying practices that tend to target poorer populations. These practices

may include the tactical use of municipal programs for political gain, along with coercion or social pressure in tightly knit communities - particularly in remote areas where enforcement is limited and access is often river-based. Vote buying commonly operates through clientelist networks, involving direct exchanges of money or goods - such as food baskets, fuel, construction materials, healthcare services, transport, or access to public benefits. Local brokers, often community leaders, are central in distributing these resources and ensuring political support. Audit findings also point to lingering inconsistencies in voter registries, including entries linked to deceased individuals. While these issues largely reflect administrative shortcomings rather than systematic fraud (TCU, 2018), they can still create opportunities for marginal electoral manipulation, especially in closely contested Amazon constituencies, reflecting the interaction of strong economic incentives and weak institutional constraints (Pallier, 2018; Ruggiero et al., 2021). The adoption of electronic voting machines in 1996 reduced some traditional forms of fraud, but also introduced new vulnerabilities, such as ballot stuffing (Schneider, 2020). Given that mayors hold substantial authority over land titling, environmental licensing, and regulatory enforcement, even narrowly decided elections can shape access to significant rents from sectors such as deforestation, agriculture, and infrastructure. These incentives are reinforced by limited electoral oversight in many rural municipalities, where constrained judicial capacity allows more subtle forms of manipulation, including irregularities in ballots or voter rolls. At the same time, entrenched clientelist networks - often linked to control over jobs, welfare, and public resources - support the targeted mobilization of marginal voters.

Donut RD removes observations near the cut-off, where manipulation is most likely. Following Barreca et al. (2011), we therefore exclude observations with winning margins above -0.005 and below 0.005, and adopt a cut-off value of 0.01 to implement a donut regression. We then rerun the McCrary density test, which now does not indicate manipulation at the cut-off: the p-values are 0.8422 and 0.12 for *wmw_leftonly* and *wmw*, respectively, both exceeding the 0.05 threshold level of significance. This suggests no statistically significant discontinuity in the density of the running variable at the cut-off of 0.01, indicating the absence of manipulation for these two running variables. Furthermore, the binomial test does not reveal significant sorting around the cut-off. Overall, the RDD appears valid, with no evidence of manipulation at the threshold, allowing us to proceed confidently with the regression discontinuity design analysis. However, we discard the running variable *wmw_workers*, as the McCrary test for donut RD yields a p-value below 0.05 in this case, indicating potential manipulation at the 0.01 cut-off too - although the binomial test does not detect significant

sorting in this case. We also run the rddensity test for mayors in non-coalition governments, after excluding winning margins below 0.005 and above -0.005, and adopting a 0.01 cut-off for both left only mayors and left plus centre left mayors. These tests too confirm the validity of the RDD, with no significant manipulation detected at this threshold 0.01.

***Insert Figure 3 ***

Figure 3 (panels A1-A6) shows the histograms of the running variable after excluding the winning margin above -0.005 and below 0.005 (positive when a left party (left and centre-left or left only) mayoral candidate winning against a non-left party candidate and negative otherwise) in bins of 2 per cent. Panels A1, A3 and A5 show the cases of left plus centre-left Mayoral candidates, while panels A2, A4 and A6 show those for left only mayors. Overall, Figure 3 supports the continuity of the left party (left plus centre-left taken together) candidate's winning margin at the cut-off 0.01.

3.2.2. RD plots of outcome variables

Secondly, Figures 4a (panels A1–A4) and 4b (panels B1–B4) present the RD plots for levels of selected outcome variables: total area deforested (in square kilometres), annual change in deforested area (in square kilometres), total area reforested (in square kilometres), and annual environmental expenditure. The plots are respectively based on left-only and leftist (left plus centre-left) winning margins, using the revised cut-off value of 0.01 and a quadratic polynomial specification, using donut regression. We plot left-wing win margin on the horizontal axis. Positive win margin above 0.01 indicates that a left-wing mayoral candidate wins against a right-wing one; negative win margin below -0.01 indicates the opposite, i.e., a left-wing mayoral candidate loses against a right-wing one. We plot a lowess smoothing line for each of the selected outcomes on each side of the cut-off (indicated by the variable c) win margin 0.01 in each panel using quadratic polynomials.

*** Insert Figure 4a ***

*** Insert Figure 4b ***

In general, we observe a very small increase in area deforested (level or share) at $c=0.01$ when a left-wing mayoral candidate wins against a right-wing one in panels A1 and B1 in close elections. In contrast, there is a small reduction in area deforested (level or share) from last year when a left-wing mayoral candidate wins against a right-wing one (see panels A2 and B2) in close elections. Further, there is a very small positive effect on area reforested (panels A3

and B3), but significant increase in environmental expenses (panels A4 and B4) when a left-wing mayoral candidate wins against a right-wing one in close elections. As such, we observe the clearest treatment effect of leftist mayors on annual environmental expenses in our sample.

The pattern tells a consistent story: leftist mayors increase environmental spending but produce little significant improvement in deforestation or reforestation outcomes. This offers some initial support to our hypothesis that environmental expenditure functions as a political signal or administrative action within leftist mayors' control, while actual forest outcomes depend on forces beyond direct municipal authority - federal enforcement, commodity markets, and land tenure conflicts. The disconnect between spending and other deforestation/reforestation outcomes highlights the limits of local partisan politics in addressing structural environmental challenges in the Amazon.

3.2.3. Political fragmentation and win margin

A useful attribute of the RD design applied to Amazonian municipalities is that voter fragmentation across different candidates up for election leads to close elections over a wide range of underlying left party vote shares. This is illustrated in the first column of Figure 5, which shows the left party winning margin (the difference between the vote share for a left-wing mayoral candidate winning against a non-left runner-up candidate) against left party vote share on the horizontal axis.

*** Insert Figure 5 ***

Observations within 2 percentage points of the winning margin threshold at zero are shown in red. The diagonal line shows the hypothetical one-to-one relationship between the two variables. Observations close to the horizontal line marking the winning margin cut-off 0.01 vary from just under 2 per cent (with votes split across many candidates up for election) up to 50% (with votes more concentrated across fewer candidates up for election) of the total votes cast for a left party candidate. We get a very similar picture even when we consider mayoral candidates from left only parties winning against right-wing ones, as shown in the second column of Figure 5. We, therefore, conclude that the RD treatment effect is not singular to a specific preference point, but it is representative of a more heterogeneous constellation of political circumstances in our sample. This explicitly demonstrated an additional benefit pertaining to a core assumption of the RD design: left party preferences are continuous over the threshold defined by $c=0.01$.

3.2.4. *Balancing of the covariates*

While covariates are not strictly necessary for identification, inclusion of covariates in RD models improve precision, enable validity tests, and demonstrate robustness, thus strengthening the analysis.

So in addition to the model without covariates, we also run the models with covariates. In this context, we need to check that the treatment (leftist mayor winning against right wing candidates) has no effect on the covariates at the cut-off winning margin 0.01, and that the conditional expectations of potential outcomes and covariates are continuous at the cut-off.

The chosen covariates are the municipality's log(population), log(area in square kilometres), illiteracy rate among those aged 15 and over, share of indigenous population, share of male population, share of poor population, GDP from agriculture and cattle raising, if it is indigenous land, distance to the nearest transAmazon highway, and whether the municipality receives any oil royalties. We test the balance of these covariates around the cut-off at $c = 0.01$. Figures 6a and 6b (panels A–G) present these tests using quadratic polynomials, respectively, for left-only mayors winning or losing against right-wing candidates. Each panel plots a lowess smoothing line for each covariate on either side of $c = 0.01$, after excluding observations within the range $[-0.005, 0.005]$, where evidence of manipulation was found. Overall, the results confirm that the selected covariates are balanced around the cut-off at $c = 0.01$, regardless of the polynomial specification, except for indigenous population share, distance to the Transamazônica Highway and also GDP in agriculture and cattle raising. These two covariates are therefore excluded from the RD robust regressions discussed below.

*** Insert Figure 6a ***

*** Insert Figure 6b ***

There is some noise and outliers near the cutoff for indigenous population share variable, but not convincingly problematic; otherwise visual evidence largely supports covariate balance.

Since the McCrary test indicates no significant manipulation of the running variable - winning margin - at the 0.01 threshold, any observed discontinuity in outcomes can be attributed to the treatment (i.e., the election of a leftist mayor in narrowly decided contests against right-wing opponents). Additionally, there is sufficient number of observations near the cut-off, and observable covariates are well balanced on either side, supporting the assumption that units just above and below the threshold are otherwise comparable. Therefore, we adopt a sharp regression discontinuity design for our analysis.

3.3. RD Robust estimates

Having established that the identification conditions generally hold in our sample, we argue that the election of a leftist (against a rightist) mayor in a close election is likely to be random around the cut-off of 0.01 winning margin. The latter is guided by the McCrary test, which does not hold for the winning margin cut-off 0. Hence, we exclude observations above -0.005 and below 0.005, creating a “donut hole” and use a cut-off value 0.01 (see Barreca et al., 2011).

We obtain the robust Regression Discontinuity (RD) estimates (see Appendix 2 for further details) proposed by Calonico et al., (2014a; 2014b) that implements local polynomial RD point estimates with robust bias-corrected confidence intervals and inference procedures. The advantage here is that these estimates are robust to “large” bandwidth choices. This programme reports three different procedures: i) conventional RD estimates with a conventional variance estimator; ii) bias-corrected RD estimates with a conventional variance estimator; and iii) bias-corrected RD estimates with a robust variance estimator. Option (iii) remains our preferred estimates. Given that McCrary test does not hold for the winning margin cut-off 0, we exclude observations above -0.005 and below 0.005, creating a “donut hole” and use a cut-off value 0.01 for the rest of our analysis. Barreca et al. (2011) demonstrate that excluding a narrow band of data around the cut-off point 0 can reduce bias from sorting or heaping, provided sufficient bandwidth remains for estimation.

4. Empirical Findings

4.1. Effects of leftist mayors – full sample

Below we analyse the RD robust estimates of selected outcome variables pertaining to deforestation with and without covariates, which are balanced at the cut-off threshold 0.01. For each selected outcome, we provide estimates for mayors from left and centre left parties as well as those when mayors belong to left parties only. All estimates use optimal bandwidth only.

4.1.1. Effects on outcome levels -no covariates

Appendix 1 Table A3 shows the RD robust estimates of area deforested (panel a), annual change in area deforested (panel b), area reforested (panel c) and also the annual environmental

expenses (panel d) without any covariates for close elections of leftist Mayors (left and centre left as well as left only) against right wing candidates, using optimal bandwidth after dropping the observations in the neighbourhood $[-0.005, +0.005]$. Columns (1)-(3) show estimates for left and centre left parties taken together while column (4)-(6) show those for left only parties respectively using linear, quadratic and cubic polynomials. Including higher-order polynomials ensures that the functional form is flexible enough to capture any nonlinear trends near the cutoff and also that the estimates are robust. Evidently, close elections of leftist mayors are associated with a significant increase in the annual environmental expenses for both left only and left plus centre left mayors irrespective of the choice of polynomials. Although somewhat weaker, we also note a significant drop in area deforested for left and centre-left mayors taken together, which is not observed for left-only mayors though. Election of left-only mayors is, however, associated with annual drop in area deforested; however, no significant effect is note for the reforested area.

4.1.2. Effects on outcome levels -with covariates

We now move on to consider the RD robust estimates of selected outcome levels after including the covariates, as summarised in Table 3.

*** Insert Table 3 here ***

Table 3 estimates, different from Table A3, include the covariates, which help control for observable characteristics, increasing the efficiency and potentially reducing bias. The included covariates are: population size, geographic area, 15+ illiteracy rate, male population share, poor population share, GDP on agriculture and cattle raising, if it is a protected indigenous land, distance from transAmazon highway, if receives oil royalty share and if it is an election year. We drop the covariates that do not satisfy the balancing condition. At the cut-off 0.01 for left only mayors, there is a statistically significant drop in area deforested, annual changes in area deforested and also an increase in the expenditure on environment management, named $\ln(envxptot)$, for units just to the right of the cut-off compared to just to the left of the cut-off.

Most significant effect is seen for annual environmental expenses: close election of leftist mayors against right wing candidates is associated with a significant increase in annual environmental expenses irrespective of the choice of polynomials across columns 1-6. The coefficient of 2.3867 for determining environmental expenditure means a 238% increase in environmental expenditure (since it is log-transformed), assuming the treatment assignment happens at the threshold. The robust confidence interval $([0.69, 3.80])$ confirms the precision

of the estimate even after adjusting for potential bias and heteroskedasticity. We get similar results for left and centre-left party mayors taken together with a cubic polynomial.

The corresponding effects on various deforestation measures are relatively weaker. First, the estimated effect on area deforested is statistically significant and negative for left-only mayors in columns (5)-(6) using quadratic and cubic polynomials; impact of left and centre-left mayors taken together is significant only for quadratic polynomial in column (2) only. As far the size of the effect is concerned, it is smaller (-191.7 as against -393.7) for left and centre-left mayors relative to left only mayors while the mean value of area deforested is 937.5. Considering the effect on annual changes in area deforested in panel b, it is around -0.67 (i.e., $-11.8219/17.53$) of the mean value of annual changes in area deforested in the sample at the threshold value 0.01; but this effect is significant for left only mayors in column (6) when using cubic polynomial. The effect remains insignificant for other columns. No significant effect is, however, found on reforestation, regardless of the mayor's party affiliation.

Overall, mayors from purely leftist parties have a stronger impact on reducing deforestation than those from broader left or centre-left coalitions, likely due to fewer policy compromises. Leftist mayors of all types, however, significantly increase annual environmental expenses in our sample, as we hypothesized.

4.2. Effects of leftist mayors in non-coalition governments

4.2.1. Effects on outcome levels

About 37% of municipal governments in the dataset are governed by coalitions, which can blur the true impact of leftist mayors due to internal disagreements or compromises on issues like environment or deforestation. To better assess the effect of leftist leadership, we shall now focus only on municipalities led by non-coalition mayors, where leftist leaders are more likely to implement their policies without making compromises with coalition partners for survival.

*** Insert Table 4 here ***

First, there is confirmation of strong and significant effect of leftist mayors on environmental expenses in all columns 1-6, indicating higher environmental expenses irrespective of choice of polynomials as well as left-only or left and centre left mayors taken together. In particular, close elections of left only or left and centre-left mayors are associated with 158% to 176% increase in environmental expenses for non-coalition governments.

As before, the treatment effect of a leftist mayor is rather muted for various indices of deforestation in panels a-c of Table 4. Estimated treatment effect is generally negative for most

columns 1-6, but statistically significant only for left only mayors in columns (5) in panel a, indicating a drop in annual area deforested at the threshold; size of the effect is around 36% of the mean area deforested. For annual changes in area deforested in panel b, the effect is positive and statistically significant only among leftist mayors using quadratic polynomials, the size of the estimated coefficient being 12.7660, which is 63% of the mean change in area deforested using quadratic polynomial. Treatment effects, however, remain statistically insignificant for area reforested in all columns for non-coalition governments in our sample.

Estimates for round 1 elections only: Given that some mayoral elections in the Amazon go to second round, there may be more strategic voting at the second round. Hence, we also consider the treatment estimates for election round 1 only for non-coalition cases as a robustness test. This case satisfies the RD density test as per McCrary (2008). The corresponding RD robust estimates of selected outcomes are summarised in Appendix 1 Table A4. Evidently, these estimates are rather similar to those shown in Table 4 –a significant increase in environmental expenses (magnitude varying between 158%-177%) are noted at the threshold irrespective of whether a leftist or left only mayor is selected.

As before, the corresponding effect is rather sporadic for various deforestation outcomes. In particular, estimated treatment effect for area deforested is negative and significant only for leftist mayors in column (2) of panel a, using quadratic polynomials; Size of the estimated coefficient in this case is -455.934 for area deforested, which is around 48.9% of the mean area deforested. The corresponding effect for annual drop in area deforested is statistically significant for left only mayors in columns (4)-(5) in panel b where the size effect varies between 44%-63% of the mean.

4.2.2. Effects on outcome shares

Further, we construct various outcomes as share variables to check the robustness of the estimates of the outcome levels in Tables 3 and 4. In particular, we construct area deforested and reforested as share of total municipality area as well as total forest area, annual change in deforested area as share of total deforested area, and also environmental expenses as share of total municipality expenses. RD robust estimates of the impact of leftist mayor on outcome shares for non-coalition cases are summarised in Appendix 1. In particular, Table A5 shows the full sample estimates of outcome shares without covariates while Table A6 shows those with covariates for non-coalition cases.

While both sets of estimates are rather comparable, evidently the non-coalition estimates in Table A6 are stronger. Full sample estimates (Table A5) are statistically significant only for share of municipal area deforested and share of environmental expenses. However Table A6 estimates are more important in that these truly reflect the preferences of leftist mayors in non-coalition cases because they do not need to compromise with other party candidates.

We, therefore, focus on non-coalition estimates in Table A6. Consistent with earlier results, the strongest effects appear in panel (f), where close elections of both left-only and broader leftist mayors are associated with higher shares of annual environmental expenditure. As expected, the magnitude of these effects is smaller when using expenditure shares rather than total environmental spending, as reported in Table 4. There is no statistically significant impact of either left-only or leftist mayors on the rate of annual change in deforested area (panel c) and the shares of reforested area (panels d and e). However, in close elections, the victory of left-only mayors is associated with a significant reduction in deforested area as a share of total municipal area in columns 2 and 3, with a similar effect observed for leftist mayors in column 4 of panel (a). Panel (b), which examines deforestation relative to total forest area, shows significant negative effects only in column 1 for left-only mayors and in column 6 for leftist mayors. Interestingly, a positive and statistically significant effect for leftist mayors appears in column 4 when using a linear specification. In other words, effects of close election of leftist mayors on various deforestation and reforestation outcome shares appear rather irregular in our sample .

Further Appendix 1 Table A7 shows the estimates of selected outcome shares for election round 1 in non-coalition cases. As before, these estimates are rather similar to those shown in Appendix 1 Table A6: significant negative treatment effects are only observed for area deforested (as share of total municipal area or forest area) when a leftist mayor is elected in close elections; we also observe some irregularities in this respect. We also note significant positive effects on for annual environmental expenses shares, as before. No significant effect is found in panel c, d and e though.

Overall, left-leaning mayors are associated with significantly higher shares of environmental spending and, on balance, lower deforestation, though the results for deforestation shares are somewhat uneven. The effects are generally more muted when outcomes are expressed as proportions of total levels.

4.3. Treatment Effects when a leftist Mayor wins/loses against right-wing one

So far, we have considered the estimates for all candidates in the full sample or the non-coalition sample. We now re-estimate all the outcomes for the subsample where a leftist mayoral candidate wins/loses against a right-wing candidate. Naturally, the sample size drops significantly here. Appendix 1 Table A8 shows these RD robust estimates for area deforested, annual change in area deforested and annual environmental expenses; reforestation is excluded due to insignificant effects. Panel a shows the estimates for left only mayors while panel b shows those for left and centre-left mayors taken together. Naturally some covariates drop because of multicollinearity in a smaller sample. Even when the sample size falls significantly, there is confirmation that the close election of a left only mayor is associated with statistically significant increases in environmental expenses, which has been consistently observed in all specifications. Similar effect is not observed for left and centre-left mayors taken together in this significantly smaller subsample. The effect on area deforested, although still negative, fails to be statistically significant in this smaller sub-sample.

4.5. Underlying mechanisms

In this section, we explore the possible mechanisms in operation to explain the key results.

4.5.1. Mechanism 1

Typically, municipalities governed by the left tend to have a notably higher percentage of indigenous population, who are more likely to care about conserving the Amazon. Referring to Table 1, it is possible to verify a significant positive association between the presence of indigenous population (level or share) and the share of votes for left-only (column 1), left and centre-left (column 2) and workers' (column 3) parties. Table 2 further shows the positive and statistically significant association between the share of elected *indigenous* members and the likelihood of having a leftist mayor. Finally, panel a of Table 5 shows a positive and significant association between voter turnout and leftist vote share, highlighting that leftist electoral success is closely tied to higher voter participation, possibly arising from leftist campaign strategies and/or redistributive or progressive policies, often associated with leftist platforms, especially in areas dominated by indigenous population. All this evidence underscores the importance of accountability of leftist Mayors in meeting the needs of their constituents, especially the indigenous ones, in the legal Amazon region of the country.

*** Insert Table 2 here ***

*** Insert panel a Table 5 here ***

*** Insert panel c, Table 5 here ***

Further panel c of Table 5 shows the RD robust effects of close election of leftist mayors on local employment and local revenue share. Columns (1)-(3) show estimates of an index of local employment and income (`employ_inco`) while columns (4)-(6) show those for share of local revenue in total municipal revenue (`shlocalrev`), respectively using polynomials 1, 2, 3 for left only mayors in non-coalition governments. The employment and income component of the FIRJAN Municipal Development Index (IFDM) is a municipal-level indicator that measures local economic conditions and labour market performance across Brazilian municipalities using official administrative data, primarily from Brazil's Ministry of Labor databases such as RAIS and CAGED. The methodology is standardized for all municipalities and updated annually. The index ranges from 0 to 1, with higher values indicating better socioeconomic performance in terms of employment and income conditions. Second, local revenue refers to municipality's own source of revenue from taxes on local properties and services as share of total municipal revenue which also includes transfers from federal and provincial governments including oil royalties.

Evidently, close election of left only mayors is associated with significant increase income/employment index as well as significantly higher share of local revenue in non-coalition governments, thus enhancing their prosperity and strengthening accountability to their electorates. First, closer elections of leftist mayors can lead to targeted improvements in income and employment, especially through local development initiatives, labour-oriented policies, or better delivery of public services. Second, the observed increase in the share of locally generated revenue points to greater fiscal effort and administrative engagement. Rather than relying predominantly on intergovernmental transfers, these mayors appear more inclined to mobilise local tax bases, improve compliance, and/or expand formal economic activity, enabling them to allocate higher share of municipality revenue towards environmental management. Taken together, these patterns suggest a mechanism: electoral competition plus policy autonomy of leftist mayors lead to stronger local development and accountability in decentralised municipalities.

4.5.2. Mechanism 2

Appendix Figure A1, panel a, illustrates a strong correlation between the level of lagged deforestation and the support for leftist (left and centre-left) candidates. This relationship is

reaffirmed in Table 5, panel b estimates, indicating that voters react to lagged deforestation by favouring leftist mayoral candidates, thus resulting in higher vote shares of leftist parties in the following election as in columns 1-3. In essence, electoral democracy serves as a potential mechanism through which leftist mayors are more likely to be elected in regions with higher levels of deforestation in the legal Amazon area with a greater share of the indigenous population.

***Insert panel b of Table 5 here ***

As the Chief Executives of their municipalities, elected leftist mayors can serve their constituents in multiple ways. Beyond adopting redistributive policies, they can actively foster deforestation-free practices among local businesses by enforcing strict sourcing guidelines that require suppliers to demonstrate sustainable practices. This not only enhances corporate responsibility but also aligns with growing consumer demands for ethical and environmentally friendly products. Furthermore, they can invest in reforestation initiatives, supporting tree planting and ecosystem restoration projects that are essential for mitigating deforestation and its harmful effects.

4.6. Heterogeneous impact

The study explores whether the impact of left-only mayors on deforestation and environmental spending varies across different contexts. It analyzes differences based on election years, proximity to the Transamazônica Highway, and mayor's political alignment with the President among left-only mayors where we see stronger impacts. Results (summarized in Table 6) cover deforested area, annual changes in deforestation, and environmental expenses using various polynomial models in columns 1-6 respectively using linear and quadratic polynomials. Reforestation results are excluded due to insignificant effects throughout. All estimates follow the same methodology as the baseline analyses.

*** Insert panels a and b of Table 6 here ***

A comparison between panels a and b of Table 6 underscores the differential impacts of left-only mayors in election and non-election years. We observe significant impact on environmental expenses in both election and non-election years though the size of the effect is larger in election years. Difference arises with respect to deforestation outcomes. During election years, the treatment effects on area deforested are consistently positive and statistically

significant irrespective of choice of polynomials. This aligns with findings from electoral studies (e.g., List and Sturm, 2006), which suggest that populist leaders may offer or promise forested land to gain the support of influential stakeholders during campaigns. In contrast effect of leftonly mayors on deforestation is negative and weakly significant in both periods. The Transamazônica Highway is a long highway that connects the Amazon rainforest and enables one to transport products from the Amazon rainforest in Brazil.

Insert panels c and d of Table 6 here *

Panel c shows estimates for municipalities located farther away from the highway (>median distance), while panel d shows those located near the highway (being less than or equal to the median distance).

These robust estimates reveal that the presence of a leftonly mayor at the winning margin threshold does not lead to a statistically significant reduction in deforested area or its change in municipalities located farther from the Transamazônica Highway (i.e., beyond the median distance). Conversely, for municipalities situated closer to the highway (within the median distance), the treatment effect on area deforested is positive and statistically significant (see column 2), indicating a higher likelihood of encroachment in these municipalities, which are easily accessible. However, no notable difference is observed in the impact of left-only mayors on environmental spending across these distance-based subsamples- we observe statistically significant effect of close election of left only mayor on environmental expenses in both cases.

*** Insert panels e and f of Table 6 here ***

Panels e and f of Table 6 show the RD robust estimates of selected outcomes for close elections of leftist Mayors in aligned (panel e) and non-aligned (panel f) municipalities. In aligned municipalities (panel e), the mayor and the President are from the same party, which does not hold for non-aligned municipalities. The underlying idea is to test whether alignment with the President strengthens the leftist mayors' ability to tackle deforestation at the local level. In aligned municipalities, narrowly elected left-only mayors are associated with significantly higher deforestation, alongside a decline in the annual rate of deforestation. By contrast, in non-aligned municipalities, the increase in deforestation is smaller and not accompanied by any reduction in its rate. Non-aligned mayors enjoy greater autonomy and may often face fewer pressures to support federal pro-development or pro-agribusiness agendas. They may use environmental protection to build local legitimacy, attract support from

NGOs and indigenous groups, and differentiate themselves politically from the central government. In both settings, however, the election of left-only mayors leads to higher environmental spending, with the effect being stronger in aligned municipalities. This is because non-aligned independent mayors may have weaker access to federal resources, which is the primary source of funding municipal activities..

Overall, non-aligned left-leaning mayors tend to be more effective at reducing deforestation though environmental spending can be relatively higher in aligned municipalities. These results reflect the broader tension between local environmental governance and national political-economic interests in the Brazilian Amazon.

5. Concluding comments

The analysis shows that Brazil's political left is generally better positioned than the right to confront deforestation in the Legal Amazon, reflecting its longstanding commitments to workers, indigenous communities, and low-income populations. Using data from 760 Legal Amazon municipalities and a regression discontinuity design centered on close elections, the study finds that leftist mayors reliably increase environmental spending always and, in some cases, succeed in reducing deforestation, though these reductions are not consistent across all contexts. Their actions do not produce measurable gains in reforestation.

The effects of leftist mayors on tackling deforestation are strongest where mayors govern without coalition partners or tight fiscal constraints. Their influence is also more pronounced in municipalities located farther from the Transamazônica Highway, in non-election years, and when not aligned with the federal government. Democratic dynamics matter: municipalities with larger indigenous populations or higher levels of deforestation are more likely to elect leftist mayors, reinforcing incentives to address environmental degradation. Leftist mayors too reciprocate by enhancing efforts to boost local revenue and local employment and income.

Nevertheless, the institutional resilience demonstrated despite the environmental rollbacks of the Bolsonaro administration, coupled with the renewed federal commitments under the Lula administration, presents a critical opportunity to fortify Amazonian conservation. Ultimately, municipal executives can effectively curb deforestation if provided with adequate authority, financial resources, institutional protection, and political incentives. While decentralization presents challenges, expanding the fiscal capacity and administrative autonomy of local governments remains vital for safeguarding the Amazon. Though grounded

in the Brazilian context, these insights offer broader implications for leveraging subnational governance to strengthen environmental policy globally.

Cumulatively, these findings highlight a "political paradox" in environmental governance. Although electorates in high-risk regions frequently elect environmentally oriented candidates, these local executives face profound structural and macroeconomic pressures - predominantly local demand for agricultural expansion - that constrain their ability to curb forest loss despite increased budgetary allocations for environmental management. Consequently, this paper suggests that while local leadership possesses the potential to advance conservation, decentralized governance is not an absolute panacea. Without policy interventions that target the broader economic drivers of deforestation, well-intentioned local politicians will struggle to achieve durable ecological outcomes.

Nevertheless, the institutional resilience demonstrated despite the environmental rollbacks of the Bolsonaro administration, coupled with the renewed federal commitments under the Lula administration, presents a critical opportunity to fortify Amazonian conservation. Ultimately, municipal executives, especially leftist ones, can effectively curb deforestation if provided with adequate authority, financial resources, institutional protection, and political incentives. While decentralisation alone is insufficient, expanding the fiscal capacity and administrative autonomy of local governments remains vital for safeguarding the Amazon. Although focused on Brazil, these insights offer broader implications for understanding how local political ideology may shape environmental governance and conservation outcomes in other countries.

References

Abessa, D., A. Fama and L. Buruaem. (2019) The systematic dismantling of Brazilian environmental laws risks losses on all fronts, *Comment, Nature ecology & evolution* Vol 3: 510–511 .

Almeida, C. A. D., Coutinho, A. C., Esquerdo, J. C. D. M., Adami, M., Venturieri, A., Diniz, C. G., ... and Gomes, A. R. (2016). High spatial resolution land use and land cover mapping of the Brazilian Legal Amazon in 2008 using Landsat-5/TM and MODIS data. *Acta Amazonica*, 46, 291-302.

Baragwanath, K., and Bayi, E. (2020). Collective property rights reduce deforestation in the Brazilian Amazon. *Proceedings of the National Academy of Sciences*, 117(34), 20495-20502.

Barreca, A. I., M. Guldi, J. M. Lindo, and G. R. Waddell (2011): “Saving babies? Revisiting the effect of very low birth weight classification,” *Quarterly Journal of Economics*, 126, 2117–2123.

Bolognesi, Ribeiro, Codato (2023) A New Ideological Classification of Brazilian Political Parties, *DADOS*, Rio de Janeiro, vol.66 (2): e20210164, 2023.

Boucher, D., S. Roquemore, E. Fitzhugh. 2013. “Brazil’s Success in Reducing Deforestation”, *Tropical Conservation Science*.

Bratton, K. A., and Ray, L. P. (2002). Descriptive representation, policy outcomes, and municipal day-care coverage in Norway. *American Journal of Political Science*, 428-437.

Brollo, F., T. Nannicini, R. Perotti and G. Tabellini. 2013. The Political Resource Curse, *American Economic Review* 103(5)

Brooks, Clem. 1994. Class Consciousness and Politics in Comparative Perspective. *Social Science Research* 23(2): 167–95

Brown, Gardner M. Renewable Natural Resource Management and Use without Markets. *Journal of Economic Literature* 38, no. 4 (2000): 875–914.

Burgess, R., M. Hansen, B. Olken, P. Potapov and S. Sieber. (2012) The Political Economy of Deforestation in the Tropics, *Quarterly Journal of Economics*.

Calonico, S., M. Cattaneo and R. Titunik. (2014a). Robust nonparametric confidence intervals for regression-discontinuity designs. *Econometrica* 82: 2295–2326.

Calonico, S., M. Cattaneo and R. Titunik. (2014b) Robust data-driven inference in the regression-discontinuity design, *The Stata Journal* 14(4): 909–946

Campbell, J. E. (1992). Forecasting the presidential vote in the states. *American Journal of Political Science*, 386-407.

Campbell, J. E. (1996). Polls and votes: the trial-heat presidential election forecasting model, certainty, and political campaigns. *American Politics Quarterly*, 24(4), 408-433.

Carnes, Nicholas. 2012. Does the Underrepresentation of the Working Class in Congress Matter? *Legislative Studies Quarterly* 37(1): 5–34.

Carnes, Nicholas. 2013. *White-Collar Government: The Hidden Role of Class in Economic Policy Making*. Chicago: University of Chicago Press.

Carnes, N. and N. Lupu. (2015) Rethinking the Comparative Perspective on Class and Representation: Evidence from Latin America, *American Journal of Political Science* 59(1): 1-18.

Chiplunkar, G., and S. Das. (2025). “Decentralising the Development–Conservation Trade-off: Evidence from Forestland Diversions in India.” *STEG: Growth Research Platform Policy Brief*.

Cisneros, E., Zhou, S. L., & Börner, J. (2015). Naming and shaming for conservation: evidence from the Brazilian Amazon. *PloS one*, 10(9), e0136402.

Cotofan, M., Kuralbayeva, K., and Matakos, K. (2024). Global warming cools voters down: how climate concerns affect policy preferences.

Cunha, Manuela Carneiro da. Índios na Constituição. (2018) *Novos estudos CEBRAP* 37, no. 3: 429-443. <http://dx.doi.org/10.25091/S01013300201800030002>

Dasgupta, Partha, and Heal, G. (1974) The Optimal Depletion of Exhaustible Resources. *The Review of Economic Studies* 41: 3–28. <https://doi.org/10.2307/2296369>.

Dasgupta, P. (1982) *The Control of Resources* (Cambridge, MA: Harvard University Press).

Demange, G., and Van der Straeten, K. (2020). Communicating on electoral platforms. *Journal of economic behavior & organization*, 174, 402-419.

Dunlap, R. E., Xiao, C., & McCright, A. M. (2001). Politics and environment in America: Partisan and ideological cleavages in public support for environmentalism. *Environmental politics*, 10(4), 23-48.

Evans, Geoffrey. (2000) The Continued Significance of Class Voting. *Annual Review of Political Science* 3: 401–17.

Ferreira, Fernando, and João Rocha. (2020). “Political Turnover and Deforestation in the Brazilian Amazon.” *Environmental Research Letters*, 15(8): 084030.

Gelman, A. and G. Imbens. (2018) Why High-Order Polynomials Should Not Be Used in Regression Discontinuity Designs, *Journal of Business and Economic Statistics*: 447-456. <https://doi.org/10.1080/07350015.2017.1366909>

Korpi, Walter. (1983) *The Democratic Class Struggle*, London: Routledge.

Lima M., Vale J.C.E., Costa G.M., Santos R.C., Correia Filho W.L.F., Gois G., Oliveira-Junior J.F., Teodoro P.E., Rossi F.S., and C.A. Silva Junior (2020). The forests in the indigenous lands

in Brazil in peril, *Land Use Policy*, v.90, 104258, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2019.104258>.

Lee, D. S. (2001). The Electoral Advantage to Incumbency and Voters' Valuation of Politicians' Experience: A Regression Discontinuity Analysis of Elections to the US..

List, J.A., D.M. Sturm. (2006) How elections matter: theory and evidence from environmental policy, *Quarterly Journal Economics*, 121: 1249-1281.

Lupu, Noam, and Susan C. Stokes. (2009) “The Social Bases of Political Parties in Argentina, 1912–2003.” *Latin American Research Review* 44(1): 58–87.

Manza, Jeff, Michael Hout, and Clem Brooks. (1995) Class Voting in Capitalist Democracies since World War II: Dealignment, Realignment, or Trendless Fluctuation? *Annual Review of Sociology* 21: 137–62.

McCrary, J. (2008) Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test, *Journal of Econometrics* 142: 698-714.

Medina, S., G. Moromizato and M. Barron. 2020. Deforestation and Re-elected Local Authorities: Evidence from Peru, paper presented at the NEUDC 2020.

Neumayer, E. (2004). The environment, left-wing political orientation and ecological economics. *Ecological economics*, 51(3-4), 167-175.

Pailler, S. (2018) Re-election incentives and deforestation cycles in the Brazilian Amazon, *J. Environ. Econ. Manag.*, 88 : 345-365.

Papp, Z. (2022). Environmental attitudes, environmental problems and party choice. A large-N comparative study. *Political Geography*, 97, 102652.

Pailler, S. 2018. Re-election incentives and deforestation cycles in the Brazilian Amazon, *Journal of Environmental Economics and Management* 88: Pages 345-365

Pettersson-Lidbom, P. (2008). Do parties matter for economic outcomes? A regression-discontinuity approach. *Journal of the European Economic Association*, 6(5), 1037-1056.

Rodrigues-Filho, S, R. Verburg, M. Bursztyn, D. Lindoso, N. Debortoli, A.M.G. Vilhena. (2015) Election-driven weakening of deforestation control in the Brazilian Amazon, *Land Use Policy*, 43: 111-118

Ruggiero, P.G.C., A. Pfaff, E. Nichols, M. Rosa, J. P. Metzger. 2021. “Election cycles affect deforestation within Brazil’s Atlantic Forest”. *Conservation Letters*. DOI: 10.1111/conl.12818

Samuelson, Paul. (1976) Economics of forestry in an evolving society. *Economic Inquiry*, 14 (Dec), pp. 466–492.

Schaffer, F. C. (2007). *Elections for Sale: The Causes and Consequences of Vote Buying*. Lynne Rienner.

Schneider, R. 2020. “Free or Fair Elections? The Introduction of Electronic Voting in Brazil”, *Economia*, Fall.

Simpser, A. (2013). *Why Governments and Parties Manipulate Elections*. Cambridge University Press.

Tribunal de Contas da União (2018). *Auditoria no Cadastro Eleitoral Brasileiro*. Acórdão nº 2.522/2018 – Plenário.

Stavins, Robert N. (2011) The Problem of the Commons: Still Unsettled after 100 Years. *American Economic Review*, 101 (1): 81-108. DOI: 10.1257

Schakel, W., and Burgoon, B. (2022). The party road to representation: Unequal responsiveness in party platforms. *European Journal of Political Research*, 61(2), 304-325.

Simorangkir, D. (2007). Fire use: is it really the cheaper land preparation method for large-scale plantations?. *Mitigation and adaptation strategies for global change*, 12(1), 147-164.

West, T. A., and Fearnside, P. M. (2021). Brazil’s conservation reform and the reduction of deforestation in Amazonia. *Land use policy*, 100, 105072.

Van der Ploeg, F. (2011) Natural Resources – Curse or Blessings, *Journal of Economic Literature* 49(2).

Webb, J. (2019) “Indigenous led conservation in the Amazon- A win-win solution”, *Amazon Frontlines* <https://amazonfrontlines.org/chronicles/indigenous-conservation-amazon/>

Tables

Table 1. Association between Indigenous population and the likelihood of a leftist mayor

VARIABLES	(1) Left+centreleft	(2)	(3) Leftonly	(4)	(5) Workers'party	(6)
Indig pop/10000	0.100*** (0.0218)		0.0750*** (0.0212)		0.0253 (0.0191)	
Share of indig pop		0.00108** (0.000434)		0.000847** (0.000421)		0.000606 (0.000390)
Constant	0.236*** (0.00361)	0.238*** (0.00364)	0.193*** (0.00337)	0.195*** (0.00340)	0.164*** (0.00315)	0.164*** (0.00317)
Observations	15,160	15,160	15,160	15,160	15,160	15,160
R-squared	0.002	0.000	0.001	0.000	0.000	0.000

Note: The table reports the likelihood of having a leftist mayor- columns (1)-(2) show the estimates of the likelihood of having a mayor from left plus centre-left (leftparty) parties, columns (3)-(4) that of left only party and columns (5)-(6) those from workers' parties. Row (1) shows the estimate of indigenous population (as a share of 10000), row (2) shows that of indigenous population as share of total municipality population. Standard errors are clustered at the municipality level and shown in the parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Table 2. Association between elected indigenous members and the likelihood of leftist Mayor

VARIABLES	(1) Leftonly	(2) Left+centre-left	(3) Workers' party
Elected indigenous members 2016	0.0450*** (0.00701)	0.0482*** (0.00755)	0.0260*** (0.00656)
Intercept	0.193*** (0.00327)	0.237*** (0.00352)	0.163*** (0.00306)
Observations	15,200	15,200	15,200
R-squared	0.003	0.003	0.001

Note: The table reports the likelihood of having a leftist mayor as function of number of elected indigenous members - columns (1)-(3) respectively show the estimates of the likelihood of having a mayor from left only, left plus centre-left and worker's party. Standard errors are clustered at the municipality level and shown in the parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Table 3. RD robust estimates of outcome levels - with covariates, all cases

	Left & centre-left			Left only		
Polynomial	(1)	(2)	(3)	(4)	(5)	(6)
	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
Panel a	Area deforested in sq km (Mean: 936.4862)					
Robust	-62.9118	-191.6974**	-124.4909	-85.9283	-393.7249***	-337.2491***
(t-stat)	(58.613)	(95.070)	(93.173)	(57.828)	(109.301)	(108.561)
Panel b	Annual change in area deforested in sq km (Mean: 17.9351)					
Robust	2.4868	2.4479	-4.8174	0.6121	-9.2090	-11.8219*
(t-stat)	(4.692)	(5.454)	(5.435)	(5.466)	(6.043)	(6.868)
Panel c	Area reforested in sq km (Mean: 0.642066)					
Robust	2.6062	2.7775	2.9178	3.2969	3.8348	4.0021
(t-stat)	(2.949)	(3.613)	(3.754)	(3.484)	(5.083)	(5.720)
Panel d	Log(Annual environmental expenses) (Mean: 5.0138)					
Robust	2.0082***	2.2566***	2.3867***	1.9575***	2.3396***	2.3867***
(t-stat)	(0.575)	(0.717)	(0.812)	(0.582)	(0.793)	(0.812)
Other covs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6667	6667	6667	6667	6667	6667

The table shows the RD robust estimates (with optimal bandwidth) of shares of total municipal area deforested (panel a), shares of total forest area deforested (panel b), rate of annual change in area deforested (panel c), share of total municipal area reforested (panel d), share of total forest area reforested (panel e) and also share of total municipal expenses on environment (panel f) for close elections of leftist Mayors (various proxies) using optimal bandwidth for $-0.005 < \text{winning margin} < 0.005$ after dropping the cases of coalition governments. Columns (1)-(3) show estimates for left and centre-left cases while column (4)-(6) show those for left only mayors elected in close elections, respectively using linear, quadratic and cubic polynomials. Included covariates are: population size, geographic area, 15+ illiteracy rate, male population share, municipality considered as extremely poor, GDP agriculture and cattle raising, if protected indigenous land, distance from Amazon highway, if receives oil royalty share and if it is an election year. Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1,5 and 10 percent levels, respectively.

Table 4. RD robust estimates of outcome levels, with covariates, non-coalition cases

	Left & centre-left			Left only		
	(1)	(2)	(3)	(4)	(5)	(6)
Polynomial	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
Panel a	Area deforested in sq km (Mean: 949.5998)					
Robust	12.6201	-19.7810	25.5053	-16.0101	-342.7226***	17.2512
(t-stat)	(61.877)	(86.611)	(84.856)	(50.422)	(82.631)	(76.180)
Panel b	Annual change in area deforested in sq km (Mean: 20.15925)					
Robust	8.2678	12.7660**	4.4280	5.2782	-5.1212	-2.2783
(t-stat)	(5.099)	(5.897)	(5.809)	(5.982)	(7.394)	(7.481)
Panel c	Area reforested in sq km (Mean: 0.3992732)					
Robust	2.6746	3.6733	4.0050	3.8794	4.5011	4.8294
(t-stat)	(2.769)	(4.268)	(4.789)	(3.876)	(5.160)	(5.605)
Panel d	Log(Annual environmental expenses) (Mean: 4.521305)					
Robust	1.5822***	1.7531**	1.7469**	1.5783***	1.7674**	1.7469**
(t-stat)	(0.596)	(0.687)	(0.802)	(0.608)	(0.786)	(0.802)
Other covs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6667	6667	6667	6667	6667	6667

The table shows the RD robust estimates (with optimal bandwidth) of shares of total municipal area deforested (panel a), shares of total forest area deforested (panel b), rate of annual change in area deforested (panel c), share of total municipal area reforested (panel d), share of total forest area reforested (panel e) and also share of total municipal expenses on environment (panel f) for close elections of leftist Mayors (various proxies) using optimal bandwidth for $-0.005 < \text{winning margin} < 0.005$ after dropping the cases of coalition governments. Columns (1)-(3) show estimates for left and centre-left cases while column (4)-(6) show those for left only mayors elected in close elections, respectively using linear, quadratic and cubic polynomials. Included covariates are: population size, geographic area, 15+ illiteracy rate, male population share, municipality considered as extremely poor, GDP agriculture and cattle raising, if protected indigenous land, distance from Amazon highway, if receives oil royalty share and if it is an election year. Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Table 5. Underlying Mechanisms

Panel a:			
Mechanism 1	(1)	(2)	(3)
VARIABLES	voteshare leftparty	voteshare leftonly	voteshare workers
ln(turnout)	0.0581*** (0.00722)	0.0521*** (0.00449)	0.128*** (0.0185)
Year dummies	Yes	Yes	Yes
Observations	13,804	14,188	14,188
R-squared	0.028	0.036	0.084

Panel b:			
Mechanism 2	(1)	(2)	(3)
VARIABLES	voteshare leftparty	voteshare leftonly	voteshare workers
lag(lndeforested)	0.00466*** (0.00178)	0.00495*** (0.00174)	0.00513*** (0.00174)
Intercept	0.0410*** (0.0103)	0.0242** (0.00950)	0.0519*** (0.0104)
Observations	14,312	14,188	14,188
R-squared	0.025	0.029	0.051

This table shows the results in favour of Mechanism 1 and Mechanism 2. Columns (1)-(3) of the upper panel show the estimates of ln(turnout) on the likelihood of having a leftist mayor while columns (1)-(3) of the bottom panel show the estimates of one period lagged value of log(deforested area) on leftist vote shares. Leftparty is a binary variable indicating if the mayor is from left and centre-left parties; leftonly is a binary variable indicating if the mayor is from left parties only while worker's party is another binary variable indicating if the mayor is from the workers' parties. These binary variables are 0 otherwise. Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Panel C. Mechanism 3: Effect of leftist mayors on local employment and local revenue

	employ_inco	employ_inco	employ_inco	shlocalrev	shlocalrev	shlocalrev
Robust	0.0358*** (0.00926)	0.0412*** (0.0154)	0.0356* (0.0187)	0.0270** (0.0128)	0.0218 (0.0144)	-0.00607 (0.0154)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,537	6,537	6,537	6,664	6,664	6,664

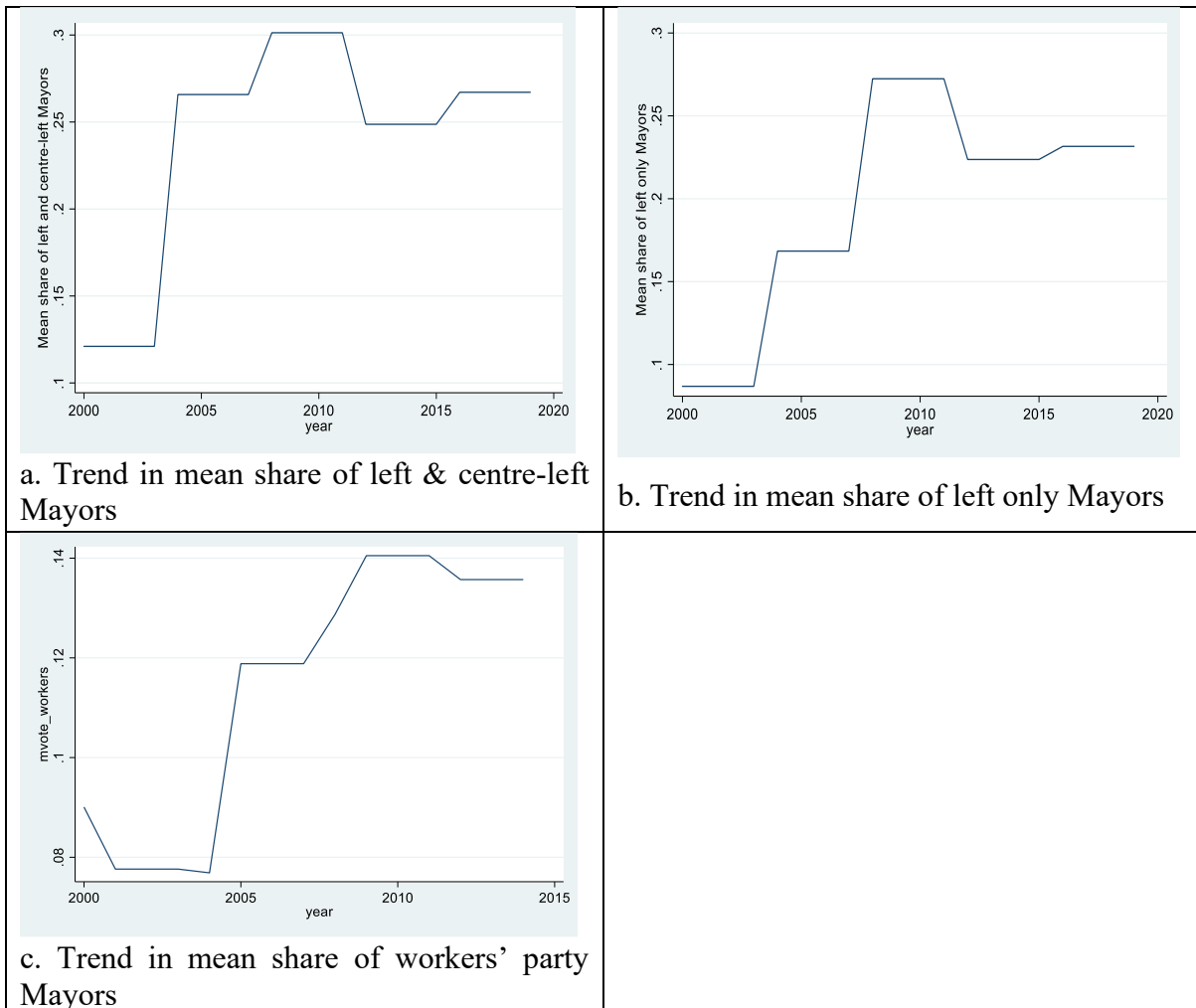
Panel c shows RD robust effects of close election of leftist mayors on local employment and local revenue. Columns (1)-(3) show estimates of an index of local employment and income (employ_inco) while columns (4)-(6) show those for share of local revenue in total municipal revenue (shlocalrev), respectively using polynomials 1, 2, 3 for left only mayors in non-coalition governments. We include the same set of covariates as in Table 3. Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Table 6. Heterogeneous impact of left only Mayors

VARIABLES `	(1) Area deforested		(3) Annual change in area deforested		(5) Environmental Expenses	
	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
(a) elec_year=0						
Robust	-3.453	170.6	-19.77**	-14.85	3.408**	3.965*
	(211.2)	(328.7)	(8.587)	(16.10)	(1.594)	(2.254)
Observations	2,369	2,369	2,369	2,369	2,369	2,369
(b) elec_year=1						
Robust	425.9***	664.0***	-3.733	-18.28*	1.736**	2.656**
	(127.2)	(188.5)	(6.368)	(10.59)	(0.755)	(1.201)
Observations	6,382	6,382	6,382	6,382	6,382	6,382
(c) distance from transamazon highway>Median						
Robust	50.28	40.73	-6.037	-10.44	2.692***	2.615***
	(102.8)	(106.7)	(6.741)	(9.182)	(0.763)	(0.958)
Observations	4,381	4,381	4,381	4,381	4,381	4,381
(d) distance from transamazon highway<=Median						
Robust	50.28	1,147***	-0.108	-15.48	1.843**	3.221**
	(102.8)	(138.9)	(6.432)	(11.48)	(0.730)	(1.294)
Observations	4,370	4,370	4,370	4,370	4,370	4,370
(e) Mayor & President aligned						
Robust	234.4*	267.9*	-31.17***	-37.01***	3.300***	2.865**
	(122.3)	(145.0)	(9.296)	(13.24)	(1.141)	(1.310)
Observations	976	976	976	976	976	976
(f) Mayor & President non-aligned						
Robust	167.5*	351.1	-0.681	-27.38*	1.743**	3.260**
	(97.22)	(230.8)	(6.385)	(14.16)	(0.733)	(1.465)
Observations	7,775	7,775	7,775	7,775	7,775	7,775

The table shows the RD robust estimates of area deforested, annual change in deforested area since last year and environmental expenses for close elections of left only mayors, when left only mayors are elected against right wing candidates in close elections using optimal bandwidth. The table shows the estimates for election year (panel a), non-election years (panel b), distance from the TransAmazon highway being greater than median (panel c), distance from the TransAmazon highway being less than or equal to median (panel d), mayor's party is aligned with the President's party (panel e) and mayor's party non-aligned with President's party (panel f). Columns (1)-(2) show estimates for area deforested, columns (3)-(4) show estimates for annual changed in area deforested and columns (5)-(6) show those for ln(environmental expenses) respectively using linear and quadratic polynomials . All estimates use optimal bandwidth. All regressions also include covariates: population size, geographic area, 15+ illiteracy rate, male population share, if it is a protected indigenous land, distance from transAmazon highway, if receives oil royalty share and if it is an election year (the latter is dropped in panels c and d). Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Figure 1. Trend in the share of left-leaning Mayors



b. Trend in mean share of left only Mayors



Figure 2. Trends in deforested area, change in deforested areas and environmental expenses in the Brazilian Amazon

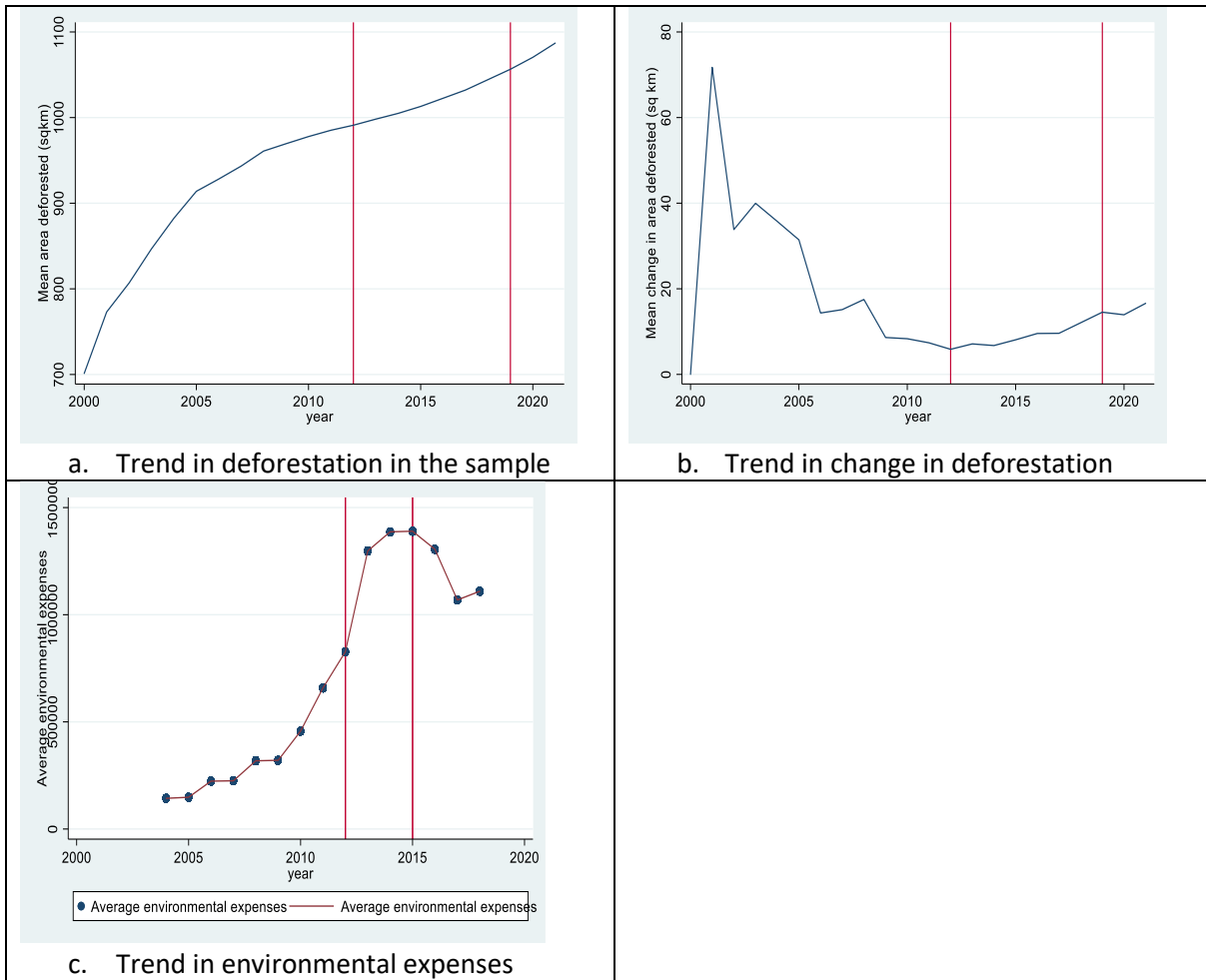


Figure 3. Distribution of leftist Mayoral winning margin, full sample

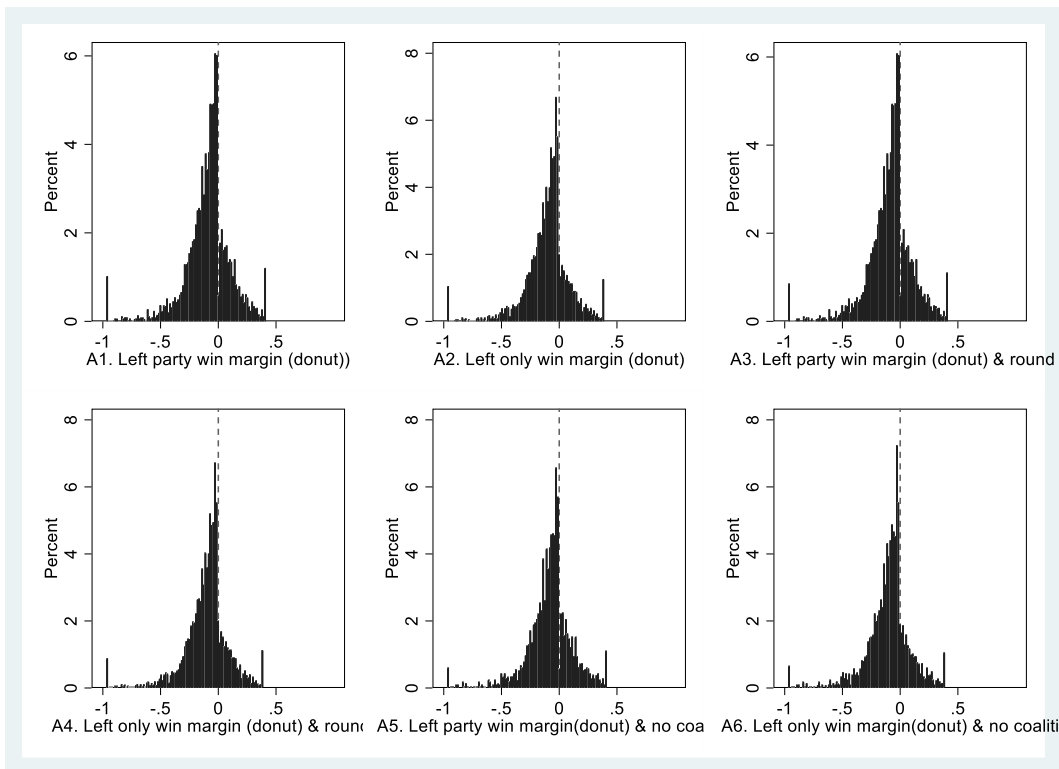


Figure 4a. RD plot of deforestation/reforestation outcomes – left only Mayors

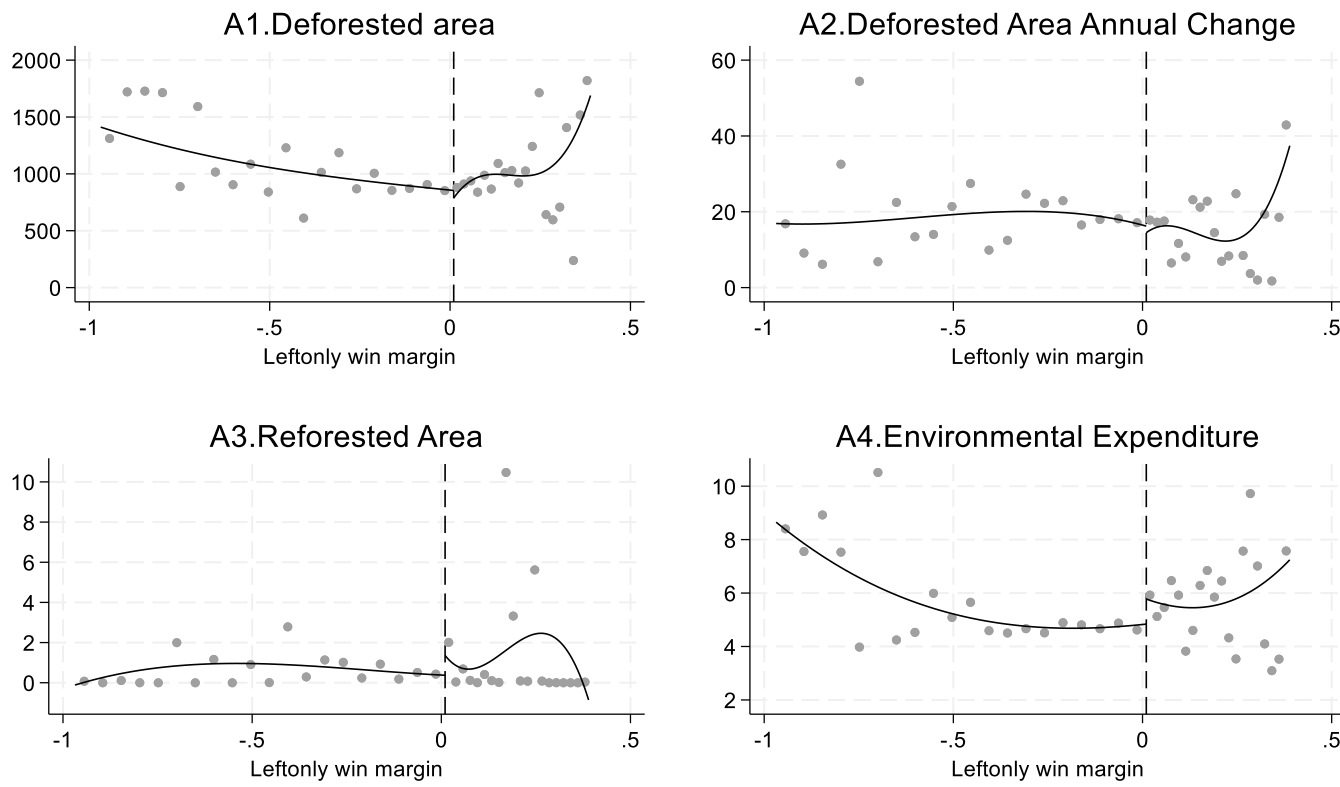


Figure 4b. RD plot of deforestation/reforestation outcomes – left plus centre-left Mayors

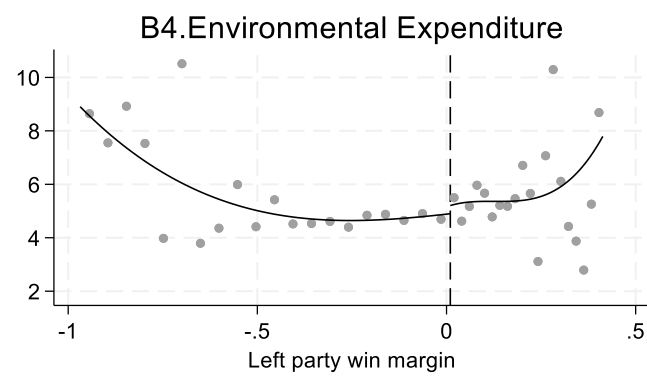
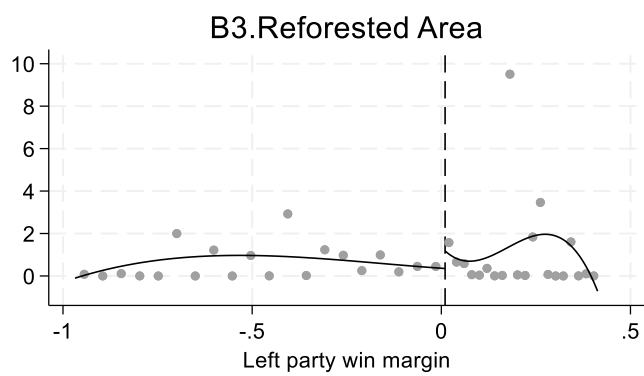
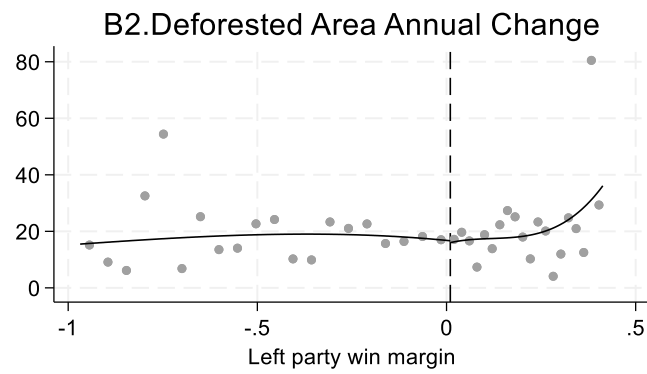
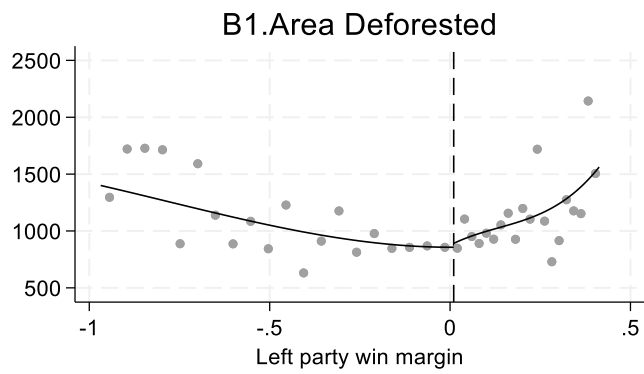


Figure 5. Political fragmentation and win margin

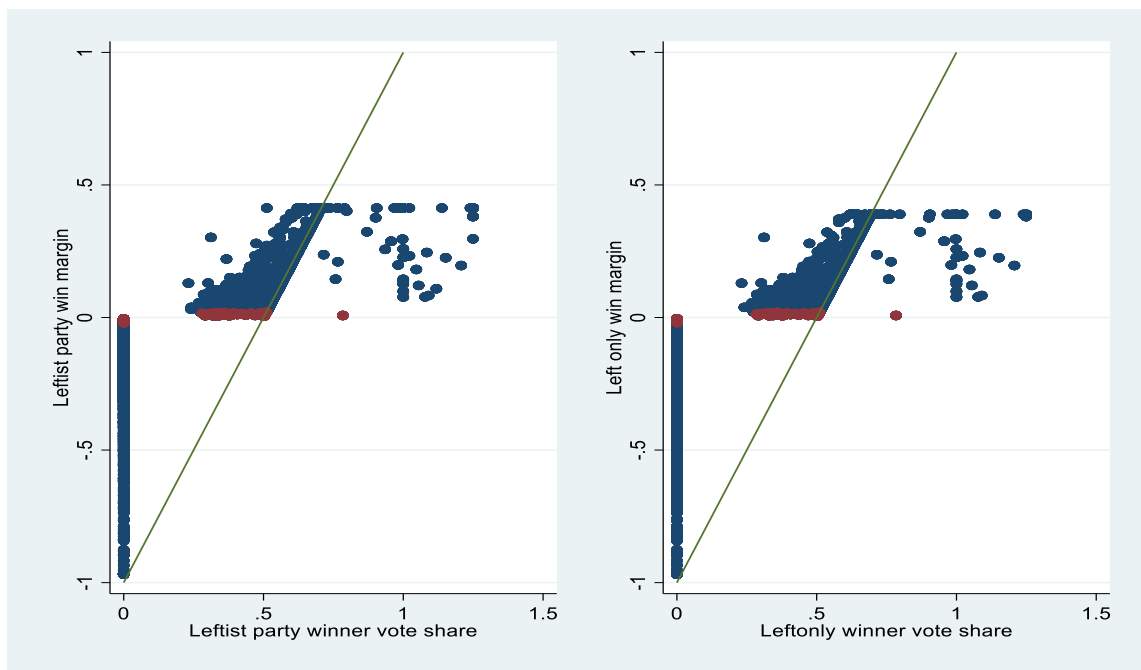


Figure 6a. Balancing of the covariates around the cut-off – left only winning margin

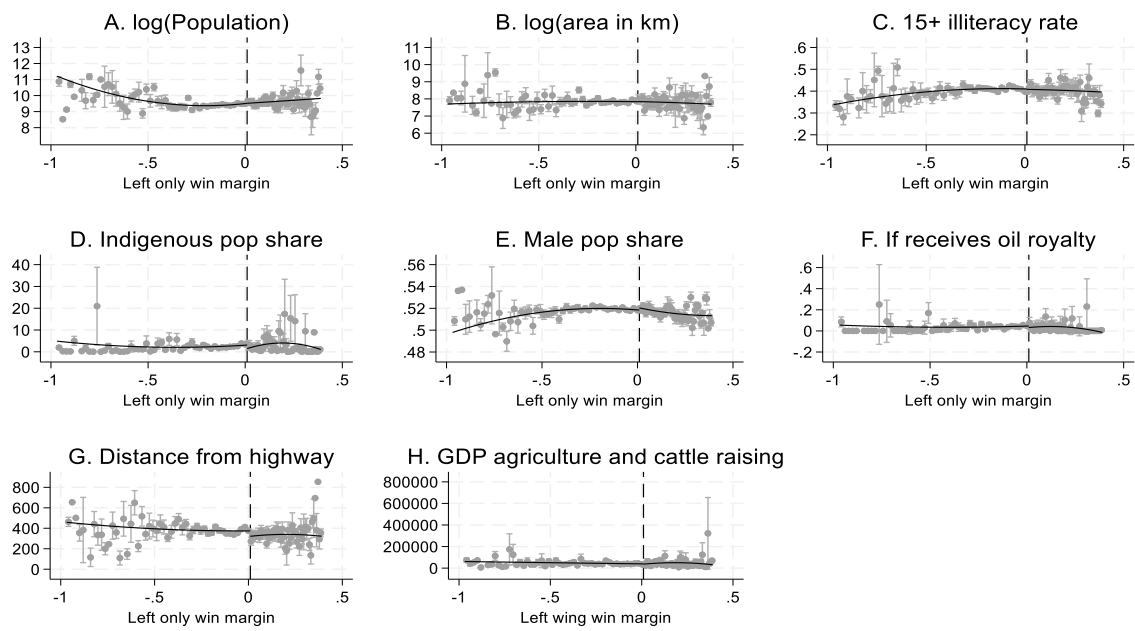
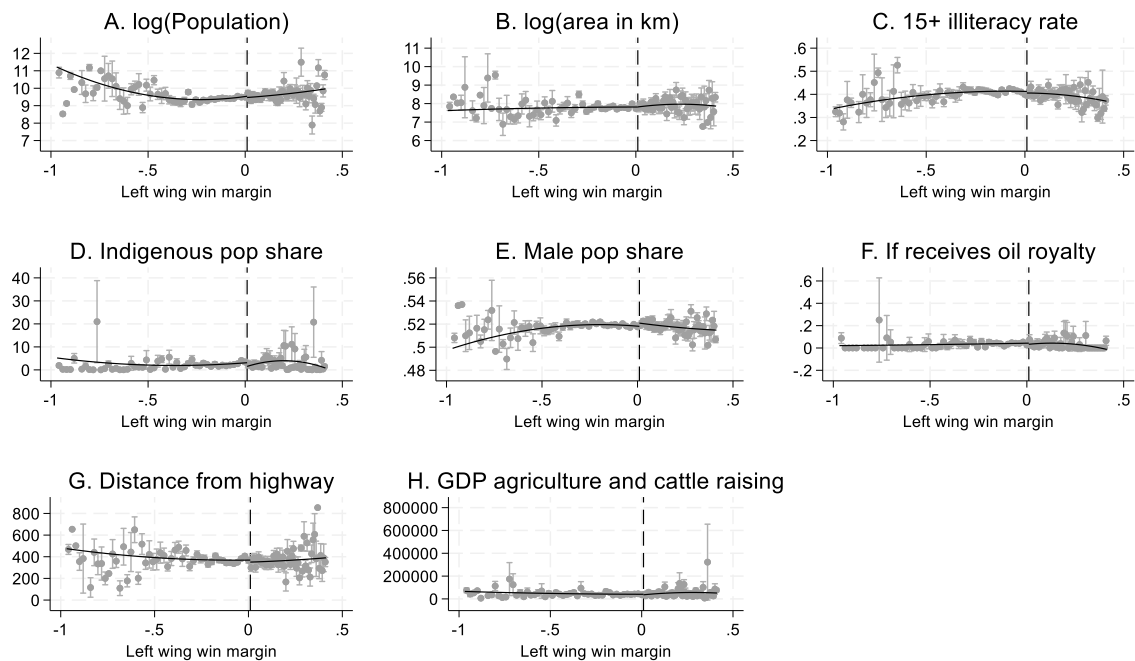


Figure 6b. Balancing of the covariates around the cut-off (0.01)– left plus centre-left winning margin



Appendix 1 – Additional results

Table A1. Data sources

Variables	Source	Method
Deforestation	PRODES – National Institute for Space Research (INPE) https://www.gov.br/inpe	Satellite-based annual monitoring of clear-cut deforestation. High spatial resolution (6.25 ha or larger).
Deforestation Transamazônica	TerraClass – INPE and EMBRAPA (Almeida et al. 2016)	Biennial land use and land cover mapping within the PRODES mask, including secondary vegetation areas not captured by PRODES or DETER.
Highway (BR-230)	DNIT - https://www.gov.br/infraestrutura/pt-br/assuntos/dados-de-transportes/bit/bitmodosmapas#maprodo MMA – Ministry of the Environment https://www.gov.br/mma/pt-br/assuntos/servicosambientais/control-de-desmatamento-e-incendios-florestais/pdf/Listagemmunicipiosprioritriosparaesdepreveno2021.pdf	Distance tool calculating nearest point of the municipality polygon to the highway and centroid distance to highway.
Blacklist		Official list of municipalities with highest deforestation rates subject to restrictions.
Elections	TSE – Superior Electoral Court https://www.tse.jus.br	Electoral data at the municipal level for elections from 1998 to 2018.
Homicides	IPEA – Atlas da Violência https://www.ipea.gov.br/atlasviolencia	Municipal-level homicide rates.
Other crime indices	SUS – National Health Service http://www2.datasus.gov.br/DATASUS/index.php?area=0205&id=1878964	Mortality and violence-related health data from DATASUS.
Conflict with Indigenous peoples	CPT – Comissão Pastoral da Terra https://www.cptnacional.org.br/downloads/category/4-areas-em-conflito	Data on land conflicts involving Indigenous peoples.
Municipality finances	Tesouro Nacional – https://www.tesourotransparente.gov.br	Financial data from 2000 to 2018 from FINBRA and SICONFI.
Demographics	IBGE Census 2000 & 2010	Population and demographic characteristics at the municipal level.

Table A2: Summary statistics of key regression variables

Variable	Obs	Mean	Std. Dev.
Area Deforested (sq km)	15,200	942.4842	1347.288
Deforested change (sq km)	15,200	17.7649	67.09414
Area reforested (sq km)	12160	0.7625	13.0048
Environmental expenses (Real)	15,200	641481.5	4418154
Share of municipal area deforested	14440	0.3505152	0.3301608
Share of forest area deforested	11882	23.9134	244.8397
Rate of change of area deforested	12549	0.020023	0.0739665
Share of municipal area reforested	14440	0.0001734	0.0042069
Share of forest area reforested	11882	0.0049374	0.2285419
Share of environmental expenses	6352	0.0017307	0.0052592
Winning margin	14,148	-0.0874255	0.2058052
Leftparty (left & centre-left)	15,200	0.2407895	0.4275768
Leftonly (left only)	15,200	0.1965789	0.3974243
Workers' party	15200	0.1654605	0.3716079
Indigenous elected in 2016	3040	0.0460526	0.209606
Ln(population)	13,433	9.536831	1.102628
Ln(Size)	15,200	7.830709	1.355557
15+ illiterate rate	10,516	0.4077388	0.0877455
Indigenous pop share	15,160	2.644885	8.719648
Male pop share	15,179	0.5178572	0.0150216
Poor pop share	15,200	0.2947368	0.4559394
If has oil royalty	15,200	0.0373684	0.1896692
GDP agriculture & cattle raising	14417	43799.56	88143.81
If it is protected indigenous land	14440	0.3763158	0.4844775
Distance from Transamazônica			
Highway	14,440	368.6225	258.1701

Note: The table shows the means and standard deviations of the key regression variables in our sample

Table A3. RD robust estimates of outcomes without covariates, full sample

Outcome levels	Left+centre-left			Left only		
	(1)	(2)	(3)	(4)	(5)	(6)
Polynomial	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
Panel a	Area deforested in sq km (Mean: 936.4862)					
Robust	-170.57***	-620.9***	-621.48***	7.8931	-23.362	-536.69
(t-stat)	(-3.2559)	(-6.1680)	(-6.2511)	(0.0799)	(-0.6831)	(-5.6118)
Panel b	Annual change in area deforested in sq km (Mean: 17.9351)					
Robust	3.3701	-0.1453	-8.5951***	-5.6692*	-1.9114	-5.7926*
(t-stat)	(1.2903)	(-0.3059)	(-2.8566)	(1.7457)	(-0.7986)	(-1.6988)
Panel c	Area reforested in sq km (Mean: 0.642066)					
Robust	0.9165	1.1743	0.9116	1.6053	1.9068	1.9435
(t-stat)	(0.3586)	(0.4023)	(0.2515)	(0.5455)	(0.5796)	(0.5442)
Panel d	Log(Annual environmental expenses) (Mean: 5.0138)					
Robust	0.6590**	0.8395*	0.9203	1.1675***	1.3161**	1.2173**
(t-stat)	(1.9758)	(1.8385)	(1.2302)	(3.0125)	(2.3167)	(1.9769)
Other covs	No	No	No	No	No	No
Observations	12987	12987	12987	12987	12987	12987

The table shows the RD robust estimates of area deforested (panel a), annual change in area deforested (panel b), area reforested (panel c) and also the annual environmental expenses (panel d) for close elections of leftist Mayors (various proxies) using optimal bandwidth for $-0.005 < \text{winning margin} < 0.005$. Columns (1)-(3) show estimates for left and centre left party taken together, column (4)-(6) show those for left only parties respectively using linear, quadratic and cubic polynomials. Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Table A4. RD robust estimates of level outcomes with covariates, election round 1, non-coalition govts only

	Left only			Left+centre-left		
Polynomial	(1)	(2)	(3)	(4)	(5)	(6)
	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
Panel a	Area deforested in sq km (Mean: 933.209)					
Robust	-9.0392	-455.934***	13.7166	5.0743	6.4622	22.6053
(t-stat)	(48.728)	(84.363)	(76.734)	(57.289)	(85.391)	(84.778)
Panel b	Annual change in area deforested in sq km (Mean: 19.64812)					
Robust	5.5050	-4.1677	-2.4837	8.6464*	12.5394**	4.2940
(t-stat)	(6.006)	(7.402)	(7.552)	(5.054)	(5.716)	(5.813)
Panel c	Area reforested in sq km (Mean: 0.4101)					
Robust	3.9225	4.5034	4.8056	2.6822	3.6724	4.0045
(t-stat)	(3.936)	(5.194)	(5.589)	(2.779)	(4.257)	(4.787)
Panel d	Log(Annual environmental expenses) (Mean: 4.4691)					
Robust	1.5786***	1.7673**	1.7394**	1.5888***	1.7533**	1.7394**
(t-stat)	(0.607)	(0.786)	(0.868)	(0.598)	(0.688)	(0.868)
Other covs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6643	6643	6643	6643	6643	6643

The table shows the RD robust estimates of area deforested (panel a), annual change in area deforested (panel b), area reforested (panel c) and also the annual environmental expenses (panel d) for close elections of leftist Mayors (various proxies) using optimal bandwidth for $-0.005 < \text{winning margin} < 0.005$. Columns (1)-(3) show estimates for left and centre left party taken together, column (4)-(6) show those for left only parties respectively using linear, quadratic and cubic polynomials. Covariates included are the same as in Table 4. Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Table A5. RD estimates of outcome shares without covariates – full sample

	Left only			Left & centre-left		
	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
	(a) Deforested area as a share of total municipality area					
Robust	-0.0171 (0.011)	-0.1825*** (0.015)	-0.2101*** (0.016)	0.0153 (0.011)	-0.0349** (0.018)	-0.0581*** (0.020)
	(b) Deforested area as a share of total forest area					
Robust	-3.0087* (1.553)	-3.4565 (2.221)	-4.6112* (2.797)	-1.7642 (1.207)	-1.9179 (1.709)	-0.0540 (2.294)
	(c) Rate of annual change of deforested area					
Robust	0.0036 (0.009)	0.0070 (0.008)	0.0033 (0.012)	0.0030 (0.007)	0.0057 (0.010)	0.0069 (0.011)
	(d) Reforested area as a share of total municipality area					
Robust	-0.0003 (0.000)	-0.0002 (0.000)	-0.0001 (0.000)	-0.0004 (0.000)	-0.0002 (0.000)	-0.0002 (0.000)
	(e) Reforested area as a share of total forest area					
Robust	-0.0264 (0.019)	-0.0087 (0.031)	-0.0076 (0.032)	-0.0272 (0.020)	-0.0170 (0.028)	-0.0111 (0.031)
	(f) Share of environmental expenses in total municipality expenses					
Robust	0.0009* (0.000)	0.0012** (0.001)	0.0015* (0.001)	0.0007* (0.000)	0.0013** (0.001)	0.0015** (0.001)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes

Table A6. RD robust estimates of Outcomes Shares with Covariates -Non-coalition Cases

	Left only			Left & centre-left		
	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
	(a) Deforested area as a share of total municipality area					
Robust	0.0088 (0.014)	-0.0632*** (0.023)	-0.0649*** (0.024)	-0.0310** (0.014)	-0.0243 (0.021)	-0.0266 (0.022)
	(b) Deforested area as a share of total forest area					
Robust	-5.9636*** (1.348)	-7.1801 (6.189)	-6.7115 (7.386)	6.4547* (3.346)	-1.0881 (2.883)	-10.6260* (6.194)
	(c) Rate of annual change of deforested area					
Robust	0.0054 (0.010)	0.0024 (0.012)	-0.0027 (0.013)	0.0018 (0.008)	0.0036 (0.007)	0.0022 (0.010)
	(d) Reforested area as a share of total municipality area					
Robust	-0.0007 (0.001)	-0.0008 (0.001)	-0.0009 (0.001)	-0.0008 (0.001)	-0.0009 (0.001)	-0.0009 (0.001)
	(e) Reforested area as a share of total forest area					
Robust	-0.0304 (0.042)	-0.0441 (0.053)	-0.0543 (0.059)	-0.0437 (0.048)	-0.0437 (0.048)	-0.0591 (0.058)
	(f) Share of environmental expenses in total municipality expenses					
Robust	0.0008* (0.000)	0.0011** (0.001)	0.0011* (0.001)	0.0009* (0.001)	0.0010 (0.001)	0.0010 (0.001)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes

The table shows the RD robust estimates (with optimal bandwidth) of shares of total municipal area deforested (panel a), shares of total forest area deforested (panel b), rate of annual change in area deforested (panel c), share of total municipal area reforested (panel d), share of total forest area reforested (panel e) and also share of total municipal expenses on environment (panel f) for close elections of leftist Mayors (various proxies) using optimal bandwidth for $-0.005 < \text{winning margin} < 0.005$ after dropping the cases of coalition governments. Columns (1)-(3) show estimates for left only cases while column (4)-(6) show those for left and centre-left mayors elected in close elections, respectively using linear, quadratic and cubic polynomials. Included covariates are: population size, geographic area, 15+ illiteracy rate, male population share, municipality considered as extremely poor, GDP agriculture and cattle raising, if protected indigenous land, distance from Amazon highway, if receives oil royalty share and if it is an election year. Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Table A7. RD robust estimates of outcomes as shares with covariates for non-coalition cases, election round 1

	Left only			Left & centre-left		
	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
	(a) Deforested area as a share of total municipality area					
Robust	0.0074 (0.014)	-0.0644*** (0.023)	-0.0765*** (0.024)	-0.0314** (0.014)	-0.0243 (0.021)	-0.0264 (0.022)
	(b) Deforested area as a share of total forest area					
Robust	-6.0115*** (1.353)	-8.3129 (6.148)	-6.7226 (7.370)	6.4281* (3.337)	-1.5638 (2.913)	-10.6263* (6.193)
	(c) Rate of annual change of deforested area					
Robust	0.0055 (0.010)	0.0025 (0.012)	-0.0027 (0.013)	0.0026 (0.007)	0.0057 (0.010)	0.0069 (0.011)
	(d) Reforested area as a share of total municipality area					
Robust	-0.0007 (0.001)	-0.0008 (0.001)	-0.0009 (0.001)	-0.0008 (0.001)	-0.0009 (0.001)	-0.0009 (0.001)
	(e) Reforested area as a share of total forest area					
Robust	-0.0304 (0.042)	-0.0442 (0.053)	-0.0543 (0.059)	-0.0435 (0.048)	-0.0468 (0.050)	-0.0590 (0.058)
	(f) Share of environmental expenses in total municipality expenses					
Robust	0.0009* (0.001)	0.0010 (0.001)	0.0010 (0.001)	0.0006 (0.000)	0.0012** (0.001)	0.0011* (0.001)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes

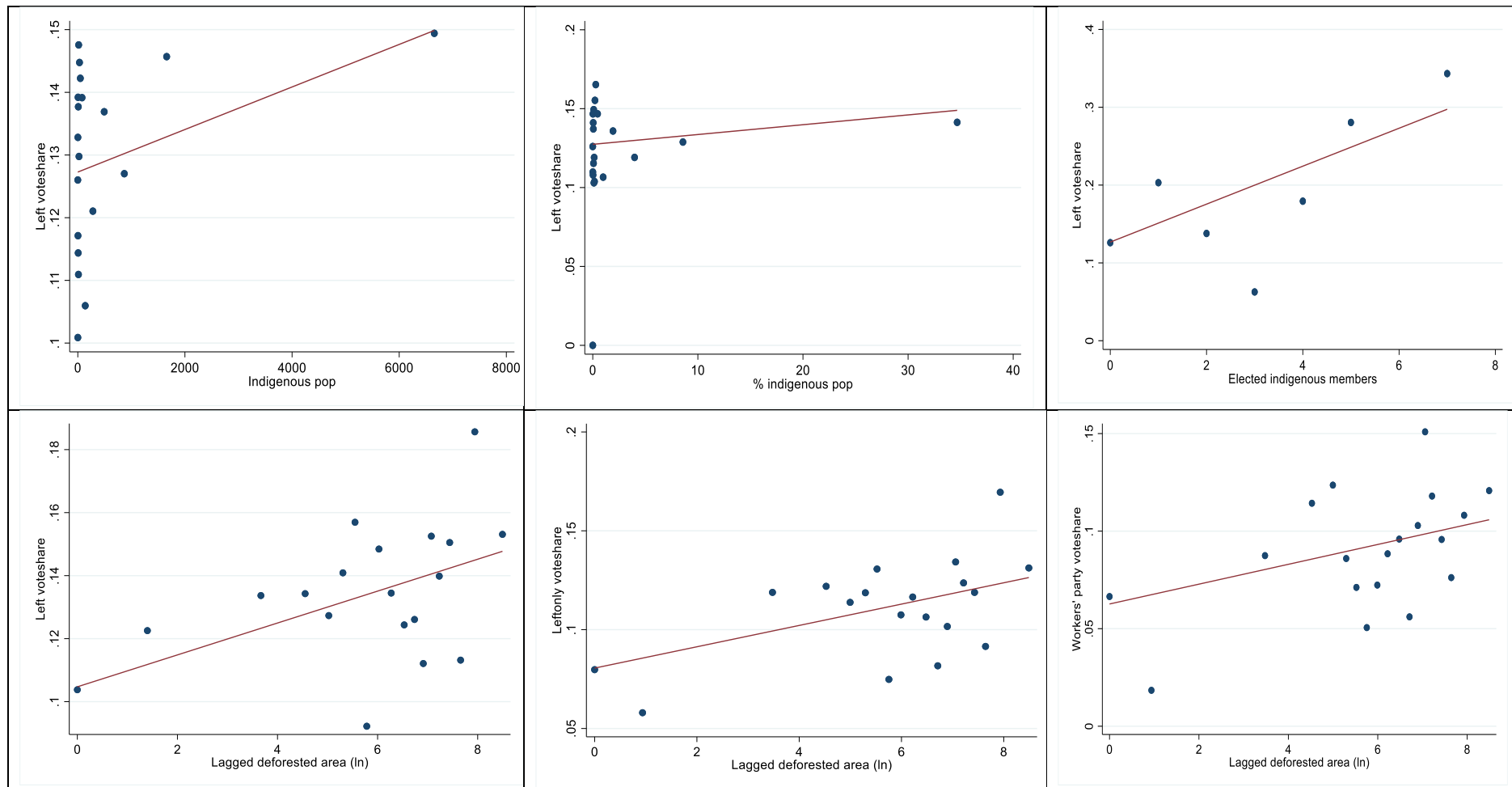
The table shows the RD robust estimates (with optimal bandwidth) of shares of total municipal area deforested (panel a), shares of total forest area deforested (panel b), rate of annual change in area deforested (panel c), share of total municipal area reforested (panel d), share of total forest area reforested (panel e) and also share of total municipal expenses on environment (panel f) for close elections of leftist Mayors (various proxies) using optimal bandwidth for $-0.005 < \text{winning margin} < 0.005$ after dropping the cases of coalition governments. Columns (1)-(3) show estimates for left only cases while column (4)-(6) show those for left and centre-left mayors elected in close elections, respectively using linear, quadratic and cubic polynomials. Included covariates are: population size, geographic area, 15+ illiteracy rate, male population share, municipality considered as extremely poor, GDP agriculture and cattle raising, if protected indigenous land, distance from Amazon highway, if receives oil royalty share and if it is an election year. Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Table A8. RD robust estimates for leftist candidates winning against right wing ones -non-coalition cases

Panel a: Left only mayors winning against right-wing candidates						
Polynomials:	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
	(1)	(2)	(3)	(4)	(7)	(8)
VARIABLES	Area deforested		Annual change in deforested area		Ln(envexp)	
Robust	-197.1960 (434.010)	-134.5976 (674.102)	-1.2199 (12.345)	-0.2358 (16.903)	4.2498** (2.105)	4.7443** (2.494)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Observations	295	295	295	295	295	295
Panel b: Left plus centre left Mayors winning against right-wing candidates						
VARIABLES	(1)	(2)	(3)	(4)	(7)	(8)
	deforested	deforested	deforested_change	deforested_change	lenvexp	lenvexp
Robust	-174.1610 (291.504)	-254.2857 (464.695)	12.3247 (9.059)	11.0453 (12.344)	0.5000 (1.616)	1.0616 (2.892)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Observations	532	532	532	532	532	532

The table shows the weighted RD robust estimates of all outcome variables, area deforested in columns 1-2, annual change in area deforested in columns 3-4, area reforested in columns 5-6 and ln(environmental expenses) in columns 7-8 in close elections of leftist Mayors winning against right-wing ones and vice-versa. We show estimates using linear and quadratic polynomials and optimal bandwidth. Panel a shows the estimates for left only Mayors while the panel b shows those for left and centre left Mayors. All regressions include covariates: population size, geographic area, 15+ illiteracy rate, male population share if it is a protected indigenous land, distance from TransAmazon highway, and if receives oil royalty share and if it is an election year. Standard errors shown in parentheses. Significance levels: ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Figure A1. Association between indigenous population, deforested area and leftist vote share - Binscatter plots of outcomes



Appendix 2. Additional Materials

Table A2.1. - Classification of party ideology

<i>Party ideology</i>						
<i>Party Anacronym</i>	<i>Full Name</i>	<i>Originated from previous party</i>	<i>Year of creation/Year of official registration</i>	<i>Details</i>	<i>BBC Brasil</i>	<i>Bolognesi et al. 2023</i>
PL	Partido Liberal		2005/2006	2006	Right	NC
PATRIOTA	Patriota		2011/2012	2012	Right	Extreme-Right
PODE	Podemos	Partido Trabalhista Nacional (PTN)	1995/1995	1995	Right	Right
				Changes in the party name: Partido Progressista Brasileiro	Right	
PP	Progressistas	Partido Progressista (PP)	2017/2017	(PPB) 1995–2003; Partido Progressista (PP) 2003–2017; and Progressistas (PP) 2017–present		Extreme-Right
PRTB	Partido Renovador Trabalhista Brasileiro		1990/1997		Right	Right
PSC	Partido Social Cristão		1985/1990		From Right to Extreme Right	Right
PTB	Partido Trabalhista Brasileiro		1979/1981	It incorporated PSD (Partido Social Democrático) in 2002 and PAN (Partido dos Aposentados da Nação) in 2007.	From Right to Extreme-Right	Centre-Right
PTC	Partido Trabalhista Cristão		1989/1989		Right	Right

DEM	Democratas	PFL (Partido da Frente Liberal). Changed its name to DEM in 2007.	1985/1986	In 2021 DEM split and generated PDS (Partido Democrático Social) and UB (União Brasil) joint to PSL (Partido Social Liberal)	Centre-Right	Extreme-Right
Republicanos	Republicanos	Partido Municipalista Renovador (PMR)	2003/2005	Partido Municipalista Renovador (PMR) had its name changed to Partido Republicano Brasileiro (PRB) in 2005 and to Republicanos in 2019	From Centre-Right to Right	NC
PPB (also PP)	Partido Progressista Brasileiro		1995/1995	In 2003 it was extinct to generate Partido Progressista (PP)	Right	Extreme-Right
PR	Partido Liberal	Partido de Reedificação da Ordem Nacional (PRONA) and Partido Liberal (PL)	2006/2006	It was generated by the merger of PRONA and PL	From Right to Extreme Right	Right
PRB	Partido Republicano Brasileiro	Partido Municipalista Renovador (PMR)	2005/2005	In 2019 had its name changed to Republicanos (Republicanos) Extinct in 2022.	From Centre-Right to Right	Right
PSL	Partido Social Liberal		1994/1998	Bolsonaro was elected in 2019 by this party Created from a dissidence from the	From Right to Extreme Right	Right
PSDB	Partido da Social Democracia Brasileira	-	1988/1989	Partido do Movimento Democrático Brasileiro (PMDB)	From Centre to Centre-Right	Right
PMB	Partido da Mulher Brasileira		2008/2015	It was renamed to Brasil 35 in 2021	Centre-Right	Right
PSD	Partido Social Democrático	-	2011/2011		Centre	Right
DC	Democracia Cristã	-	1995/1997	Party connected to religion	From Centre to Centre-Right	Right

PRP	Partido Republicano Progressista	-	1989/1991	Party finished in 2019	Centre-Right	Right
PT	Partido dos Trabalhadores	-	1980/1982	Party of the former president Lula	From Centre-Left to Left	Left
PCB	Partido Comunista Brasileiro	-	1993/1996		Extreme-Left	Extreme-Left
PC do B	Partido Comunista do Brasil	Created from Partido Comunista (PC) dissidents	1962-1988		From Centre-Left to Left	Left
PCO	Partido da Causa Operária	Created from Partido dos Trabalhadores (PT) dissidents	1995/1997		Extreme-Left	Extreme-Left
PDT	Partido Democrático Trabalhista		1979/1981		From Centre-Left to Left	Centre-Left
PMN	Partido da Mobilização Nacional		1984/1990		Centre-Left	Centre-Right
PSB	Partido Socialista Brasileiro		1985/1988		Centre-Left	Centre-Left
PSOL	Partido Socialismo e Liberdade	Created from Partido dos Trabalhadores (PT) dissidents	2004/2005		From Left to Extreme-Left	Left
PSTU	Partido Socialista dos Trabalhadores Unificado	Created from Partido dos Trabalhadores (PT) dissidents	1994/1995		Extreme-Left	Extreme-Left
PV	Partido Verde		1986/1993		Centre-Left	Centre-Left
AVANTE	Avante	Created from Partido Trabalhista Brasileiro (PTB) dissidents	1989/2004	The original name of the party was Partido Trabalhista do Brasil (PTdoB). Changed to AVANTE in 2017 Initial name was Partido Popular Socialista (PPS), changed to Cidadania in 2019	Centre-Left	Centre-Left
CIDADANIA (also PPS)	Cidadania		1992/1992		Centre-Left	Centre-Left
PROS	Partido Republicano da Ordem Social		2010/2013		Centre-Left	NC
SOLIDARIEDADE (also SDD)	Solidariedade		2012/2013		Centre-Left	Right

PPS (also CIDADANIA)	Partido Popular Socialista		1992/1992	Former name of the current Cidadania	Centre-Left	Centre-Left
REDE	Rede Sustentabilidade		2013/2015	Marina Silva is the founder	From Centre-Left to Centre-Right	Centre-Left
PMDB	Partido do Movimento Democrático Brasileiro	Partido do Movimento Democrático Brasileiro (PMDB) of 1966-1979	1980/1981	Changed its name to MDB in 2017	Centre	NC
MDB	Movimento Democrático Brasileiro	Partido Movimento Democrático Brasileiro (PMDB of 1980-2017)	1980/1981	Named PMDB until 2017	Centre	Centre-Left
PTB	Partido Trabalhista Brasileiro		1979/1981	It incorporated PSD (Partido Social Democrático) in 2002 and PAN (Partido dos Aposentados da Nação) in 2007.	From Right to Extreme-Right	Centre-Left

Note: NC stands for no classification. Source: BBC Brasil and Bolognesi et al. (2023)

Appendix 2 (continued): RD Robust estimates

We assume that the treatment assignment, m_{it} , for the i -th municipality in t -th election year is determined solely based on a cut-off score, c , on an observed forcing variable, x_i . We take the forcing variable x to be the winning margin for a leftist mayor relative to a non-leftist one; the cut-off is $c = 0.01$ as we consider close elections after excluding the central observations in the neighbourhood $\{-0.005, 0.005\}$. The municipalities that fall below the cut-off ($c = 0.01$), constitute the control group ($m_i = 0$) that elects a non-leftist mayor who ran against a leftist mayoral candidate. Those above the cut-off, the treatment group ($m_i = 1$), elect a leftist mayor who ran against a non-leftist candidate. The assignment follows a known deterministic rule, $m_i = 1 \{x_i \geq c\}$, where $1\{\bullet\}$ is the indicator function. Accordingly, we consider the following specification for estimating the fuzzy RD estimates of the selected outcomes Y_{it} of the i -th municipality in t -th election cycle in response to the treatment m :

$$(Equation 1) Y_i = \alpha \beta m_i + f(x_i) + \varepsilon_i \mathbb{1}_{x_i \in (c-h, c+h)}$$

where Y_i is the selected outcome in question, m_i is the treatment (when a leftist mayoral candidate wins against a right-wing candidate), x_i is the forcing variable (i.e., winning margin), and h is the neighbourhood around the cut-off c of the forcing variable x , referred to as the bandwidth in the literature. We use the optimal bandwidth to indicate close elections, as commonly used in existing literature. The control function $f(x_i)$ is some continuous function, usually, a n -th degree polynomial in the forcing variable on each side – we consider linear, quadratic and cubic polynomials in our regressions.