Does Local Politics Drive Tropical Land-Use Change? Property-Level Evidence from the Amazon*

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Abstract

Land conversion to agriculture is a defining environmental challenge for tropical regions. We construct a novel panel of land-use change on the properties of municipal politicians and campaign donors in the Brazilian Amazon to assess three channels through which local politics may drive land conversion: (i) leaders' self-interest, (ii) patronage, and (iii) interest group influence. Estimating event studies around close mayoral elections, we find that winning candidates – and their campaign donors – increase soy cultivation while the candidate is in office, suggesting political connections help landholders overcome barriers to adoption for this high-value crop. At the municipal-level, close election of a mayor with personal landholdings has no effect on land-use or environmental outcomes, but election of a mayor who received campaign donations from landholders increases soy cultivation, deforestation, and environmental violations. Results provide nuanced evidence for each channel of political influence, with implications for the design of conservation policies.

JEL Codes: D72, O13, Q15, Q23, Q56

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1 Introduction

> "*Those who deforest the Amazon completely dominate local politics... The representatives of the people are, in fact, the representatives of those who deforest.*"
>
> –Federal Police Chief in Amazonas, quoted in McCoy and do Lago (2022).

Deforestation in the Brazilian Amazon – the world's largest tropical rainforest – is driven primarily by the expansion of commodity agriculture, particularly cattle ranching and soy (Pendrill et al., 2022). These activities contribute to economic growth but also empower large landholders, exacerbating local inequalities (Weinhold et al., 2013). Landholding elites are key arbiters of economic development and governance, and may capture or influence local political processes to promote their interests (Viana et al., 2016; Anderson et al., 2015; Amsden et al., 2012; Acemoglu et al., 2007; Bardhan and Mookherjee, 2000).[1]

Tropical deforestation is the second largest source of human-caused carbon emissions after fossil fuel combustion (van der Werf et al., 2016), and represents one of the primary obstacles to achieving global emission reduction targets (Harris et al., 2021). Deforestation also has serious *local* consequences, including biodiversity loss (Giam, 2017), higher temperatures and associated health complications (Zeppetello et al., 2020; Lawrence and Vandecar, 2015), and reductions in agricultural productivity (Leite-Filho et al., 2021).

In this paper, we quantify the degree to which landholders intervene in local politics to shape land use and deforestation in the Brazilian Amazon. We focus on three channels: (i) politicians' self-interest, (ii) patronage, i.e., rewarding campaign donors through favors or special treatment, and (iii) interest group influence. To assess (i) and (ii), we measure whether landholders use the power of mayoral office to increase deforestation or overcome barriers to adopting higher-value agriculture on their own properties, or reward campaign donors by enabling these outcomes on donors' properties. To assess (iii), we measure how

[1] Recent reporting by The Washington Post identified tens of millions of dollars in campaign donations made by landholders accused of environmental violations in the Amazon, as well as 1,900 cases in which landholders accused of environmental violations were elected to public office in the last two decades, concluding that: "*electoral victories and campaign financing have formed a parallel political system... that has undermined attempts to safeguard a natural resource that scientists warn must be preserved to avert catastrophic climate change* (McCoy and do Lago, 2022)." In a review of models of tropical deforestation, McCarthy and Tacconi (2011) conclude that: "Policies that demand reform in developing countries with high rates of deforestation will be ineffective unless they address the power, incentives and culture of local political elites."

election of a mayor who receives campaign donations from landholders affects aggregate land use, environmental outcomes, and governance at the municipal-level.

We combine individually-identified, geo-referenced land cadasters, universal registries of political candidates and campaign donors across five municipal elections (2000-2016), and remote sensing data to build a novel panel dataset measuring land use transitions on properties belonging to municipal political candidates and campaign donors in Brazil's Amazon biome between 2000-2019. To our knowledge, this is the most complete accounting of its kind, encompassing over 200,000 candidates, 246,000 donors, and 120,000 associated properties.

Methodologically, we estimate effects of a landholder's entry into mayoral office on land use and deforestation on their personal properties by comparing outcomes on the properties of successful versus runner-up mayoral candidates in close mayoral elections. We make similar comparisons between outcomes on the properties of campaign donors to winners versus runners-up in close mayoral elections, thus measuring a form of "land-use patronage" analogous to public employment patronage identified in Colonnelli et al. (2020). To explore year-by-year dynamic effects before, during, and after mayors' time in office, we estimate event study specifications and implement Callaway and Sant'Anna (2020)'s *csdid* estimator to accommodate staggered treatment timing and heterogeneous treatment effects. To explore whether landholders' participation in local politics affects outcomes at the municipality level, we estimate difference-in-difference specifications to compare outcomes in municipalities where a mayor who is either a landholder or received campaign donations from landholders wins or loses a close election.

At the property level, we find that landholding mayoral candidates' entry into office after a close election leads to an upward trend in soy cultivation on their properties, relative to the properties of runner-up candidates. Although imprecise due to limited sample size, point estimates for soy are large, indicating a 2- to 10-fold increase in soy cultivation on successful candidates' properties during their mandates. Soy cultivation also increases significantly on campaign donors' properties (+185%) during their favored candidates' time in office, relative to properties of donors to runner-up candidates. Donors to successful candidates continue to undertake significant increases in soy cultivation beyond the first mayoral mandate, suggesting that – once initial barriers to soy adoption are overcome – further expansion becomes

more accessible to farmers.[2]

Turning to environmental outcomes, we measure significant increases in deforestation on successful candidates' properties between two and four years after their entry into office (+52%, +39%, and +52%, respectively). Despite this increase in deforestation, successful candidates' are significantly less likely to receive an environmental violation during years t+3 and t+4, suggesting mayors may exercise some degree of influence over environmental enforcement on their properties. We do not measure significant changes in deforestation or registry of environmental violations on donors' properties during their favored candidates' time in office. It appears that donors' significant shift toward soy cultivation while in office comes less from forest clearing at the extensive margin, and more from transitions of already-cleared land from pasture to soy. On average, winners of close mayoral elections deforest 9.2% of their property area during their first four-year mandate, while donors to these mayors deforest 5.8% during this period.

At the municipality-level, we find that close election of a mayor with personal landholdings has no significant effect on municipal land-use for pasture, soy, or other crops during their subsequent four-year mandate. In contrast, close election of a mayor who received 25% or more of their campaign donations from landholders is associated with a significant 10-fold increase in soy cultivation during the subsequent four years. The increase in municipal soy cultivation is even larger when a mayor is elected who received more than 50% of their donations from landholders.

Election of a landholder-financed mayor has adverse environmental consequences. Municipalities where a mayor who received more than 25% of campaign donations from landholders wins a close election experience 8% more deforestation and 27% more environmental violations in the following four years. Focusing on changes in governance that may underlie these effects, we find landholder-financed mayors are associated with an upward trend in municipal spending on agricultural promotion and significant increases in rural credit for agriculture

[2]Soy cultivation offers much higher profitability than pasture-fed livestock or cultivation of alternative crops, but shifting to soy is capital- and knowledge-intensive and landholders may struggle to overcome barriers to entry, including credit, technology, and training constraints (Moffette and Gibbs, 2021; Szerman et al., 2022). Political connections through mayoral office may assist winning candidates and their donors in overcoming these barriers by, for instance, giving them preferential treatment by service providers or improved access to credit or factor markets.

and livestock. We conclude that mayors who receive substantial campaign donations from landholders govern on behalf of this special interest group by promoting agriculture.

Our property- and municipal-level results tell a compatible story. Landholding politicians in the Brazilian Amazon appear to leverage their political influence to increase deforestation on their personal properties and overcome barriers to high-value soy adoption for themselves and their campaign supporters. However, these politicians do not necessarily feel political pressure to govern on behalf of agricultural special interests as a whole, explaining the null effects of landholder election on municipality-level land use. In contrast, mayors who received significant campaign donations from landholders *do* feel pressure to promote agricultural special interests through municipal spending and facilitation of rural credit – with increased deforestation and environmental violations as a consequence.

This paper contributes to three strands of literature: (i) the political economy of tropical deforestation, (ii) the practice and consequences of patronage in local government, and (iii) the effects of politician type. Previous studies on the political economy of tropical deforestation have shown that local officials' incentives for rent-seeking can drive logging (Burgess and Olken, 2012) and that regime changes are associated with increased deforestation – driven by land reform and agricultural expansion (Kuusela and Amacher, 2016). In Brazil, Pailler (2018) shows that mayors may allow landholders to deforest prior to local elections to win support from rural voters; Abman (2021) finds that, after the introduction of a deforestation disincentive policy (i.e., blacklisting), deforestation fell significantly further in municipalities where mayors were eligible for reelection. Burgess et al. (2019) exploit border discontinuities to show that deforestation rose and fell in Brazil in line with the intensity of federal anti-deforestation efforts, highlighting the key role of institutions in tropical forest governance. Particularly relevant for our study, Bragança and Dahis (2022) use politicians' self-declared occupations in candidate registries to identify "farmer politicians," and show that election of farmers as mayors led to increased deforestation and promotion of agriculture after Brazil's 2000 municipal elections. Similar effects disappear in later years after federal anti-deforestation efforts increase.

We contribute to this literature with novel evidence of how landholders interact with electoral politics for personal and interest group benefits. We are the first to measure land-

use changes on the properties of political candidates and campaign donors, which allows us to gauge (i) use of political office for personal gain, and (ii) "land-use patronage," wherein politicians reward campaign supporters by facilitating costly land-use changes on their properties. We make another novel contribution by identifying landholding donors, who were previously unobservable since they do not declare occupations in donation registries. These data advances corroborate and extend findings in Bragança and Dahis (2022): using an alternative measure of "farmer politicians" (we match 24.8% of elected mayors to landholdings, versus 12.7% who self-declare as farmers), we also find that election of a landholding mayor has no effect on municipal deforestation between 2004-2019. However, we show entry into office *does* affect soy cultivation on candidates' and donors' personal properties, and that donations from landholders have a significant effect on municipal land use and governance.

Our evidence for a novel channel of "land-use patronage" adds to prior studies documenting public employment patronage (Toral, 2022; Colonnelli et al., 2020) and increased receipt of public contracts for firms that donate to winning candidates (Boas et al., 2014) in Brazil. By identifying the landholding status of campaign donors, we are the first to quantify agricultural special interest influence on municipal environmental governance through the campaign finance channel, contributing to literatures on special interest politics (Bertrand et al., 2020; Voss and Schopf, 2018; Chamon and Kaplan, 2013; Grossman and Helpman, 2002) and campaign finance (Avis et al., 2022).

We also contribute to the literature on politician type, which includes studies on the effects of politicians' gender (Brollo and Troiano, 2016; Broockman, 2014; Balafoutas and Sutter, 2012), ethnicity (Chin and Prakash, 2011), religion (Bhalotra et al., 2014), and education (de Paola and Scoppa, 2011), among other factors. Gulzar and Pasquale (2019) find that exogenous increases in minority representation in local councils in India reduce deforestation. We find that mayors' personal landholding status does not affect their policy-making along the dimensions we measure, while receipt of donations from landholders does. Finally, our study contributes to the literature on land-use change (e.g., Hettig et al., 2016; Lambin and Meyfroid, 2011; Rudel et al., 2005) by bringing in rich institutional data to explore political economy dynamics underlying soy expansion and deforestation.

2 Context

2.1 Deforestation and Land Use in the Brazilian Amazon

Brazil is home to the majority of the world's largest tropical forest – the Amazon – which supports flourishing biodiversity and acts as an enormous carbon sink. Concerns about how Brazil can balance agricultural development with forest conservation are high (Marin et al., 2022), and efforts to reduce deforestation must account for the ways in which soybean expansion can indirectly drive forest cover loss. Across South America, soybean expansion has occurred most quickly in the Brazilian Amazon, increasing from 0.4 million hectares in 2000 to 4.6 million hectares in 2019 (Song et al., 2021). While soybean expansion contributes to income growth and poverty reduction, it is also associated with increased inequality, as large landholders benefit disproportionately from soy's large-scale, mechanized, labor-saving production processes (Sauer, 2018; Weinhold et al., 2013). At the same time, Brazil is amongst the largest pesticide consumers in the world (Panis et al., 2022), and use of pesticides for soy production is high (Garrett and Rausch, 2016). High levels of pesticide use are associated with negative health effects, including damage to the central nervous system, cancer, intoxication, infant malformations, and endocrine changes (Panis et al., 2022).

Severe deforestation in the 1990s and early 2000s led Brazil's federal government to implement a series of policies to reduce tree-cover loss in the Amazon, which proved highly effective. Deforestation fell from 27,000 km^2 in 2004 to 7,000 km^2 in 2009 (INPE, 2017).[3] This trend reversed in 2014, when deforestation rates rose again due to a weakening federal commitment to enforcement of environmental regulations (Burgess et al., 2019). The main drivers of deforestation in the Brazilian Amazon are cattle ranching and agriculture.

[3]Multiple policies and initiatives combined to bring about this decline in deforestation (Nepstad et al., 2014). The multi-pronged Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm) was the principal legal instrument to curb deforestation in the Brazilian Legal Amazon. The Priority List (also called Blacklisted Municipalities) was a vital part of the PPCDAm and contributed significantly to dissuading deforestation (Assunção et al., 2019). Studies have shown that protected and indigenous areas are effective in preserving natural vegetation and sustainable land uses (BenYishay et al., 2017; Amin et al., 2019). Most of these policies would not have been possible without the creation of cutting-edge monitoring systems, including federal annual deforestation data and a near-real-time deforestation alert system called DETER (Assunção et al., 2017). Supply-chain commitments and policies have also been put in place to reduce deforestation in specific commodity markets, including the Soy Moratorium in 2006 and the Zero-Deforestation Cattle Agreements in 2009 (Gibbs et al., 2015; Alix-Garcia and Gibbs, 2017).

Pasture, which covered 13.9% of the Legal Amazon in 2020, is generally characterized by low-productivity livestock production (Moffette et al., 2021; Ermgassen et al., 2018). Agriculture, which covered 2.8% of the Legal Amazon in 2020, exhibits much higher productivity and more sophisticated production techniques (e.g., double cropping and mechanization). In the Legal Amazon, most agricultural production is soy (88.9%), although other commodities such as sugar cane, rice, maize, cotton, and other perennial crops are also produced. Brazil is the world's leading exporter of soybean (Panis et al., 2022).

Cattle ranching and agriculture differ fundamentally in their production characteristics, with agriculture generally requiring high inputs and capital, and cattle ranching requiring low inputs and capital. Agriculture has much higher potential profitability, but farmers may struggle to convert land to agriculture due to barriers to entry including credit constraints, transportation costs, or lack of skills or training. Deforested land is often used initially as pasture for grazing before being converted to soy production (Moffette and Gibbs, 2021). Deforestation is itself costly, requiring substantial labor and equipment inputs that may be compensated for, in part or in whole, by selling timber. The Brazilian Forest Code is the central piece of legislation governing land use and management on private properties, and defines the legality of deforestation across Brazil's biomes. According to this federal law, properties in the Amazon biome should retain 80% natural vegetation. As much as 90% of Brazilian deforestation has likely been illegal under these rules (Lawson et al., 2014).

Finally, the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA for its Portuguese acronym) is an arm of the Brazilian Ministry of the Environment, and has the specific mandate to enforce the Forest Code. Under Decree No. 6686, IBAMA can issue fines for illegal deforestation, destroy equipment used in illegal deforestation, and seize harvested timber. Although individuals and companies that receive environmental violations (embargoes) can appeal these decisions, violations remain costly and cumbersome, potentially limiting business opportunities in the agricultural sector. Appendix Figure A1 shows the spatial distribution of forest cover loss in the Brazilian Legal Amazon between 2000-2020.

2.2 Local Politics and Environmental Governance

Although formal environmental governance in Brazil is set and enforced mostly at federal and state levels, many municipal governments host environmental secretariats, councils, or other entities that are responsible for preservation, conservation, recuperation, and control of the environment and municipal natural resources. Municipalities also play an important role in agricultural promotion, including agricultural extension services, phytosanitary defense, irrigation, land-use policy, and rural credit (Ávila and Malheiros, 2012; Leme, 2016). These responsibilities are part of a broad municipal mandate to provide public goods and services, including education, health, public safety, and economic development. Municipalities may also apply for matching development grants from federal ministries, including the Ministry of Agriculture and Ministry of the Environment.

Brazilian municipalities are governed by a mayor and municipal council. Municipal elections occur every four years and are offset by two years from state and federal elections.[4] Both mayors and councilors serve four-year terms, and voting is obligatory.[5] Mayors are eligible to serve up to two consecutive terms (Lavareda and Telles, 2016). Brazil has over thirty political parties, which typically lack consistent programmatic identities at the municipal level, and candidates frequently switch between parties (Hott and Sakurai, 2021). Campaign donations must be registered with Brazil's Supreme Electoral Tribunal (TSE).

Mayors in the Brazilian Amazon may engage in patronage to win the support of campaign donors and special interest groups (Toral, 2022). Colonnelli et al. (2020) show that campaign donors to municipal mayoral candidates are significantly more likely to be hired to discretionary public sector jobs (*cargos comissionados*) after the candidate they supported wins a close election. Besides this form of public employment patronage, mayors could provide additional favors or benefits to supporters, or exert additional effort to govern on behalf of favored groups or individuals.

[4]In municipalities with populations less than 200,000 (including 758 out of 772 in the Legal Amazon), mayors are elected in a first-past-the-post system. For municipalities with more than 200,000 people, mayoral elections go to a second round if no candidate wins a majority in the first. Councilors are elected using an open list proportional representation system.

[5]Consequences for not voting and failing to justify this omission to election authorities within 60 days include: restrictions on receiving a passport or identify card, receiving public salaries or other benefits, or obtaining loans from public banks and credit institutions.

3 Data

In this section, we describe land registries covering the Brazilian Legal Amazon, remote sensing land use data, and political candidate and campaign donor registries, as well as supplementary datasets. Appendix Table B1 summarizes data sources.

3.1 Land Registries

Data from private land registries were provided by the Gibbs Land Use and Environment Lab, and come from three sources: Terra Legal, INCRA (*Instituto Nacional de Colonização e Reforma Agrária*), and CAR (*Cadastro Ambiental Rural*).[6] Property owners have strong incentives to register their properties under one or more of these systems in order to avoid land theft and facilitate access to environmental licensing and agricultural credit.

We combine individually-identified property records from the Terra Legal, INCRA, and CAR datasets spanning 2014-2017, 2016-2020, and 2011-2021, respectively. Properties may be retrospectively registered after their date of acquisition, allowing our data to include properties acquired or registered prior to 2011. In the states of Mato Grosso, Pará, and Rôndonia, our data represent complete coverage of property boundaries due to full availability of identified CAR registrations. Property registries are somewhat less complete in other Legal Amazon states due to partial availability of CAR. To the best of our knowledge, these combined cadasters constitute the most complete set of identified property maps individually-identified available for the Brazilian Legal Amazon.

3.2 Remote Sensing Land Use Data

We use satellite-collected remote sensing data from Collection 5 of MapBiomas to measure land-use change. Data cover the 2000-2019 period for the entire Legal Amazon with a

[6]Terra Legal is a federal program that began registering formal property rights in the Brazilian Legal Amazon in 2009, with a special focus on regularizing holdings on public lands. INCRA is a federal agency that oversees agrarian reform and land ownership issues. Its formal property registries include the Land Management System–SIGEF (*Sistema de Gestão Fundiária*), the Rural Property Registry Certificate–CCIR (*Certificado de Cadastro de Imóvel Rural*), and the Rural Property National Registry–CNIR (*Cadastro Nacional de Imóveis Rurais*). CAR, the Rural Environmental Property Registry, is a program that requires (since 2012) the mapping of property boundaries for each rural property in Brazil, whether property rights are formally held or not.

spatial resolution of 30m. Based on MapBiomas' data, we calculate land-use outcomes (deforestation, soy cultivation, non-soy agriculture, and pasture) at both the property and municipal levels. At the property level, we measure deforestation as hectares of land that transition from natural vegetation (Forest Formation and Savannah Formation classes) to non-natural (Anthropic) classes during a given year, as a percentage of property area. For robustness analysis, we also compute a binary deforestation indicator that takes a value of 1 if the property experienced deforestation of two hectares or more during the previous year.[7] To measure agricultural and livestock (primarily cattle) land uses, we compute hectares under crops (soy and other crops) and pasture as percentages of property area. We compute analogous measures of deforestation and land-use at the municipal level.[8]

3.3 Candidate and Donor Registries

Brazil's Supreme Electoral Tribunal publishes complete registries of political candidates for the 2000, 2004, 2008, 2012, and 2016 municipal elections, as well as complete registries of campaign donations made in the 2004, 2008, 2012, and 2016 elections.

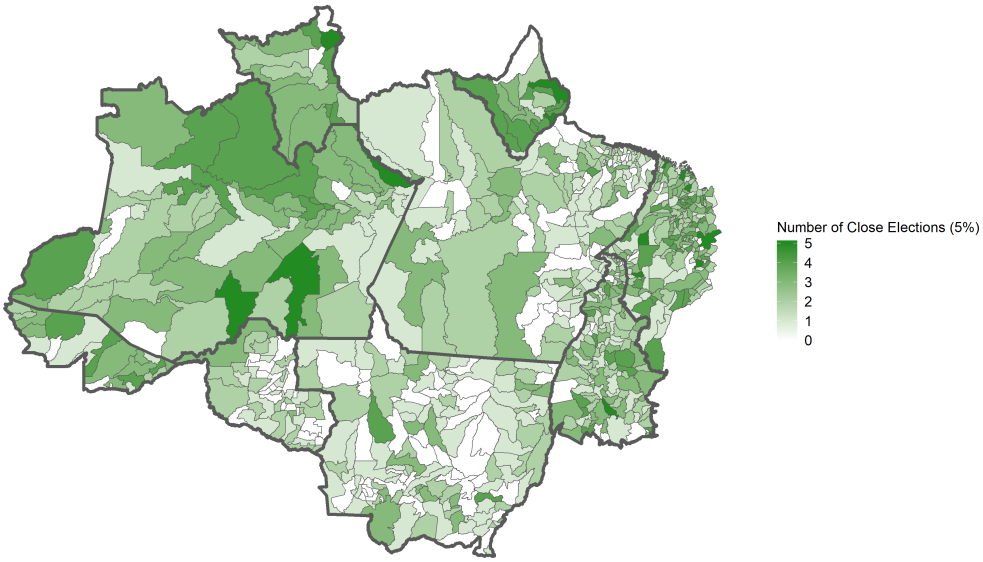
For mayoral candidates, we compute election win margins by identifying winning and runner-up vote shares and taking the difference between these shares. We set win margins to 100 when a mayoral candidate runs uncontested. Based on computed win margins, we identify municipality-election pairs with close elections ($\leq 5\%$ win margin). Figure 1 maps the number of close elections over the 2000-2016 period for each municipality in the Legal Amazon. Competitive mayoral elections are relatively evenly spread across the region and represent 25% of elections over the course of our study. We do not compute close election cutoffs for council elections, as these use an open list proportional representation system. Elected candidates enter office on January 1st of the year after their election (which occurs

[7]Since MapBiomas is meant to be used at a scale of up to 1:100,000, the minimum mappable unit of MapBiomas is one hectare (Tobler, 1987). To ensure the detected transition from natural to anthropic land use is not the result of a satellite error, we check that each pixel where deforestation was detected remains under anthropic land use in year t+1.

[8]Advantages of the MapBiomas dataset are multiple. First, the dataset has complete coverage of the region. Second, MapBiomas' methodology is customized by biome, with a collaborative network of specialists in each biome ensuring more precise land use classifications. Third, MapBiomas includes deforestation occurring in non-primary forests, allowing us to account for re-growth and secondary deforestation of previously deforested lands. In contrast, PRODES, the deforestation dataset created by the National Institute for Space Research of Brazil, does not capture secondary deforestation.

in October). Thus, their term in office spans the four years after their election year (e.g., 2013-2016 for the 2012 election).

Figure 1: Number of Close Elections ($\leq 5\%$ Win Margin) per Municipality (2000-2016)



Note: Map reports numbers of close elections in each municipality over 2000, 2004, 2008, 2012, and 2016 elections for the Brazilian Legal Amazon.

3.4 Supplementary Datasets

To measure environmental compliance, we use data on property and owner-level "embargoes" for environmental violations spanning 2005 to 2020, from IBAMA.[9] At the property level, we create an indicator that assumes a value of 1 when an embargo is associated with a property or property owner in a given year. At the municipal level, we sum individual embargoes to create an aggregate measure of environmental violations.

For analysis of mechanisms at the municipal level, we build a panel dataset spanning 2000-2019. We draw disaggregated municipal spending from FINBRA/SICONFI (the System of Fiscal and Accounting Information for the Brazilian Public Sector), from which we compute spending on Agricultural Promotion (the sum of spending on Agriculture, Colonization, Agro-livestock Defense and Sanitation, Rural Extension, Irrigation, Agrarian Or-

[9]This dataset was shared with us by the Gibbs Land Use and Environment Lab.

ganization, Agro-Livestock Promotion, Land Reform, and Other Ag. Subfunctions) and Environmental Management (the sum of spending on Environmental Control, Management, Preservation and Conservation, Recuperation of Degraded Areas, and Other Environmental Subfunctions). We draw data on federal matching grants from the *Procuradoria Geral da União*. Finally, we draw data on rural credit received by producers and cooperatives for agriculture and livestock from the National System of Rural Credit (SNCR) of the Central Bank of Brazil. Monetary variables are deflated to constant 2010 $BRL using the INPC deflator from Ipea, and continuous variables are transformed using the inverse hyperbolic sine function.

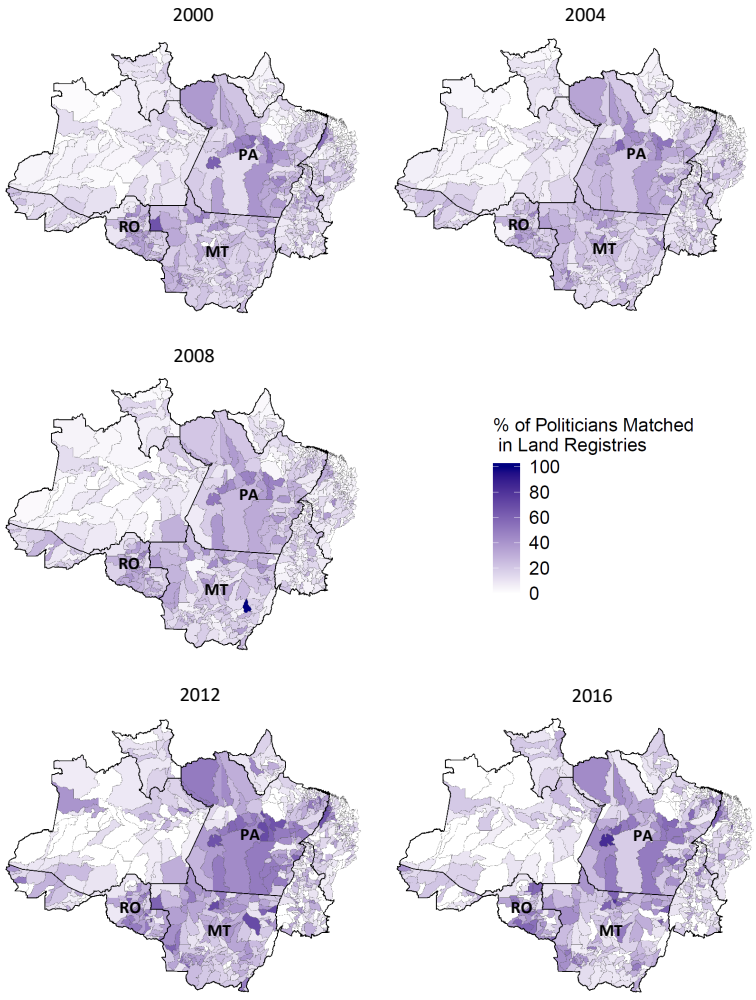
3.5 Data Merging and Limitations

We perform exact matches between (i) political candidates' and donors' name or ID number and municipality code and (ii) the name or ID number and municipality code associated with properties in the union of land registries. Since multiple properties may be associated with a single candidate, we aggregate property-level data to the candidate/donor level. We are thus able to observe land use transitions each year between 2000-2019 on the landholdings of municipal political candidates and campaign donors. In our preferred specification, we restrict the sample to municipalities within the Amazon biome (a subset of the Legal Amazon administrative region) in order to avoid inconsistencies in legal restrictions and land use dynamics between Amazon and Cerrado biomes. Amazon biome municipalities are mapped in Appendix Figure A2.

Although the quality and coverage of our combination of land registries are exceptionally high compared to data available in most developing countries, we note two limitations of this dataset. First, our matching between candidates/donors and land registries is not perfect. Identified CAR registries are not fully available outside of Mato Grosso, Pará, and Rondônia, and as a result, we may fail to correctly identify some politicians as landholders in other Amazon states. Figure 2 shows the percentage of municipal political candidates matched with properties in combined land registries by election period. Matches are not expected to reach 100%, as not all candidates are landholders. Further, land could be held by candidates' or donors' family members or associates. To address the threat from measurement

error introduced by incomplete land registries outside of Mato Grosso, Pará, and Rôndonia, we implement robustness checks wherein we limit our analysis to the subsample of properties and municipalities in these three states.

Figure 2: Percent of Mayoral Candidates Matched with Land Registries (2000-2016)



Note: Map reports percentage of municipal mayoral candidates that matched in each election with property boundaries from CAR, Terra Legal, or INCRA. Match percentages should not be expected to be near 100, as many politicians are not landowners.

A second limitation of our data is that we only observe property ownership at the moment of land titling or registration, and it is not possible to determine whether the identified holder truly held that property for the duration of the 2000-2019 period. We thus make a simplifying assumption that land ownership is time-invariant over this period.[10]

[10]We justify this assumption with recent evidence that land transactions are infrequent in the Amazon

In our property-level empirical strategy, we minimize potential bias or measurement error from these limitations by estimating effects *between* treated (winner of a close election) and control (runner-up in a close election) landowning candidates and donors. Thus, candidates or donors who we mis-identify as non-landholders due to gaps in land registries are excluded from the sample. Further, we normalize outcomes to percentage of property area to accommodate changes in property size over time.

3.6 Descriptive Statistics

In Table 1, we present descriptive statistics for mayoral candidates and campaign donors to mayoral candidates, as well as sub-samples of these groups corresponding to our treatment and control groups (i.e., winners and runners-up), for the 2000, 2004, 2008, 2012, and 2016 mayoral elections in the Brazilian Amazon biome. We match 25% of winning candidates and 17% of runners-up with land registries, as well as 8% of donors to winners and 7% of donors to runners-up. Just 13% of elected mayors self-identify as farmers or ranchers, suggesting there is substantial under-reporting of politicians' true landholding status.[11]

region – involving only 0.51% of properties during 2019-2020 (Moffette et al., 2023). This value is calculated by dividing the number of properties in Amazon states posted for sale between August 2019 and April 2020 on the sales platform OLX (similar to Craigslist, OLX is commonly used for property transactions) by the total number of registered properties in CAR in December 2021 (publicly available on the website of the Brazilian Ministry of Agriculture and Livestock) (MAPA, 2021).

[11]The share of self-declared farmers and ranchers may be lower than values derived from land registries because (i) some politicians may hold small properties, thus appearing in our classification as landholders despite holding another occupation (though candidates' large average landholding suggests this is not a primary factor); (ii) many politicians list their occupation as "politician," or do not declare an occupation, introducing measurement error and highlighting the contribution of our real matching procedure relative to the self-declared data used in Bragança and Dahis (2022).

Table 1: Descriptive Statistics: Candidates and Donors in Amazon Biome

	Municipalities in Amazon Biome (Elections: 2000, 2004, 2008, 2012, 2016)					
	Mayoral Candidates			Donors to Mayoral Candidates		
	All	Runner-Up	Winner	To All	To Runner-Up	To Winner
No. Total Candidates/Donors	7,062	2,061	2,148	277,735	40,819	90,009
No. Landholder Candidates/Donors	1,387	342	533	19,283	3,124	7,170
% Landholders	19.6	16.6	24.8	6.9	7.7	8.0
Full Sample:						
% Declared Land-Linked Occup.	10.8	11.8	12.7	-	-	-
	(31.0)	(32.3)	(33.3)			
Age	47.3	47.4	46.7	-	-	-
	(14.5)	(9.7)	(9.7)			
% Female	13.4	13.5	11.9	-	-	-
	(34.1)	(34.2)	(32.4)			
Education Level	6.1	6.0	6.0	-	-	-
	(1.9)	(1.9)	(1.8)			
No. Donations Received/Given	15.7	16.6	21.8	1.9	1.4	1.5
	(39.1)	(35.3)	(39.1)	(3.7)	(1.3)	(1.4)
Val. Donations Received/Given	62,338	69,526	75,250	3,127	4,443	2,298
	(310,473)	(348,459)	(208,075)	(54,259)	(29,555)	(10,852)
Among Landholders:						
Total Landholding (ha.)	2,074	1,742	2,898	1,538	1,592	1,410
	(7,752)	(4,239)	(9,771)	(19,221)	(17,295)	(16,591)
No. Properties	2.6	2.7	2.9	1.5	1.8	1.6
	(3.7)	(4.3)	(4.4)	(1.5)	(2.1)	(1.6)
% Baseline Forest Cover (2000)	54.8	55.8	53.4	52.7	50.7	51.7
	(31.0)	(29.8)	(31.1)	(34.0)	(33.8)	(33.6)
Avg. Yrly Deforest. (% Landholding)	2.0	2.0	2.0	2.3	2.3	2.3
	(1.8)	(1.7)	(1.8)	(2.0)	(2.0)	(1.9)
No. of Years with Deforest. Registered	3.8	4.0	4.0	2.6	2.8	2.7
	(4.2)	(4.2)	(4.6)	(3.7)	(3.7)	(3.7)
% of Landholding Deforested (2000-2020)	40.8	40.6	40.7	46.8	45.2	45.7
	(36.6)	(34.8)	(36.2)	(39.8)	(39.8)	(39.5)
% with Environmental Violation	16.4	14.9	19.9	6.3	9.2	7.7
	(37.0)	(35.7)	(40.0)	(24.3)	(28.9)	(26.7)
Avg. Yrly Pasture (% Landholding)	49.6	49.3	50.9	55.5	55.3	56.0
	(30.5)	(29.2)	(30.4)	(32.1)	(32.5)	(31.8)
% Converted to Pasture (2000-2020)	11.4	11.4	10.8	15.8	12.8	15.1
	(24.3)	(26.0)	(23.1)	(27.2)	(25.5)	(27.2)
Avg. Yrly Soy (% Landholding)	0.7	0.8	0.9	0.6	0.7	0.8
	(4.4)	(5.1)	(4.9)	(4.4)	(4.3)	(5.0)
% Converted to Soy (2000-2020)	1.8	1.8	2.1	1.7	2.1	2.0
	(8.2)	(8.0)	(8.8)	(9.8)	10.3	(10.4)
Avg. Yrly Other Ag. (% Landholding)	0.4	0.6	0.5	0.4	0.5	0.4
	(2.2)	(3.5)	(1.8)	(2.4)	(2.5)	(2.3)
% Converted to Oth Ag. (2000-2020)	0.5	0.8	0.5	0.4	0.4	0.4
	(3.8)	(6.2)	(3.2)	(3.7)	(3.3)	(3.8)
% Land-Linked Declared Occup.	22.6	22.2	22.5	-	-	-
	(41.9)	(41.6)	(41.8)			
Age	48.6	48.2	47.7	-	-	-
	(12.7)	(9.3)	(9.7)			
% Female	9.6	9.1	9.0	-	-	-
	(29.5)	(28.8)	(28.7)			
Education Level	5.9	5.8	5.9	-	-	-
	(1.9)	(1.9)	(1.9)			
No. Donations Received/Given	22.6	20.4	29.5	2.5	1.9	2.7
	(43.2)	(43.6)	(47.2)	(4.8)	(2.5)	(6.8)
Val. Donations Received/Given	94,953	102,389	110,653	6,299	10,585	7,100
	(265,478)	(399,380)	(223,227)	(38,464)	(47,323)	(37,133)

Note: Table presents sample means with standard deviations in parentheses. Data on candidates are averaged across the 2000-2016 elections, while data on donors are averaged across the 2004-2016 elections since donation data are unavailable in 2000. Data on forest cover and land use are from MapBiomas (Collection 5). Data on landholdings are drawn from Terra Legal, INCRA, and CAR. Data on mayoral candidates and campaign donors are from TSE. Environmental violations refer to IBAMA embargoes registered to either the individual or a property held by that individual. Education levels include 1 (illiterate), 2 (basic literacy), 3 (incomplete primary), 4 (complete primary), 5 (incomplete secondary), 6 (complete secondary), 7 (incomplete higher ed.), 8 (complete higher ed.). Monetary donation values are deflated to constant 2010 $BRL.

Among the subset of candidates and donors who match with land registries, the average mayoral candidate held 2,074 hectares (ha.) across 2.6 properties (2,898 ha. across 2.9 properties for elected mayors), while the average donor to a mayoral candidate held 1,538 ha. across 1.5 properties. Evidently, landholders participating in local politics in the Amazon tend to be largeholders. Landholding mayoral candidates' properties experienced significant deforestation over the 2000-2019 period (averaging 41% of baseline forest cover), and 16% received at least one environmental violation (20% for elected mayors). The average mayoral candidate had 50% of their land under pasture, 0.7% under soy, and 0.4% under other crops during the study period, and converted 1.8% (2.1% for elected mayors) of their land to soy by 2019. Landholding mayoral candidates also receive significantly more and larger donations than mayoral candidates on average (BRL$94,953 versus BRL$62,338), and landholding donors give substantially more than donors on average (BRL$6,299 versus BRL$3,127).

Turning to the municipality-level, Appendix Table B2 reports means and standard deviations of municipal characteristics for municipalities in the Brazilian Amazon biome. Of 432 municipalities in the Amazon biome, 326 had at least one close election at the 5% win-margin level. Across municipal characteristics, there are no noteworthy differences between places that had close elections and places that did not.

4 Empirical Strategies and Identification

Section 4.1 presents our empirical strategies, beginning with the property-level strategy to identify causal effects of close election of a mayoral candidate on land use and environmental outcomes on (i) the candidate's personal properties, and (ii) the properties of donors who supported that candidate. In Section 4.1.2, we present a municipal-level strategy to identify causal effects of election of a mayor with (i) personal landholdings, or (ii) who received landholder donations, on municipal land-use and governance mechanisms. Section 4.2 discusses assumptions and challenges to identification.

4.1 Empirical Strategies

4.1.1 Candidate and Donor-Level Event Studies

We leverage candidate and donor-level annual panel datasets spanning 2000-2019 to estimate dynamic event study specifications (e.g., Schmidheiny and Siegloch, 2019). Specifically, we compare land use transitions on properties held by winning versus runner-up mayoral candidates (separately, donors to these candidates) in years before and after the winner's entry into office. To account for endogeneity of election outcomes, we restrict our sample to close elections ($\leq 5\%$ win margin) – where the outcome was plausibly random.[12] To avoid bias introduced by staggered treatment timing and heterogeneous treatment effects (Goodman-Bacon, 2021), we implement Callaway and Sant'Anna (2020)'s group-time average treatment effect estimator (*csdid*) with never-treated and not-yet treated runners-up as controls.[13]

For mayoral candidate or donor i in year t, let E_i be the year in which a successful candidate enters office for the first time. Let $K_{it} = t - E_i$ be the relative number of years before or after this event. We regress outcome y_{it} on $\mathbb{1}(K_{it} = k)$ relative year indicators for the fully saturated set of indicators going from the beginning to the end of sample. We control for individual and year fixed effects as well as a vector of time-varying covariates for the winning mayor (sex and education level), and cluster standard errors at the level of treatment (i.e., candidate/donor-level) (Abadie et al., 2022):

$$y_{it} = \theta_i + \lambda_t + \sum_{k \neq -1} [\mathbb{1}(K_{it} = k)]\beta_k + \epsilon_{it}.$$

This specification flexibly identifies dynamic effects of entry into office and enables evaluation of the identifying parallel pre-trends assumption. Controlling for individual fixed effects identifies treatment effects off of within-individual variation over time. Year fixed effects remove variations that affect all units in specific years, such as world commodity price changes or policy changes at the national level.

[12] Close election identification strategies have been employed previously in the context of Brazilian municipal elections, e.g., Bragança and Dahis (2022), Colonnelli et al. (2020) and Brollo and Troiano (2016).

[13] A new literature is currently emerging on nonclassical measurement error in satellite data (e.g., Alix-Garcia and Millimet, 2023). However, this literature is thus far limited to binary outcomes and cannot be combined with estimators such as *csdid* from Callaway and Sant'Anna (2020).

4.1.2 Municipality-Level Difference-in-Differences

We next develop a municipal-level generalized difference-in-differences strategy to explore aggregate land-use effects of landholders' participation in local politics, and to measure their influence on governance.[14] We define treatment T_{me} as an indicator that assumes a value of 1 when the elected mayor in municipality m in election period e either: (i) is a landholder, (ii) is a large landholder ($\geq$500 ha.), (iii) received campaign donations from landholders, (iv) received more than 25% of their total value of donations from landholders, and (v) received more than 50% of their total value of donations from landholders; T_{me} assumes a value of 0 otherwise. We regress outcomes y_{me} separately on these treatment indicators, including municipality and election-period fixed effects and a vector of time-varying controls for the winning mayor (sex and education level):

$$y_{me} = \beta T_{me} + \mathbf{X}'_{ime}\mu + \delta_m + \ \theta_e + \epsilon_{me}.$$

We cluster standard errors at the municipality-level and limit the sample to municipality-election pairs with close elections ($\leq$5% win-margin), thus reducing concerns over the endogeneity of election outcomes. Outcomes of interest at the municipality level include land use (pasture, soy, and other agricultural crops as a percentage of municipal area), environmental outcomes (deforestation as a percentage of municipal area and environmental violations per thousand municipal residents), and governance mechanisms, including per capita municipal spending on agricultural promotion and environmental management, municipal receipt of federal matching grants from the Ministries of Agriculture and the Environment, and the value of rural credit for livestock and agriculture received per hectare .

[14] We do not implement Callaway and Sant'Anna (2020) at the municipality-level in our preferred specification since election of a landholding or landholder-financed mayor is a treatment that turns on and off again, while the *csdid* estimator assumes treated units remain treated. To test for pre-trends and gauge the extent of bias from retention of already-treated units, we estimate municipality-level event studies for key outcomes using the *csdid* estimator in Appendices C22-C31. These specifications reveal dynamic effects, but have the disadvantage of registering only the first time a municipality is treated.

4.2 Identification

Implementation of close election identification strategies typically involves a regression discontinuity (RD) approach, wherein outcomes in municipalities where a mayor with the characteristic of interest (e.g., landholder) wins a close election are compared to outcomes in municipalities where a mayor with that characteristic loses a close election. Eggers et al. (2015) document that assumptions underlying valid inference using close election RDs are likely to hold in most contexts. However, Marshall (2022) shows that the cross-sectional close election RD approach may fail to identify effects of candidate characteristics if other characteristics correlate with the characteristic of interest.

We leverage our rich panel dataset to implement a hybrid approach, wherein we estimate dynamic difference-in-differences specifications comparing outcomes on the properties of treated (winners of close elections) and control (runners-up in close elections) candidates and donors, including individual fixed effects to absorb time-invariant variation at the individual level. The identifying assumption is that, absent the "as-if-random" close election result, outcomes on the properties of winning mayoral candidates would have followed the same trajectory as outcomes on the properties of runners-up. Control units are restricted to runners-up who are never-treated or not-yet-treated. Constraining the sample in this way avoids concerns over endogenous selection-into-candidacy.

Violations of the parallel pre-trends assumption could occur if (i) anticipation effects are large or (ii) the as-if-random close election assumption does not hold and winners are on significantly different trajectories than runners-up. A further threat could come from spatial spillovers between treated and control units. We evaluate pre-trends directly in event studies and moderate the strength of causal interpretations in light of this. Spatial spillovers are unlikely at the property-level, given that municipalities in the Brazilian Amazon are large (averaging 6,682 km^2) and properties of winners and runners-up are unlikely to abut. Spillovers are also unlikely at the municipal-level, given that municipalities with both close elections and treated mayors are unlikely to be adjacent in space and coincident in time. Furthermore, governance mechanisms (e.g., municipal public spending and federal matching grants) are mostly use-restricted to within a municipality's boundaries.

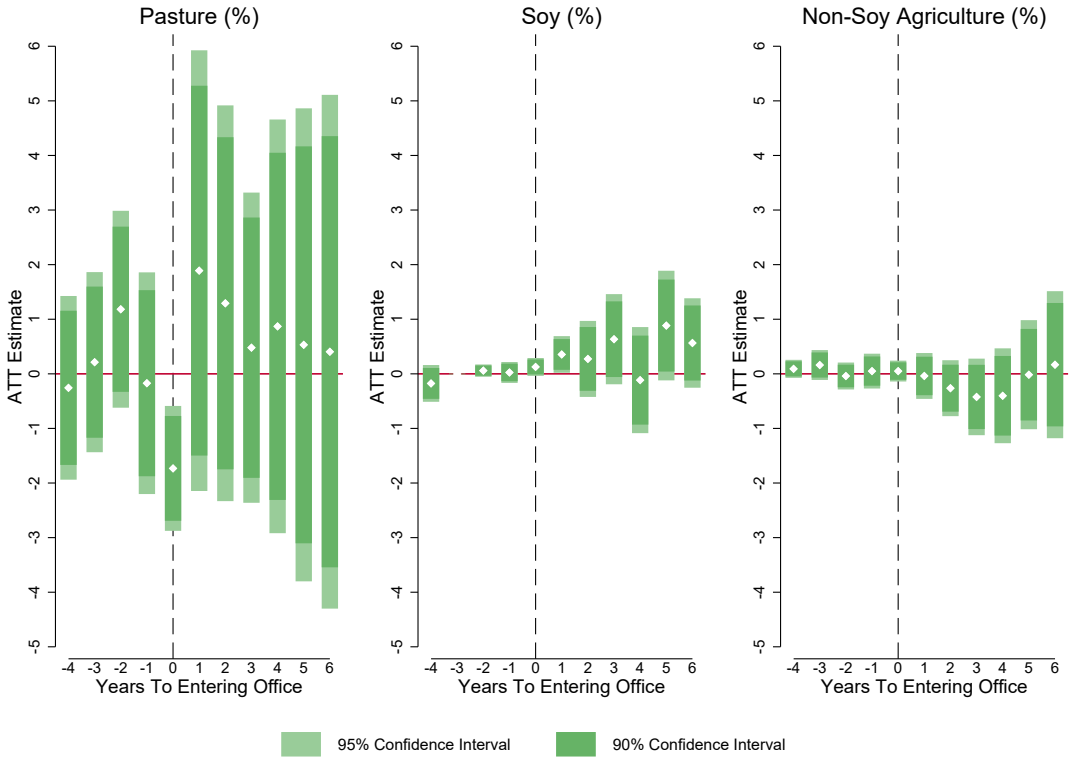
5 Results: Candidate and Donor Level

We first examine the effects of winning a close ($\leq$5% win-margin) mayoral election on land use and environmental outcomes on properties belonging to winning candidates, relative to outcomes on properties belonging to never-treated and not-yet treated runners-up. Figure 3 reports the effects of a mayoral candidate's entry into office on pasture, soy, and other crop cultivation as percentages of property area. Tables corresponding to results figures are reported in Appendixes B3-B6. While estimates at the candidate level are imprecise due to limited sample size,[15] we note that entry into office substantially increases point estimates of soy cultivation during the first mayoral mandate (+212% in the first year, +592% in the second year, and +1057% in the last year of the mandate, from a baseline mean of 0.06% of property area).[16] Land dedicated to cultivation of other agricultural crops declines weakly after candidates' entry into office in a close election, while there is a 4% decrease in pasture area during the first year as mayor.

[15] Our empirical strategy compares mayoral candidates within the Amazon biome (a subset of the Legal Amazon) who match with land registries and are winners or losers in a close election at the 5% win-margin level. These criteria limit the sample size, and thus the statistical power, of estimates at the candidate-level. Since there are substantially more campaign donors than candidates, these estimates are more precise.

[16] To estimate effect sizes, we compute the percentage increase relative to the baseline. In the case of soy cultivation for candidates (baseline percentage of 0.06, point estimate of 0.127 for the first year in office), this amounts to: [(0.06+0.127)-0.06]/0.06 = 212%. In all estimations, the baseline dependent variable mean is equal to its average at t-1 for treated units and in 2001 for control units. All dependent variable baseline means are presented in Tables B3-B6 at the property-level and in Tables B7-B8 at the municipal level.

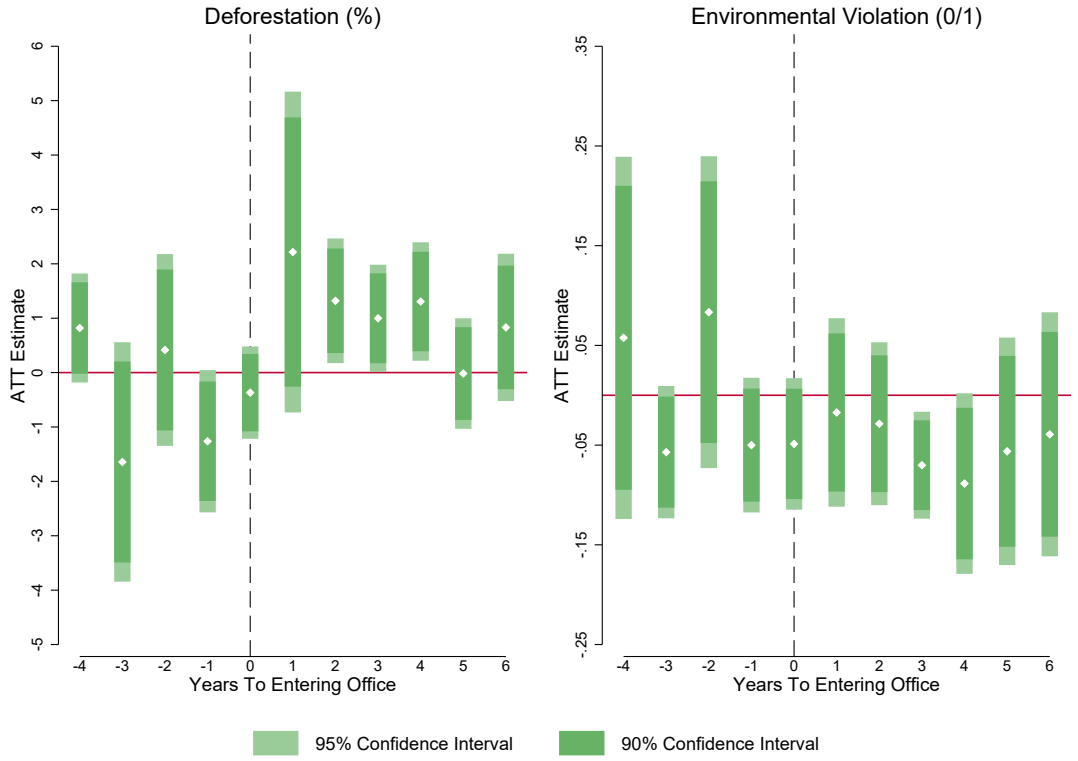
Figure 3: Candidates: Effects of Entry into Office on Land Use
(Sample = Elections with $\leq$ 5% Win Margin)



Note: Figures report dynamic ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never treated and not yet treated compose the control group. Candidate and year fixed effects are included and standard errors are clustered at the candidate level. Sample is a 20-year candidate panel (2000-2019) for all municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcomes measure hectares of pasture, soy, and other crops as a percentage of property area.

As reported in Figure 4, successful mayoral candidates deforest significantly more than runners-up in years two, three, and four after their entry into office (+52%, +39% and +52%, respectively). This finding provides evidence that mayors increase deforestation on their personal properties while in office. The effect of entry into office on environmental violations presents a noteworthy contrast: successful candidates are significantly less likely than runners-up to receive environmental violations in years three and four after entry into office. Taken together with the simultaneous increase in deforestation on successful candidates' properties, this suggests mayors may enjoy some level of political cover from federal environmental enforcement on their personal properties.

Figure 4: Candidates: Effects of Entry into Office on Environmental Outcomes (Sample = Elections with $\leq$ 5% Win Margin)

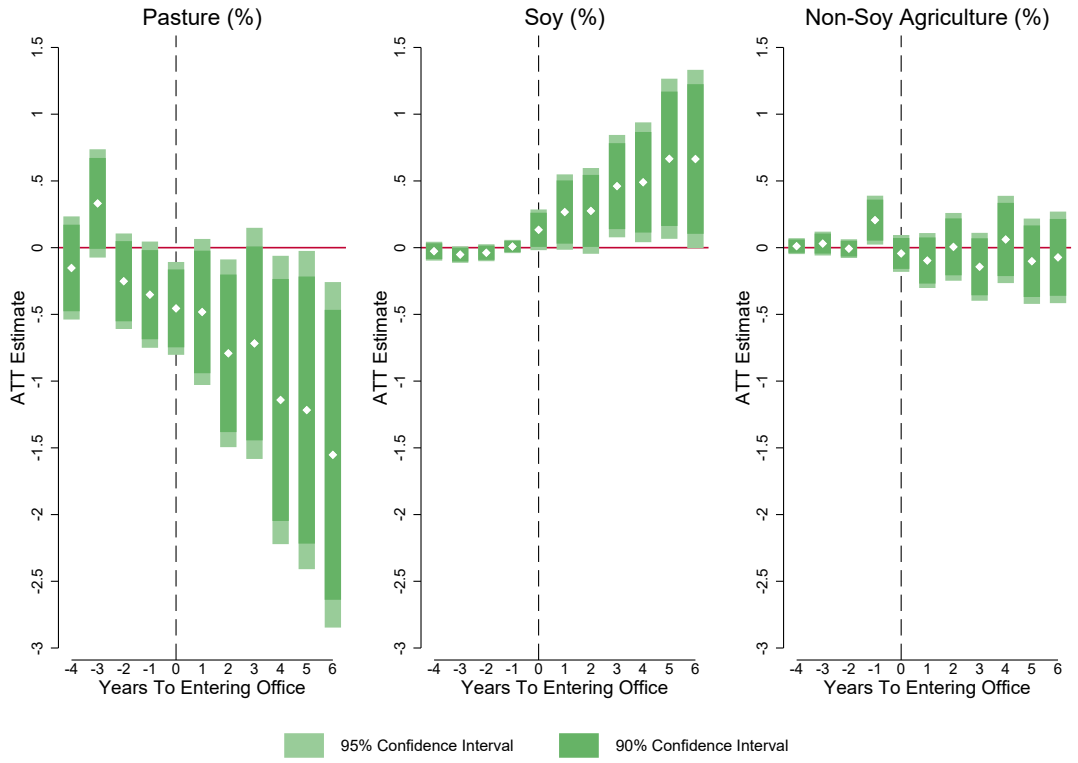


Note: Figures report dynamic ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never treated and not yet treated compose the control group. Candidate and year fixed effects are included and standard errors are clustered at the candidate level. Sample is a 18-year candidate-level panel (2001-2018) for all municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcomes are (i) hectares that transitioned from natural vegetation (Forest and Savannah Formations) to anthropic use as a percentage of property area, and (ii) an indicator of whether an IBAMA environmental embargo was registered to an individual's ID or properties in a given year.

Turning to campaign donors, we find that close election of a mayoral candidate to whom a landholder gave donations leads to a statistically significant increase in soy cultivation both during and after the first mayoral mandate (+185% three years after the candidate's entry into office and +247% six years on, from a baseline mean of 0.27% of property area), relative to properties of landholders who donated to runner-up candidates (Figure 5). Simultaneously, pastureland declines significantly by 1-3% from a baseline mean of 53% of property area. Land dedicated to other crops remains unchanged. We measure no significant effects of candidates' entry into office on deforestation or environmental violations on their donors' properties (Figure 6), suggesting federal environmental enforcement was strong enough during this period to counter a "deforestation patronage" channel.

These findings suggest that donors undertook significant shifts of already-cleared pasture-land to soy while the candidate they supported was in office. Soy is much more profitable than raising livestock on pasture, but also involves capital, knowledge, and technical inputs that may present barriers to adoption for landholders (Moffette and Gibbs, 2021). A political connection to the mayor may enable landholding donors to overcome these barriers and place them on a trajectory of sustained soy-intensification. This finding provides evidence for a novel channel of "land-use patronage."[17]

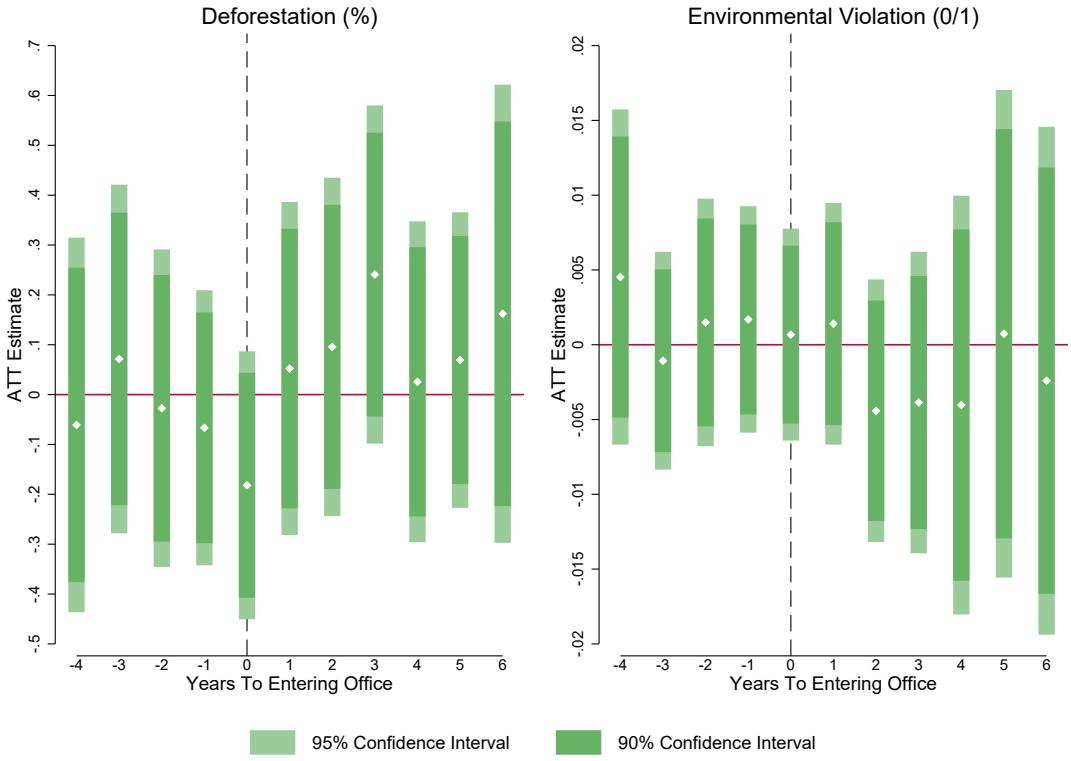
Figure 5: Donors: Effects of Supported Candidate's Entry Into Office on Land Use (Sample = Elections with $\leq$ 5% Win Margin)



Note: Figure reports dynamic ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated and never-treated donors. Donor and year fixed effects are included and standard errors are clustered at the donor level. Sample is a 20-year donor panel (2000-2019) for all donors to municipal mayoral candidates in close elections in 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcomes measure hectares of pasture, soy, and other crops as a percentage of property area.

[17]Our ability to analyze additional mechanisms (e.g., credit or agricultural inputs) at the property-level is limited by data requirements, since these analyses require identified property-level panel data.

Figure 6: Donors: Effects of Supported Candidate's Entry Into Office on Environmental Outcomes (Sample = Elections with $\leq$ 5% Win Margin)



Note: Figure reports dynamic ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated and never-treated donors. Donor and year fixed effects are included and standard errors are clustered at the donor level. Sample is 18-year donor panel (2001-2018) for all donors to municipal mayoral candidates in close elections in 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcomes are (i) hectares that transitioned from natural vegetation (Forest and Savannah Formations) to anthropic use as a percentage of property area, and (ii) an indicator of whether an IBAMA environmental embargo was registered to an individual's ID or properties in a given year.

6 Results: Municipal Level

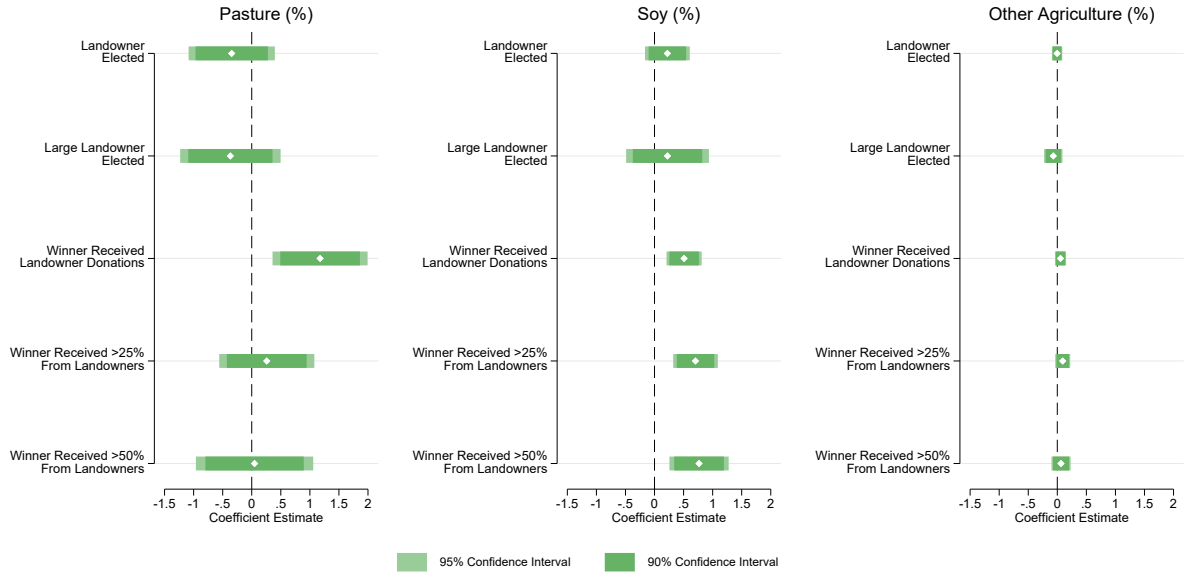
As shown in Section 5, mayors with personal landholdings may convey individualized benefits to themselves or their donors (e.g., improved access to agricultural inputs or factor markets, facilitating soy adoption). However, landholding or landholder-financed mayors may also govern differently. In this section, we estimate municipality-level difference-in-difference specifications where treatment is defined as close election ($\leq$ 5% win-margin) of a mayor who (i) is a landholder, (ii) is a large landholder ($\geq$500 ha.), (iii) received campaign donations from at least one landholder, (iv) received 25% or more of total donation value from landholders, or

(v) received 50% or more of total donation value from landholders. In Section 6.1, we examine the impact of these ties on municipal land use and environmental outcomes, paralleling our study at the property level. In Section 6.2, we examine potential governance mechanisms underlying effects on land use and environmental outcomes.

6.1 Municipal Level: Land Use and Environmental Outcomes

Figure 7 reports results for municipal land use. Corresponding tables are reported in Appendices B7-B8. Each column reports coefficient estimates and 90 and 95% confidence intervals for separate estimation of the specified treatment variable on an outcome of interest. As shown in Figure 7, close election of a mayor with personal landholdings or large landholdings has no significant effect on municipal land use for pasture, soy, or other crops over their subsequent four-year mandate. In contrast, election of a mayor who received more than 25% of the total value of their campaign donations from landholders increases land under soy cultivation by 1,007% (from a baseline mean of 0.07% of municipal area) during their four-year mandate. This effect is even larger for municipalities where a close election is won by a mayor who received more than 50% of their campaign donations from landholders.

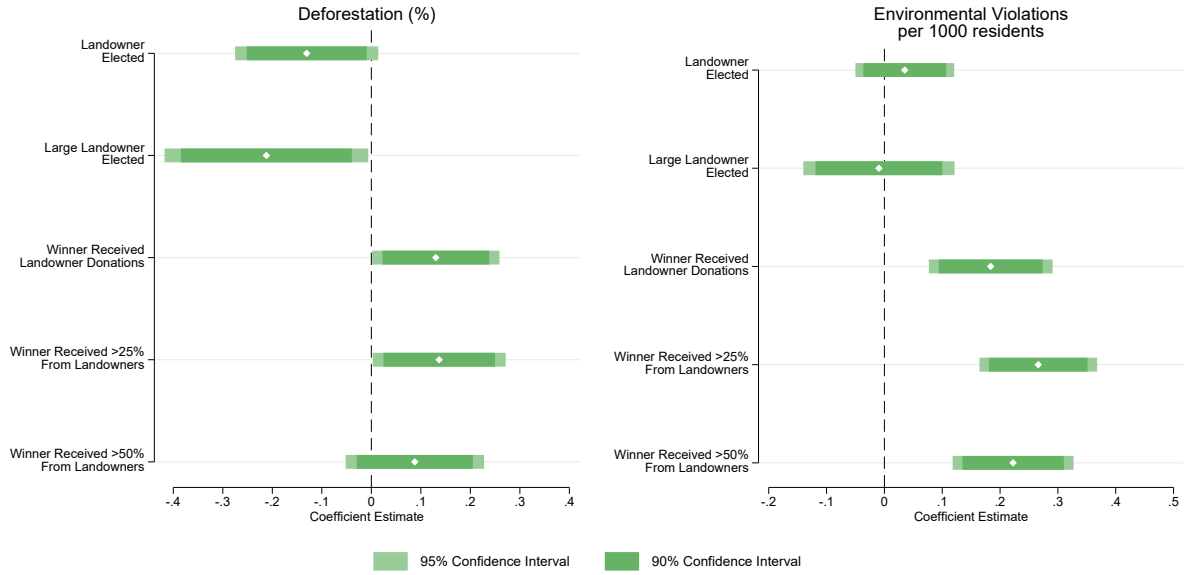
Figure 7: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Land Use (Sample = Elections with $\leq$ 5% Win Margin)



Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% of their donations from landholders in office, and mayor who received $\geq$ 50% of their donations from landholders in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Figures report, from left to right, estimated effects on pasture, soy, and other crops as percentages of municipal area.

Sizeable increases in municipal soy cultivation upon election of a landholder-financed mayor are not associated with measurable decreases in pasture or other agricultural crops. However, as shown in Figure 8, increased soy cultivation while closely-elected, landholder-financed mayors are in office coincides with a significant 8% increase in forest clearing (from a baseline mean of 1.1% of municipal area). Since land is typically converted from natural vegetation to pasture and then to soy – rather than directly from natural vegetation to soy – this suggests that null effects on the stock of pasture disguise increased conversion of natural vegetation to pasture, which is countervailed by conversion of pasture to soy (Moffette and Gibbs, 2021). Perhaps surprisingly, close election of landholding mayors appears to result in *less* municipal deforestation. This finding suggests there is no necessary correlation between mayors' personal interests (e.g., increasing high-value soy on their own properties) and governance choices they make to affect aggregate outcomes.

Figure 8: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Environmental Outcomes (Sample = Elections with $\leq$ 5% Win Margin)



Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% of their donations from landholders in office, and mayor who received $\geq$ 50% of their donations from landholders in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Left figure reports estimated effects on deforestation (hectares of land that transitioned from natural vegetation (Forest and Savannah Formations) to anthropic use) as a percentage of municipal area. Right figure reports estimated effects on the number of IBAMA environmental embargoes registered on ID numbers and properties within municipal boundaries per thousand municipal residents (transformed by inverse hyperbolic sine function).

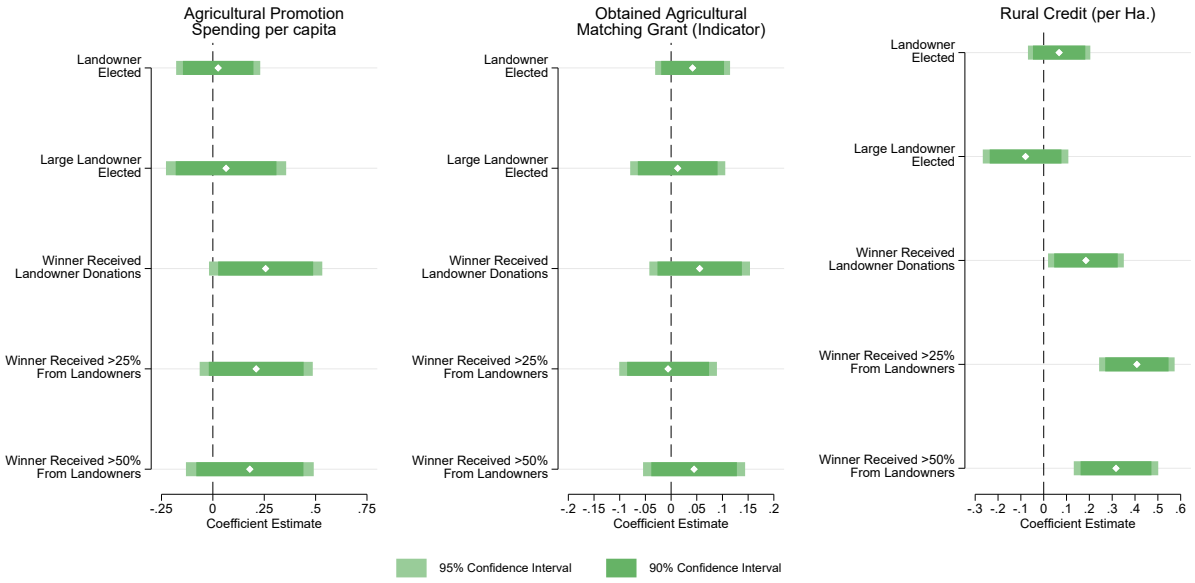
6.2 Municipal Level: Mechanisms

What do landholder-financed mayors do differently to enable significant increases in soy cultivation and deforestation while they are in office? To explore mechanisms, we estimate effects of identical treatment variables on municipal-level registration of environmental violations, municipal spending on agricultural promotion and environmental management, receipt of municipal matching grants from the Federal Ministries of Agriculture and the Environment, and receipt of rural credit for livestock and agriculture.

We first assess the effects of electing a landholding or landholder-financed mayor on a potential proxy for corruption: registry of IBAMA environmental violations, or "embargoes." While registration of violations is endogenous to the effort and strategy of federal environmental inspectors, we expect that – all else equal – increased deforestation in an Amazon municipality (where almost all forest clearing is illegal) should result in more environmental

violations if inspections and enforcement are applied objectively. A significant increase in deforestation that is not accompanied by increased registration of violations would thus provide suggestive evidence that local actors exert influence over federal inspectors to shelter local landholders from environmental enforcement. As reported in Figure 8, election of a mayor who received more than 25% of their campaign donation value from landholders is associated with a 27% increase in registration of environmental violations.[18] These findings lend evidence against a potential illicit influence channel underlying increases in soy cultivation and deforestation.

Figure 9: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Governance Mechanisms (Sample = Elections with $\leq$ 5% Win Margin)



Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% of their donations from landholders in office, and mayor who received $\geq$ 50% of their donations from landholders in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Left figure reports estimated effects on municipal spending on Agricultural Promotion (Agriculture, Colonization, Agro-livestock Defense and Sanitation, Rural Extension, Irrigation, Agrarian Organization, Agro-Livestock Promotion, Land Reform, and Other Agricultural Subfunctions); central figure reports estimated effects on the likelihood the municipality receives a matching grant from the Federal Ministry of Agriculture; right figure reports estimated effects on the total value of rural credit for agriculture and livestock per hectare of municipal area. Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

[18]Since all outcomes that are neither binary nor a percentage are transformed using the inverse hyperbolic sine function, point estimates can be interpreted directly as percentage effects.

Does close election of a landholding or landholder-financed mayor change municipal governance? As reported in Figure 9, municipal spending on agricultural promotion trends upward during the mandate of mayors who received campaign donations from landholders, though estimates are not statistically significant at conventional levels.[19] We next turn to a measure of mayoral effort: receipt of federal matching grants. Municipalities must apply for grants and exert effort in developing proposals, lobbying federal leaders, and negotiating terms. In Figure 9, we report estimated effects on the likelihood of receiving a federal matching grant from the Ministry of Agriculture during a mayor's four-year mandate. Estimates are not significantly different from zero for both landholding and landholder-financed mayors, suggesting they do not exert additional effort to promote agriculture through grants.[20]

Finally, we explore effects of close election of landholder and landholder-financed mayors on the total value of rural credit received by farmers and ranchers within the municipality. Rural credit is allocated to producers primarily through public and commercial banks as well as credit cooperatives, all of which can have close ties with municipal governments.[21] As reported in Figure 9, close election of mayors with personal landholdings has no measurable effect on rural credit. However, the total value of rural credit received per hectare increases by an average of 41% during the mandate of mayors who won close elections and received more than 25% of their total campaign donation value from landholders. The effect is also significantly positive among mayors who received any donations from landholders, as well as among those who received more than 50%.

[19] As reported in Appendix Figure A5, municipal spending on environmental protection and management increases significantly after close of election of mayors who received any donations from landholders, but this effect disappears for definitions of treatment that consider *substantial* donations from landholders (defined as receiving more than 25% or 50% of total donation value from landholders). Effects of election of landholder-financed mayors on total municipal spending are null.

[20] In Appendix Figure A6, we report results for grants from the Ministry of the Environment, as well as total grants. We find that the likelihood of a municipality receiving a grant from the Ministry of the Environment trends downward after close election of a mayor who received more than 25% of their donation value from landholders, but estimates are not statistically significant. We find no effects of entry into office of landholder or landholder-financed mayors on the overall likelihood of receiving any matching grant.

[21] Some municipal governments operate their own rural credit cooperatives, while others provide facilities and staff for cooperatives' operations. Thus, there are a variety of formal and informal channels through which mayors could influence local provision of rural credit. In 2021, 13.7% of rural credit was allocated to small producers, 11.5% to medium producers, and 74.8% to large producers, suggesting that large landholders are major beneficiaries of increases in rural credit (Ministério da Agricultura e Pecuária, 2022).

Taken together, our analysis of mechanisms suggests that landholder-financed mayors promote agriculture to a greater degree than do non-landholder-financed mayors: spending to promote agriculture trends upwards while they are in office, and rural credit for agriculture and livestock expands significantly, which may facilitate the significant increases in soy cultivation and deforestation that we document. Landholder-financed mayors do not appear to exercise illicit influence over federal environmental enforcement, as evidenced by the significant increase in environmental violations registered during their mandates.

Could it be that significant effects of landholder-financed mayors' entry into office are merely the effect of receiving large donation values, and that the origin of these donations from landholders is spurious? To exclude this possibility, we re-estimate difference-in-difference specifications with an alternative definition of treatment: municipalities are considered treated if a mayor who received more than the median donation value – but no donations from landholders – wins a close election. The intention of this exercise is to isolate the effect of receiving large donation values. Results, presented in Appendix Figure A7, show that simply receiving large donation values does not reproduce the previous findings. In fact, close election of mayors who receive above median donation values from sources other than agriculture leads to significantly *reduced* soy cultivation and deforestation as a percentage of municipal area, and significantly *reduced* environmental violations per capita. Evidently, politicians who receive substantial donations from non-landholding donors may govern on behalf of non-landholding special interest groups (e.g., urban or commercial), which may desire less deforestation and reduced promotion of agriculture relative to alternative investments.

7 Robustness

We implement a battery of robustness checks to test the sensitivity of findings to alternative samples and estimators. First, we re-estimate candidate and donor-level event studies using an alternative 10% win-margin cutoff, with results reported in Appendix Figures C1-C4. Results are comparable to our preferred specification but less precise. We consider the 5% win-margin cutoff to be preferable since it makes the as-if-random close election assumption more credible. We next re-estimate event studies for the subsample of municipalities in the

states of Mato Grosso, Pará, and Rondônia, where our combined land registries are most complete (Appendix Figures C5-C8). Results are comparable to our preferred specification. Finally, we re-estimate event studies for the entire Legal Amazon region, which encompasses our preferred sample (municipalities within the Amazon biome) as well as municipalities in Cerrado and Pantanal biomes (Appendix Figures C9-C12). These ecosystems present alternative land use dynamics and fall under different legal regimes. In this broader sample, results remain similar but become less precise due to increased heterogeneity.

At the municipal-level, we estimate event study specifications using yearly data and the Callaway and Sant'Anna (2020) estimator to (i) evaluate the validity of the parallel pre-trends assumption, (ii) explore dynamic year-on-year effects, and (iii) address concerns over bias introduced by staggered treatment timing. Results are reported in Appendix Figures C22-C31. In general, there are no significant differences in pre-trends between treated and control municipalities.[22] Post-treatment event study estimates corroborate our main finding that close election of landholder-financed mayors leads to increased soy cultivation, deforestation, environmental violations, and municipal spending on agricultural promotion.

In Appendix Figures C13-C15, we re-estimate municipal difference-in-difference specifications with a strongly balanced panel, which we enforce by keeping only municipalities that had close elections at the 10% win-margin level in each election period between 2004-2019. Our main results are generally robust to this balance restriction, though effects of landholder-financed mayors on deforestation lose statistical significance. In Appendix Figures C16-C18, we re-estimate specifications for municipalities in Mato Grosso, Pará, and Rondônia – where land registries are most complete. This restriction reduces the statistical power of our estimates, but we still find significant positive effects of landholder-financed mayors on soy and rural credit. Finally, we re-estimate specifications for the entire Legal Amazon (Appendix Figures C19-C21). Results are strongly robust to this broader sample definition.

[22]Exceptions to parallel pre-trends include rural credit, which is lower in treated municipalities in $t-4$, deforestation, which is higher in treated municipalities in $t-3$, and pasture, which is higher for $t<0$ when treatment is defined as close election of a candidate who received more than 25% of their donation value from landholders.

8 Conclusion

We construct a novel, individually-identified panel dataset measuring land-use and deforestation on the properties of municipal political candidates and campaign donors across five elections in the Brazilian Amazon. We leverage these data to evaluate three channels through which local politics may drive land-use change: (i) politicians' self-interest, measured by changes in land-use on winning candidates' properties while they are in office, (ii) land-use patronage, measured by land-use changes on donors' properties, and (iii) interest group influence, measured by municipal-level outcomes after the close election of a landholder-financed mayor.

At the property level, we find that candidates and their campaign donors increase land conversion to soy while the candidate is in office, suggesting that local political connections help farmers overcome barriers to agricultural intensification. Landholding mayors also significantly increase deforestation on their properties while in office, yet are significantly less likely to receive an environmental violation, indicating potential political influence over environmental enforcement. Notably, landholding mayors deforest on average 9.2% of their property area during their first four-year mandate alone. At the municipal-level, we find that close election of mayors with personal landholdings has no effect on aggregate municipal outcomes, but that close election of mayors who received campaign donations from landholders leads to significant increases in soy cultivation, deforestation, and environmental violations. These effects may result from mayors governing on behalf of agricultural special interests: municipal spending on agricultural promotion trends upward in these municipalities, and receipt of rural credit increases significantly.

Findings also suggest that rural producers face constraints on agricultural intensification in the Amazon. Conversion of pasture to soy requires significant capital, technological, and labor inputs, and landholders may turn to buying political influence through campaign donations as a way of overcoming these constraints. Mayors, in turn, may use the power of their office to facilitate preferential access to credit, services, or inputs for themselves and their donors. This dynamic represents a channel of land-use patronage that has not been documented previously, and which merits further study. At the municipal-level, we show

that agricultural special interest groups may use campaign donations to shape municipal governance in their favor – with adverse environmental consequences.

Cattle ranching on pasture in the Amazon is notoriously unproductive (Bragança et al., 2022), and conversion of pasture to soy can increase land productivity substantially – with concomitant contributions to local economic development. Nevertheless, soy production in the Amazon also leads to increased agro-chemical use and associated health and environmental complications, as well as exacerbation of inequalities between large landholders and the broader population. These inequalities may manifest in unequal local political representation, leading to a self-reinforcing cycle wherein politicians favor landholders, empowering this group and thus enabling further political influence. Quantifying these local incentives and channels of influence is an important step toward achieving more inclusive and sustainable land-use practices that enable economic development while respecting ecosystems and traditional communities.

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Online Appendix

Does Local Politics Drive Tropical Land-Use Change?

Property-Level Evidence from the Amazon

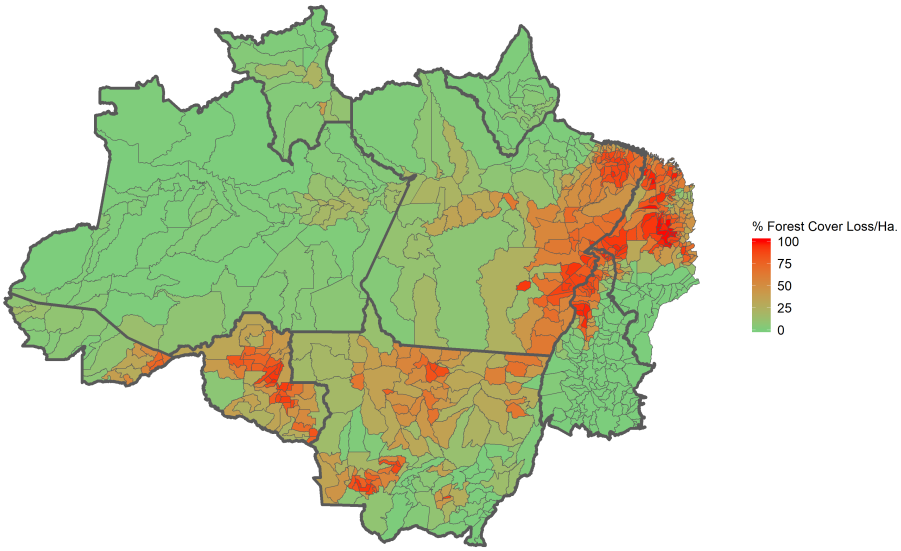
Erik Katovich and Fanny Moffette

Table of Contents

A Supplementary Figures

A.1 Descriptive Figures

Figure A1: Forest Cover Loss in Brazilian Legal Amazon (2000-2020)



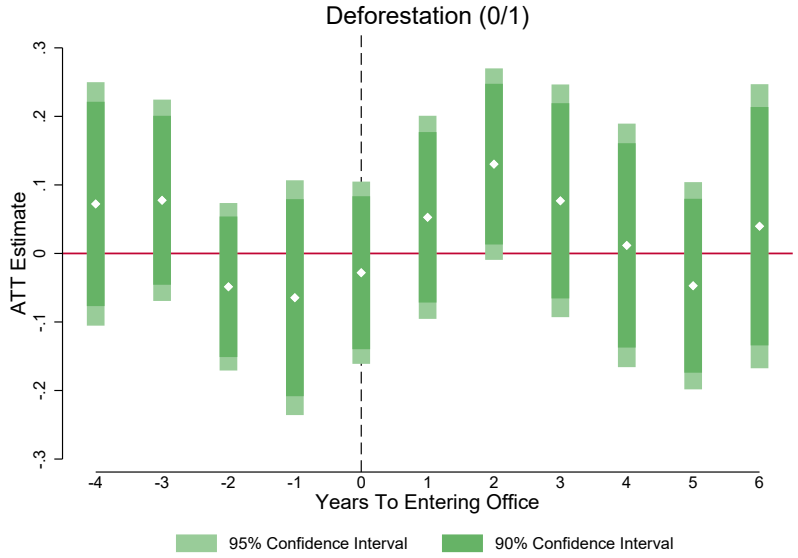
Note: Map reports municipal-level forest cover loss per hectare between 2000-2020 for Brazilian Legal Amazon, from MapBiomas.

Figure A2: Biomes in Brazilian Legal Amazon

Note: Biome data are drawn from MapBiomas. Municipalities are classified as part of the Amazon biome if more than 50% of their land area is in the Amazon.

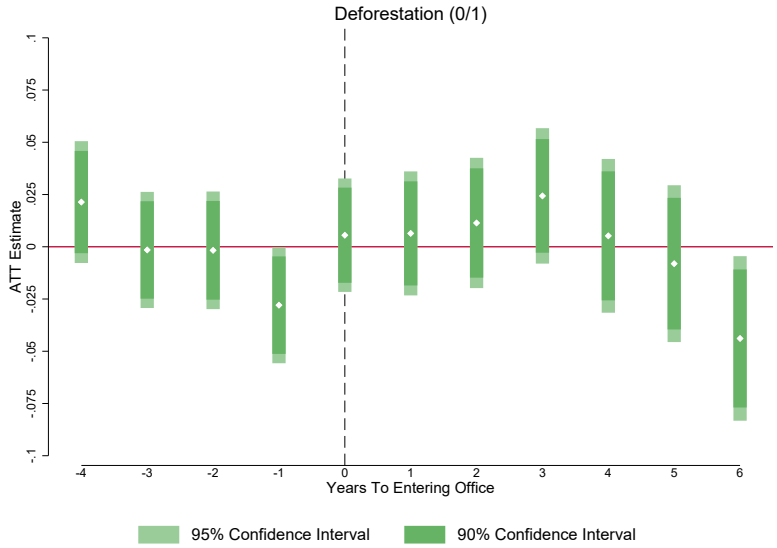
A.2 Additional Results: Candidate and Donor Level

Figure A3: Candidates: Effects of Entry into Office on Deforestation Indicator (Sample = Elections with $\leq$ 5% Win Margin)



Note: Figure reports ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never-treated and not-yet-treated compose the control group. Candidate and year fixed effects are included and standard errors are clustered at the candidate level. Sample is 20-year candidate-level panel (2000-2019) of municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcome is an indicator of whether deforestation of more than 2 hectares was registered on a candidates' landholdings in a given year in MapBiomas.

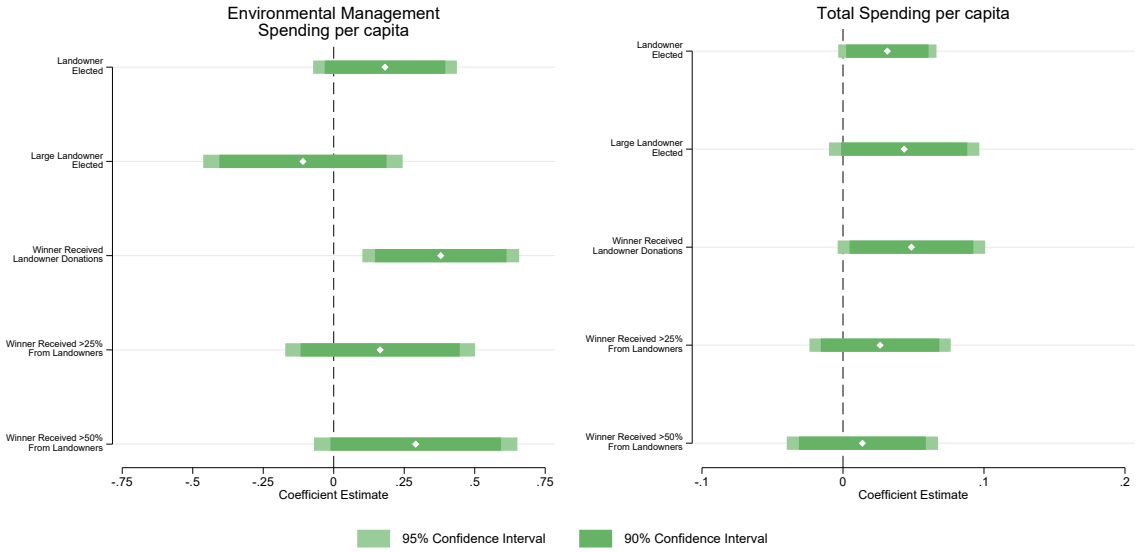
Figure A4: Donors: Effects of Supported Candidate's Entry Into Office on Deforestation Indicator (Sample = Elections with $\leq$ 5% Win Margin)



Note: Specification is analogous to that described in **??**, but for sample of donors to successful versus runner-up mayoral candidates.

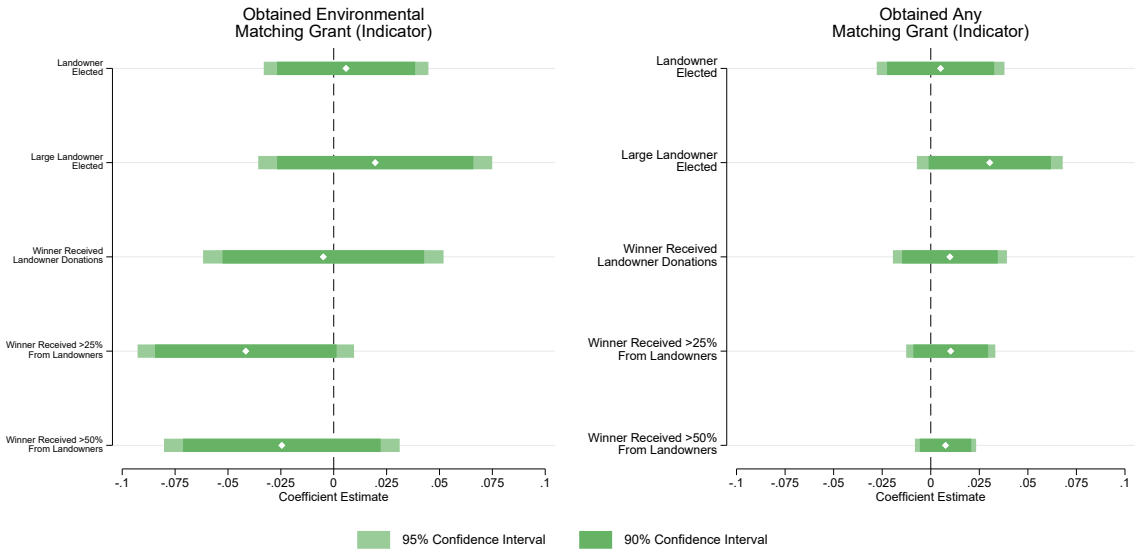
A.3 Additional Results: Municipal-Level

Figure A5: Effects of Election of Mayor with Personal or Donor Ties to Land on Other Municipality Spending (Sample = Elections with 5% Win Margin)



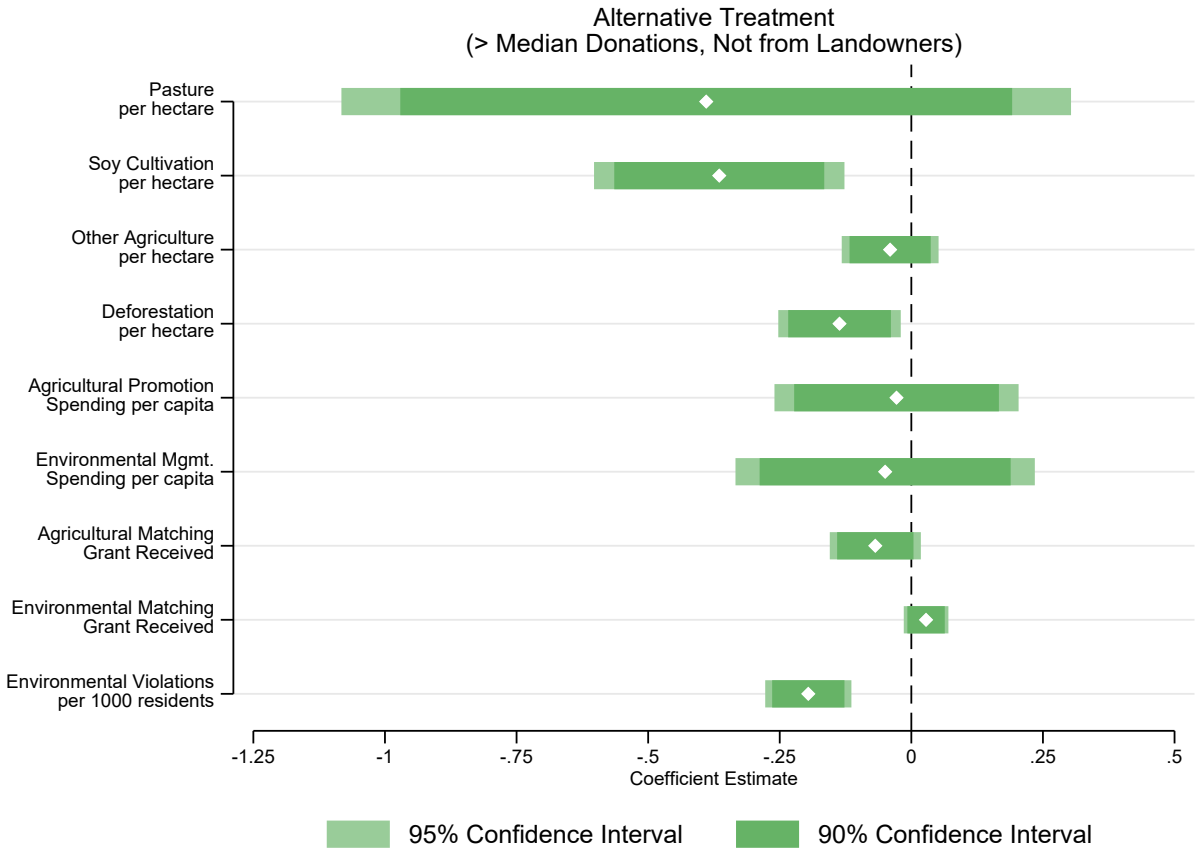
Note: Figure is organized as described in 9. Left figure presents estimated effects on municipal environmental spending (Environmental Control, Management, Preservation and Conservation, Recuperation of Degraded Areas, and Other Environmental Subfunctions); right figure presents estimated effects on total municipal spending. Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

Figure A6: Effects of Election of Mayor with Personal or Donor Ties to Land on Other Municipality Grants (Sample = Elections with 5% Win Margin)



Note: Figure is organized as described in 9. Left figure presents estimated effects on likelihood of municipality receiving a matching grant from the Federal Ministry of the Environment; right figure reports estimated effects on likelihood of the municipality receiving any federal matching grant.

Figure A7: Effects of Election of Mayor with Above Median Donations but No Donations from Landowners on Selected Outcomes (Sample = Elections with $\leq$ 5% Win Margin)



Note: Figure reports coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummy (mayor who received $\geq$ median value of total campaign donations but no donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Outcomes are pasture, soy, and other agriculture as percentages of municipal area, hectares transitioned from natural vegetation (Forest and Savannah Formations) to anthropic use as a percentage of municipal area, agricultural and environmental promotion spending per capita (transformed by inverse hyperbolic sine and deflated to constant 2010 BRL), indicators of whether the municipality received a federal matching grant from the Ministry of Agriculture or Environment, and number of environmental violations per 1000 residents (IBAMA embargoes transformed by inverse hyperbolic sine)

B Supplementary Tables

B.1 Descriptive Tables

Table B1: Data Sources

Data	Source	Years	Raw Level	Analysis Level
Deforestation & Land Use	MapBiomas	2000-2019	Pixel	Property/Municipality
Land Registries	CAR	2011-2020	Property	Property
	Terral Legal	2014-2017	Property	Property
	INCRA	2016-2020	Property	Property
Elections (Candidates)	TSE	2000-2016	Individual	Individual
Elections (Donors)	TSE	2004-2016	Individual	Individual
Environmental Violations	IBAMA	2005-2020	Property/ID	Property/Municipality
Public Finances	FINBRA	2000-2020	Municipality	Municipality
Greenhouse Gas Emissions	SEEG	2000-2018	Municipality	Municipality
Federal Matching Grants	PGU	2000-2020	Municipality	Municipality
Rural Credit	Banco Central	2004-2017	Municipality	Municipality
Municipality Characteristics	Census/Ipea	2000	Municipality	Municipality
Municipal Development Index	FIRJAN	2000	Municipality	Municipality

Table B2: Descriptive Statistics: Municipalities in Amazon Biome

	Close Election ($\leq$ 5% Win Margin)	Close Election ($\leq$ 10% Win Margin)	All Municipalities
No. Municipalities	326	409	432
Descriptives:			
Size (sq. km.)	10,728	10,225	9,218
	(20,508)	(20,071)	(17,605)
Dist. from State Capital (km.)	310.0	308.6	323.0
	(280.1)	(269.7)	(266.8)
% Forest Cover Loss (to 2020)	39.81	40.61	43.08
	(32.48)	(32.66)	(32.77)
Population	35.0	36.7	33.2
	(103.2)	(119.5)	(100.8)
GDP (Millions of 2010 BRL)	163.7	198.2	177.9
	(697.9)	(1,117.6)	(1,007.2)
Mun. Development Index	0.44	0.45	0.45
	(0.09)	(0.08)	(0.08)
% of Population Urban	50.83	51.43	51.33
	(23.25)	(23.57)	(23.22)
Income Gini Coefficient	0.60	0.59	0.59
	(0.06)	(0.07)	(0.07)
% of Population in Poverty	63.30	63.19	61.63
	(16.82)	(16.76)	(17.50)
% Workers Empl. in Agricult.	49.44	49.95	49.88
	(18.97)	(18.71)	(18.48)
No. of Donations/1000 ppl.	18.61	19.24	19.84
	(19.02)	(19.87)	(19.19)
Value Donations/1000 ppl.	21,645	22,009	21,437
	(16,527)	(17,915)	(17,787)

B.2 Results Tables: Candidate and Donor Level

Table B3: Candidates: Dynamic Effects of Entry into Office on Land Use (Sample = Elections with $\leq$ 5% Win Margin)

Relative Year	**Pasture (%)**		**Soy (%)**		**Other Ag. (%)**	
	Coef.	*(St. Err.)*	*Coef.*	*(St. Err.)*	*Coef.*	*(St. Err.)*
-4	-0.257	(0.858)	-0.176	(0.172)	0.091	(0.084)
-3	0.214	(0.842)	-0.003	(0.003)	0.162	(0.140)
-2	1.183	(0.920)	0.059	(0.057)	-0.040	(0.126)
-1	-0.172	(1.036)	0.025	(0.098)	0.050	(0.163)
0	-1.732	(0.584)	0.127	(0.083)	0.051	(0.097)
1	1.890	(2.059)	0.355	(0.171)	-0.039	(0.214)
2	1.292	(1.849)	0.273	(0.355)	-0.263	(0.261)
3	0.479	(1.450)	0.634	(0.421)	-0.423	(0.358)
4	0.870	(1.933)	-0.115	(0.496)	-0.402	(0.443)
5	0.531	(2.210)	0.884	(0.512)	-0.016	(0.510)
6	0.405	(2.401)	0.565	(0.418)	0.168	(0.687)
n =	1,717		1,717		1,717	
Baseline DV Mean	41.74		0.06		0.27	
Candidate FE	YES		YES		YES	
Year FE	YES		YES		YES	

Note: Table reports dynamic ATT estimates and standard errors from Callaway and Sant'Anna (2020)'s *csdid* estimator corresponding to Figure 3. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin). Treatment is defined as a candidate's first entry into mayoral office; Never-treated and not-yet-treated candidates compose the control group. Candidate and year fixed effects are included and standard errors are clustered at the candidate level. Outcomes measure hectares of pasture, soy, and other crops as a percentage of property area. Baseline dependent variable mean corresponds to the average between the value at t-1 for treated units and at t=2001 for controls.

Table B4: Candidates: Dynamic Effects of Entry into Office on Environmental Outcomes (Sample = Elections with $\leq$ 5% Win Margin)

Relative Year	**Deforestation (%)**		**Deforestation (0/1)**		**Embargo (0/1)**	
	Coef.	*(St. Err.)*	*Coef.*	*(St. Err.)*	*Coef.*	*(St. Err.)*
-4	0.820	(0.511)	0.072	(0.091)	0.058	(0.093)
-3	-1.643	(1.123)	0.078	(0.075)	-0.057	(0.034)
-2	0.416	(0.900)	-0.049	(0.062)	0.083	(0.080)
-1	-1.262	(0.667)	-0.065	(0.087)	-0.050	(0.034)
0	-0.368	(0.433)	-0.028	(0.068)	-0.049	(0.034)
1	2.216	(1.505)	0.053	(0.076)	-0.017	(0.048)
2	1.320	(0.585)	0.130	(0.071)	-0.029	(0.042)
3	0.998	(0.503)	0.077	(0.087)	-0.070	(0.027)
4	1.307	(0.556)	0.012	(0.091)	-0.089	(0.046)
5	-0.017	(0.518)	-0.047	(0.077)	-0.056	(0.058)
6	0.831	(0.691)	0.040	(0.106)	-0.039	(0.062)
n =	1,573		1,573		1,331	
Baseline DV Mean	2.53		0.59		0.05	
Candidate FE	YES		YES		YES	
Year FE	YES		YES		YES	

Note: Table reports dynamic ATT estimates and standard errors from Callaway and Sant'Anna (2020)'s *csdid* estimator (Deforestation (%) and Embargo (0/1) results are presented in Figure 4). ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never treated and not yet treated compose the control group. Candidate and year fixed effects are included and standard errors are clustered at the candidate level. Outcomes are (i) hectares that transitioned from natural vegetation (Forest and Savannah Formations) to anthropic use as a percentage of property area, (ii) deforestation as a binary outcome, and (iii) an indicator of whether an IBAMA environmental embargo was registered to an individual's ID or properties in a given year. Baseline dependent variable corresponds to the average between the value at t-1 for treated units and at t=2001 for controls.

Table B5: Donors: Dynamic Effects of Favored Candidate's Entry into Office on Land Use (Sample = Elections with $\leq$ 5% Win Margin)

Relative Year	**Pasture (%)**		**Soy (%)**		**Other Ag. (%)**	
	Coef.	*(St. Err.)*	*Coef.*	*(St. Err.)*	*Coef.*	*(St. Err.)*
-4	-0.152	(0.197)	-0.026	(0.036)	0.011	(0.030)
-3	0.332	(0.207)	-0.052	(0.032)	0.031	(0.046)
-2	-0.251	(0.183)	-0.038	(0.032)	-0.007	(0.036)
-1	-0.352	(0.203)	0.009	(0.025)	0.206	(0.093)
0	-0.455	(0.177)	0.134	(0.078)	-0.043	(0.070)
1	-0.482	(0.279)	0.267	(0.144)	-0.096	(0.105)
2	-0.792	(0.359)	0.275	(0.164)	0.006	(0.130)
3	-0.717	(0.442)	0.461	(0.196)	-0.143	(0.130)
4	-1.141	(0.551)	0.490	(0.229)	0.061	(0.167)
5	-1.217	(0.608)	0.666	(0.306)	-0.102	(0.163)
6	-1.552	(0.660)	0.664	(0.341)	-0.073	(0.175)
n =	29,480		29,480		29,480	
Baseline DV Mean	52.57		.27		0.18	
Donor FE	YES		YES		YES	
Year FE	YES		YES		YES	

Note: Table reports dynamic ATT estimates and standard errors from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated and never-treated donors. Donor and year fixed effects are included and standard errors are clustered at the donor level. Sample is a 20-year donor panel (2000-2019) for all donors to municipal mayoral candidates in close elections in 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcomes measure hectares of pasture, soy, and other crops as a percentage of property area. Baseline dependent variable corresponds to the average between the value at t-1 for treated units and at t=2001 for controls.

Table B6: Donors: Dynamic Effects of Favored Candidate's Entry into Office on Environmental Outcomes (Sample = Elections with $\leq$ 5% Win Margin)

Relative Year	**Deforestation (%)**		**Deforestation (0/1)**		**Embargo (0/1)**	
	Coef.	*(St. Err.)*	*Coef.*	*(St. Err.)*	*Coef.*	*(St. Err.)*
-4	-0.061	(0.192)	0.021	(0.015)	0.005	(0.006)
-3	0.071	(0.178)	-0.002	(0.014)	-0.001	(0.004)
-2	-0.027	(0.162)	-0.002	(0.014)	0.001	(0.004)
-1	-0.067	(0.141)	-0.028	(0.014)	0.002	(0.004)
0	-0.182	(0.137)	0.006	(0.014)	0.001	(0.004)
1	0.052	(0.170)	0.006	(0.015)	0.001	(0.004)
2	0.096	(0.173)	0.002	(0.017)	-0.004	(0.004)
3	0.241	(0.173)	0.018	(0.018)	-0.004	(0.005)
4	0.026	(0.164)	0.005	(0.019)	-0.004	(0.007)
5	0.069	(0.151)	-0.008	(0.019)	0.001	(0.008)
6	0.162	(0.234)	-0.017	(0.026)	-0.002	(0.009)
n =	26,532		28,006		23,584	
Baseline DV Mean	2.20		0.40		0.05	
Donor FE	YES		YES		YES	
Year FE	YES		YES		YES	

Note: Table reports dynamic ATT estimates and standard errors from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated and never-treated donors. Donor and year fixed effects are included and standard errors are clustered at the donor level. Outcomes are (i) hectares that transitioned from natural vegetation (Forest and Savannah Formations) to anthropic use as a percentage of property area, (ii) deforestation as a binary outcome, and (iii) an indicator of whether an IBAMA environmental embargo was registered to an individual's ID or properties in a given year. Baseline dependent variable corresponds to the average between the value at t-1 for treated units and at t=2001 for controls.

B.3 Results Tables: Municipal-Level

Table B7: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Land Use and Environmental Outcomes (Sample = Elections with $\leq$ 5% Win Margin)

	Pasture (%)	**Soy (%)**	**Other Ag. (%)**	**Deforest. (%)**	**Embargos**
Land	-0.344	0.221	-0.003	-0.131	0.035
	(0.377)	(0.196)	(0.045)	(0.074)	(0.043)
Large Land	-0.367	0.224	-0.069	-0.212	-0.009
	(0.439)	(0.362)	(0.080)	(0.105)	(0.067)
Land Donations	1.176	0.509	0.055	0.130	0.184
	(0.416)	(0.154)	(0.049)	(0.065)	(0.054)
>25% Land Donations	0.259	0.705	0.093	0.137	0.266
	(0.416)	(0.195)	(0.065)	(0.068)	(0.052)
>50% Land Donations	0.049	0.766	0.064	0.088	0.223
	(0.513)	(0.259)	(0.084)	(0.071)	(0.053)
n =	1,264	1,264	1,264	1,264	983
Baseline DV Mean	27.05	0.07	0.13	1.71	0.32
Municipality FE	YES	YES	YES	YES	YES
Election FE	YES	YES	YES	YES	YES
Candidate Controls	YES	YES	YES	YES	YES

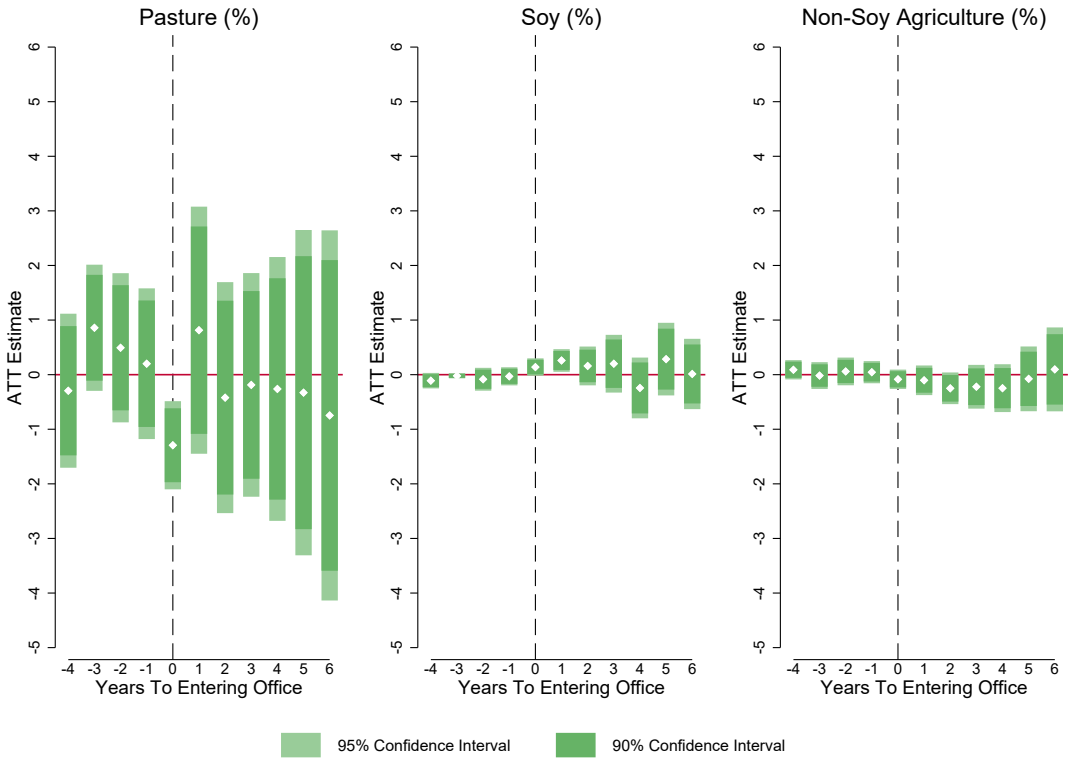
Table B8: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Mechanisms (Sample = Elections with $\leq$ 5% Win Margin)

	Ag. Spend	**Ag Grant**	**Rural Credit**	**Env. Spend**	**Env. Grant**
Land	0.026	0.042	0.068	0.182	0.005
	(0.104)	(0.037)	(0.069)	(0.130)	(0.020)
Large Land	0.064	0.013	-0.079	-0.109	0.020
	(0.149)	(0.047)	(0.095)	(0.180)	(0.028)
Land Donations	0.257	0.056	0.185	0.380	-0.005
	(0.140)	(0.050)	(0.084)	(0.141)	(0.029)
>25% Land Donations	0.211	-0.006	0.408	0.165	-0.042
	(0.140)	(0.048)	(0.084)	(0.171)	(0.026)
>50% Land Donations	0.180	0.045	0.317	0.291	-0.025
	(0.158)	(0.051)	(0.094)	(0.183)	(0.028)
n =	1,236	1,264	1,195	1,236	1,264
Baseline DV Mean	2.39	0.70	1.78	0.34	0.19
Municipality FE	YES	YES	YES	YES	YES
Election FE	YES	YES	YES	YES	YES
Candidate Controls	YES	YES	YES	YES	YES

C Robustness Checks

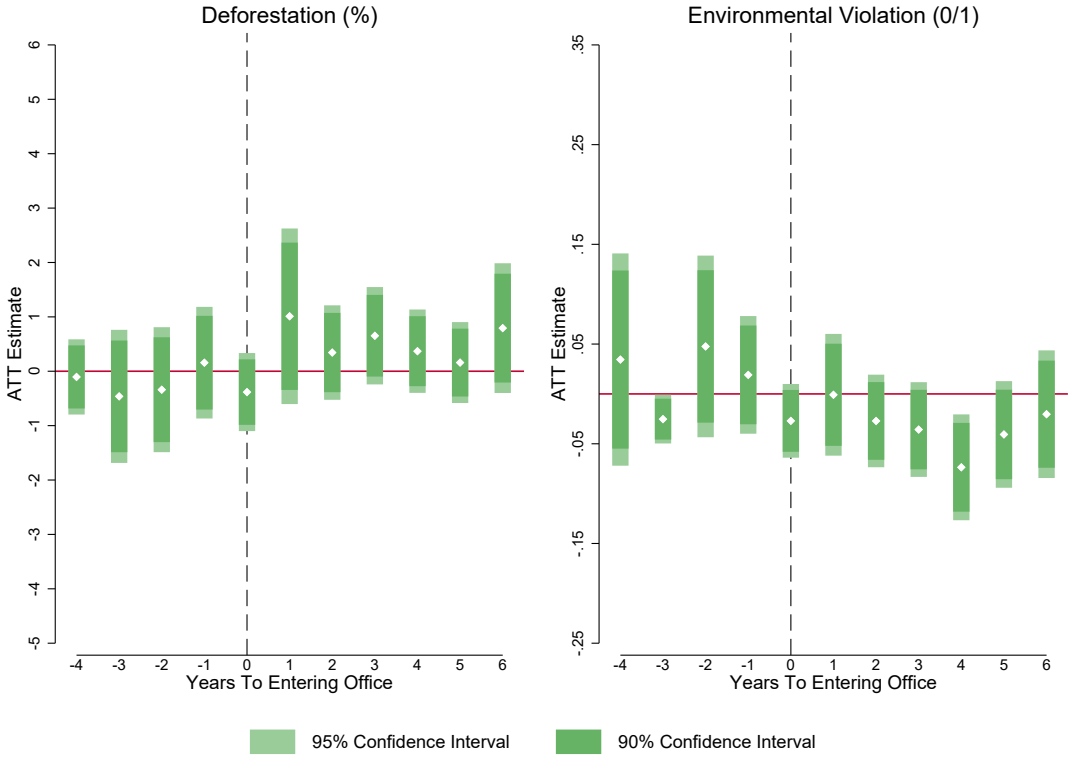
C.1 Candidate/Donor Event Studies with 10% Win-Margin Cutoff

Figure C1: Candidates: Effects of Entry into Office on Land Use (Sample = Elections with $\leq$ 10% Win Margin)



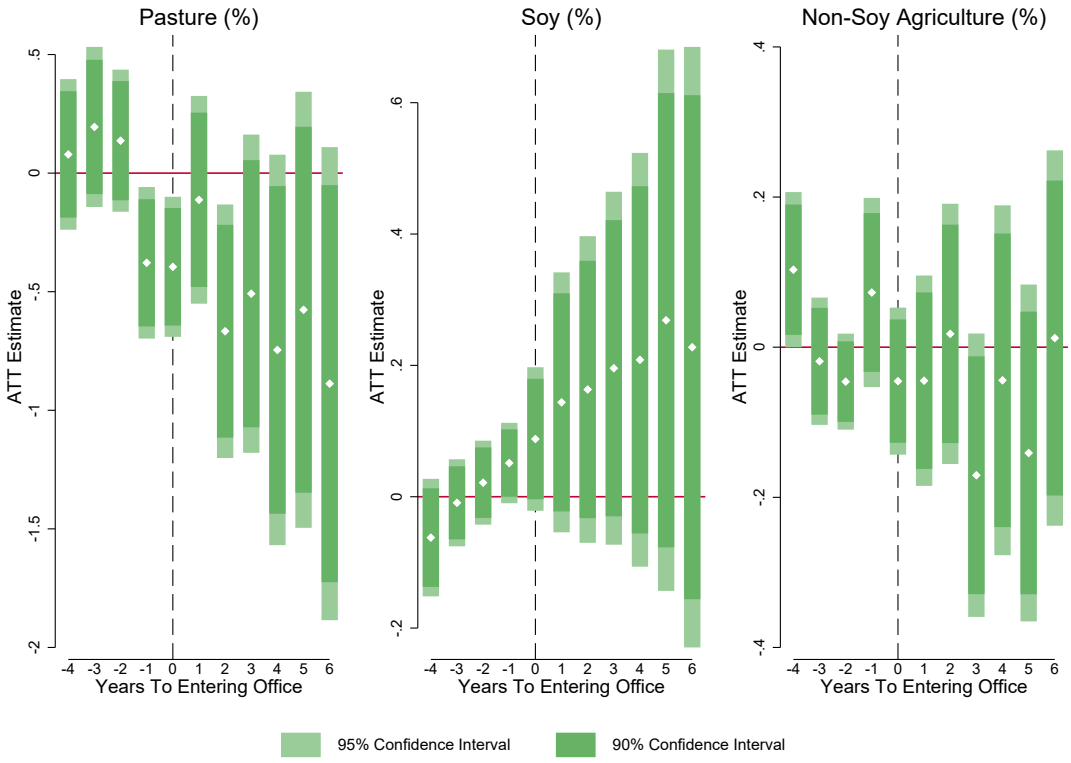
Note: Figures report ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 10% win margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never treated and not yet treated compose the control group. Candidate and year fixed effects are included, and standard errors are clustered at the candidate level. Sample is 20-year candidate-level panel (2000-2019) for all municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcomes measure hectares converted to agricultural use (sum of soy, other temporary crops, perennial crops, and sugarcane) and pasture in a given year as a percentage of property area.

Figure C2: Candidates: Effects of Entry into Office on Environmental Outcomes (Sample = Elections with $\leq$ 10% Win Margin)



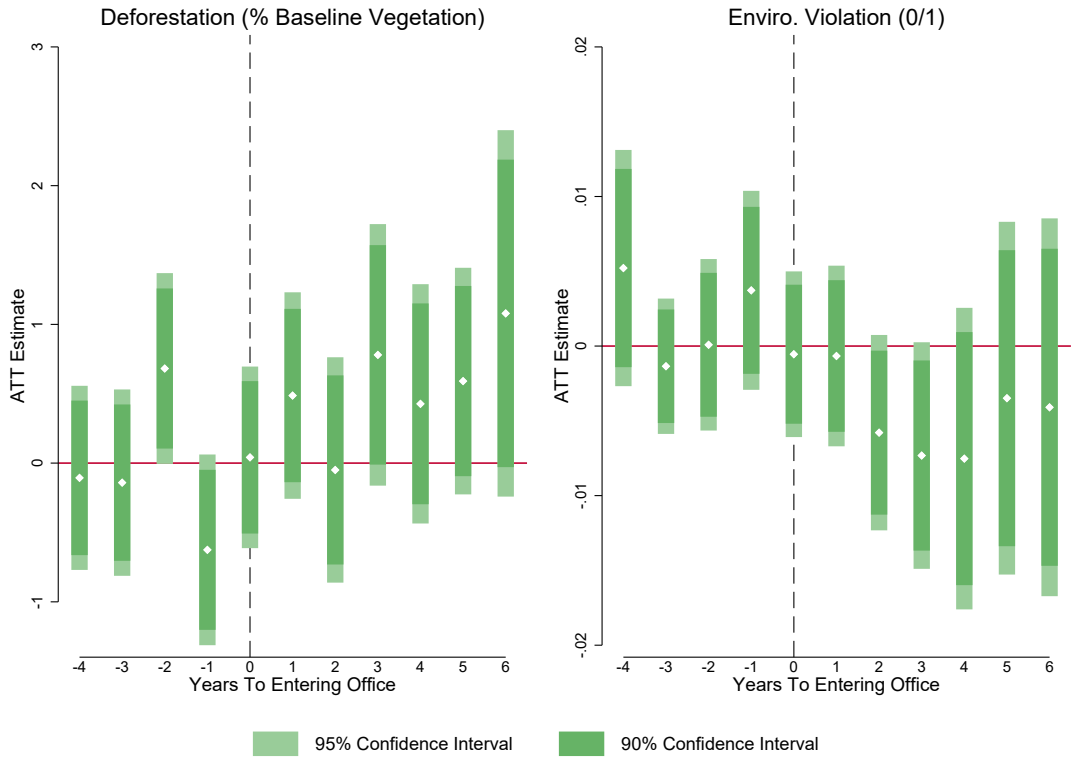
Note: Figure reports ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 10% win margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never treated and not yet treated compose the control group. Candidate and year fixed effects are included, and standard errors are clustered at the candidate level. Sample is 20-year candidate-level panel (2000-2019) for all municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcome is indicator of whether $\geq$2 ha. of natural vegetation was lost on candidate's aggregated properties in a given year.

Figure C3: Donors: Effects of Supported Candidate's Entry Into Office on Land Use (Sample = Elections with $\leq$ 10% Win Margin)



Note: Figure reports ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 10% win margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated donors. Donor and year fixed effects are included, and standard errors are clustered at the donor level. Sample is 20-year donor-level panel (2000-2019) for all donors to municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcomes measure hectares converted to agricultural use (sum of soy, other temporary crops, perennial crops, and sugarcane) and pasture in a given year as a percentage of property area.

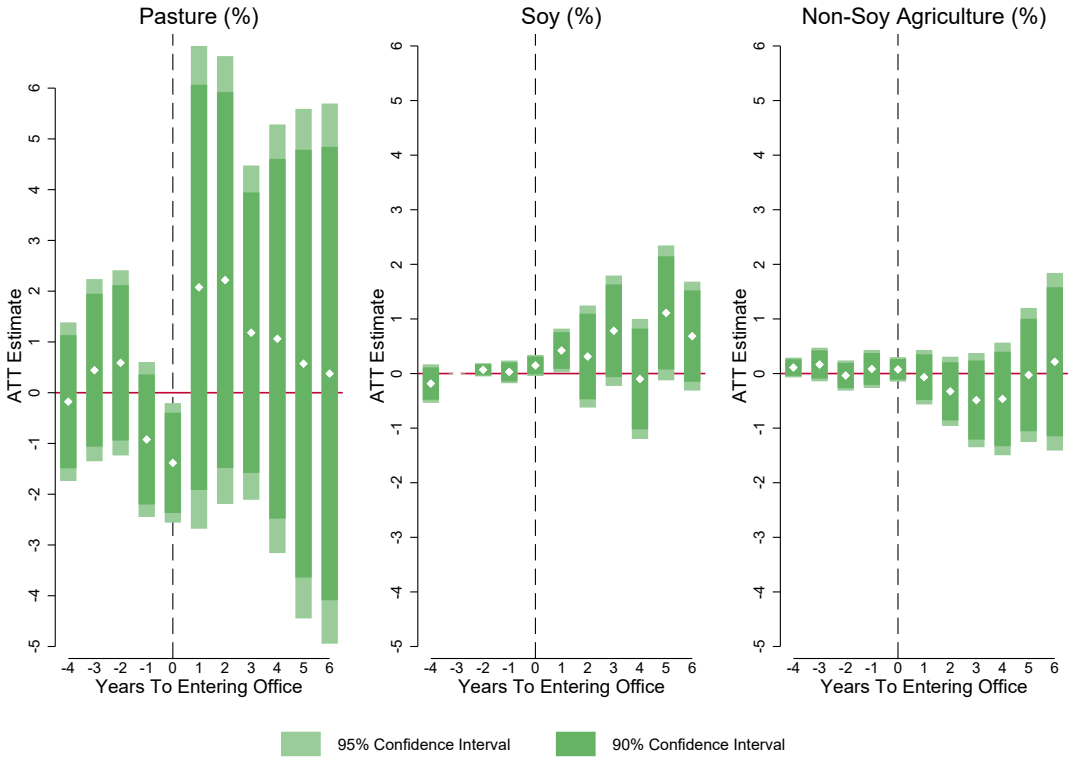
Figure C4: Donors: Effects of Entry into Office on Environmental Outcomes (Sample = Elections with $\leq$ 10% Win Margin)



Note: Figure reports ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 10% win margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated donors. Donor and year fixed effects are included, and standard errors are clustered at the donor level. Sample is 20-year donor-level panel (2000-2019) for all donors to municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcome is indicator of whether $\geq$2 ha. of natural vegetation was lost on donor's aggregated properties in a given year.

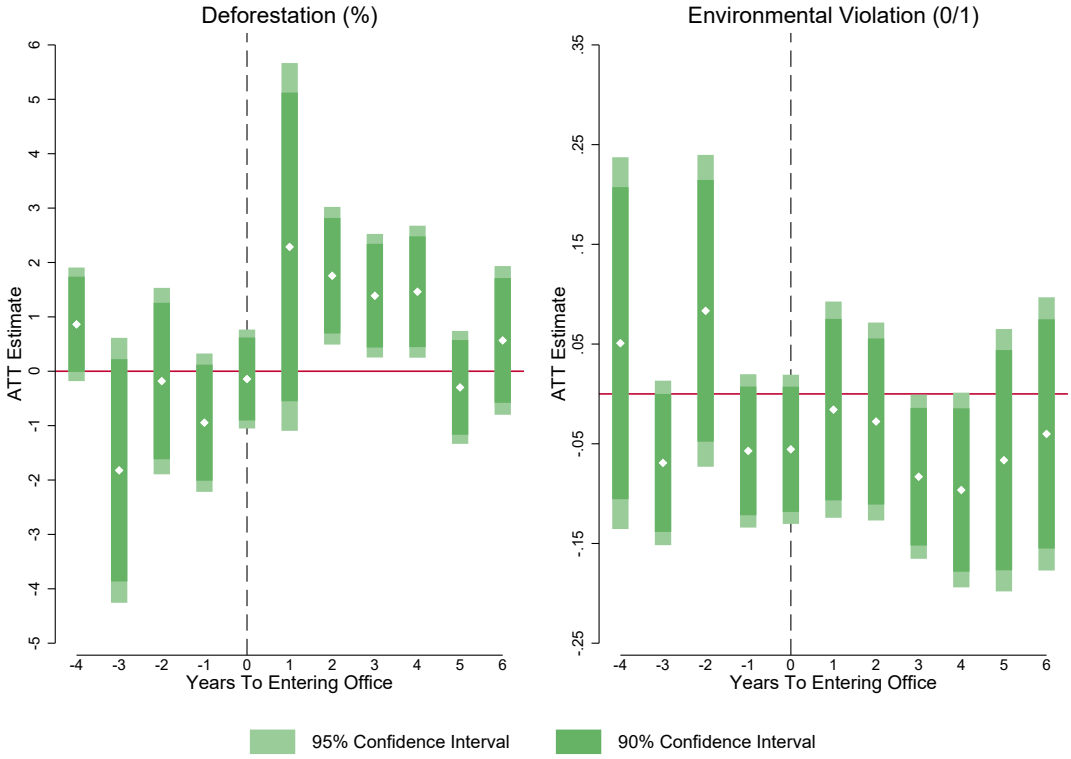
C.2 Candidate/Donor Event Studies in Mato Grosso, Rondônia, and Pará

Figure C5: Candidates: Effects of Entry into Office on Land Use (Sample = Elections with $\leq$ 5% Win Margin in Mato Grosso, Rondônia, and Pará)



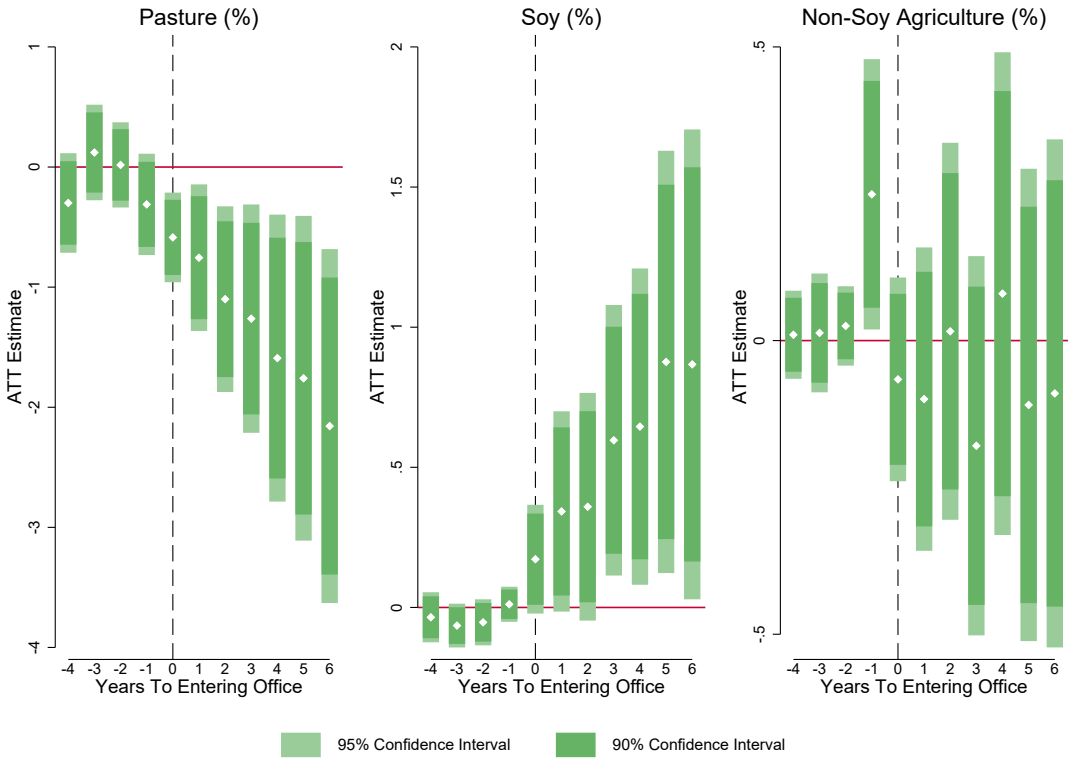
Note: Figures report ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 10% win margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never treated and not yet treated compose the control group. Candidate and year fixed effects are included, and standard errors are clustered at the candidate level. Sample is 20-year candidate-level panel (2000-2019) for all municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in states of Mato Grosso, Rondônia, and Pará. Outcomes measure hectares converted to agricultural use (sum of soy, other temporary crops, perennial crops, and sugarcane) and pasture in a given year as a percentage of property area.

Figure C6: Candidates: Effects of Entry into Office on Environmental Outcomes (Sample = Elections with $\leq$ 5% Win Margin in Mato Grosso, Rondônia, and Pará)



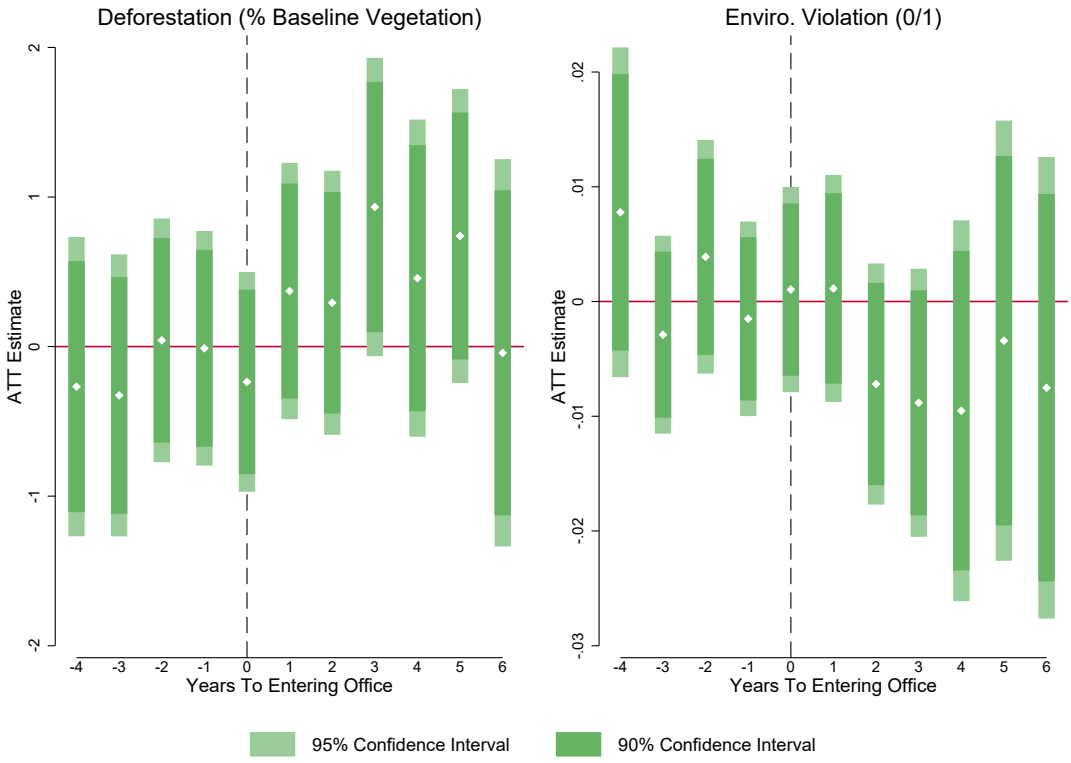
Note: Figure reports ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 10% win margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never treated and not yet treated compose the control group. Candidate and year fixed effects are included, and standard errors are clustered at the candidate level. Sample is 20-year candidate-level panel (2000-2019) for all municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in states of Mato Grosso, Rondônia, and Pará. Outcome is indicator of whether $\geq$2 ha. of natural vegetation was lost on candidate's aggregated properties in a given year.

Figure C7: Donors: Effects of Supported Candidate's Entry Into Office on Land Use (Sample = Elections with $\leq$ 10% Win Margin in Mato Grosso, Rondônia, and Pará)



Note: Figure reports ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 10% win margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated donors. Donor and year fixed effects are included, and standard errors are clustered at the donor level. Sample is 20-year donor-level panel (2000-2019) for all donors to municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in states of Mato Grosso, Rondônia, and Pará. Outcomes measure hectares converted to agricultural use (sum of soy, other temporary crops, perennial crops, and sugarcane) and pasture in a given year as a percentage of property area.

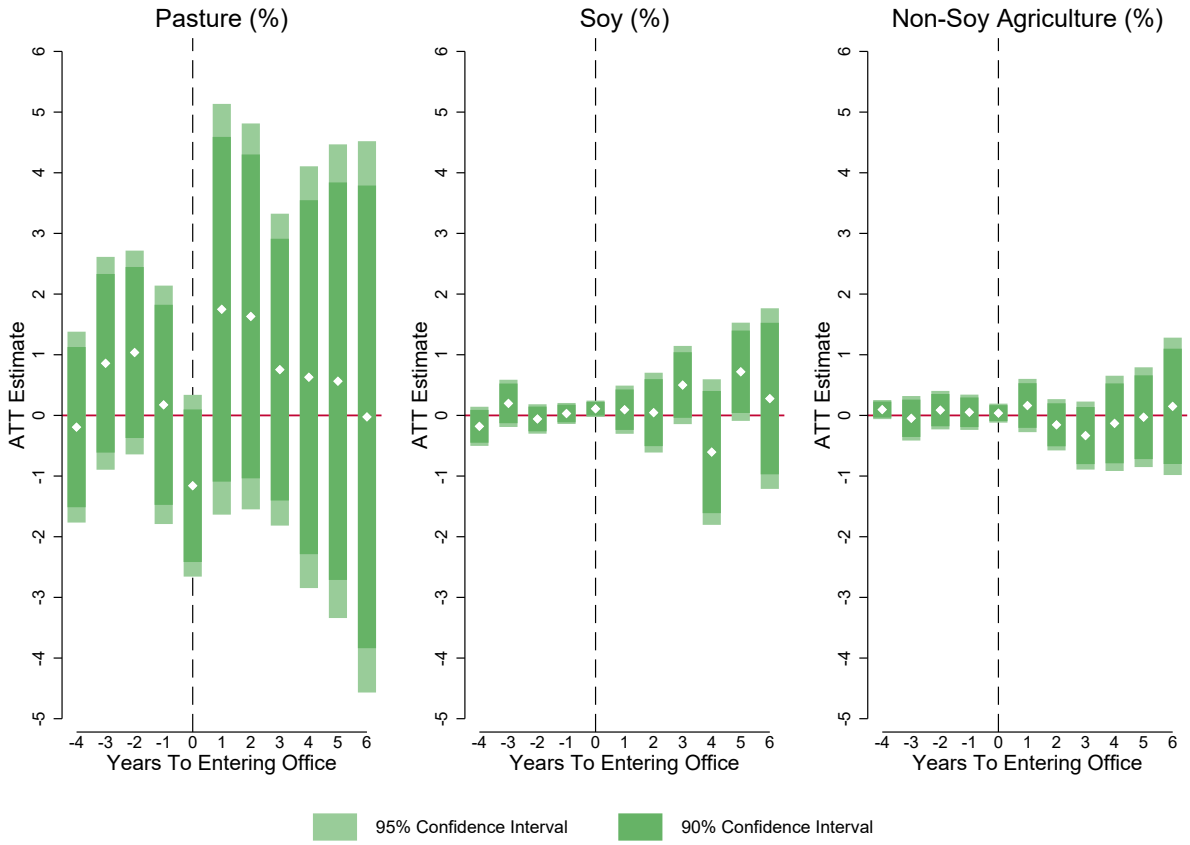
Figure C8: Donors: Effects of Supported Candidate's Entry Into Office on Environmental Outcomes (Sample = Elections with $\leq$ 10% Win Margin in Mato Grosso, Rondônia, and Pará)



Note: Figure reports ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 10% win margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated donors. Donor and year fixed effects are included, and standard errors are clustered at the donor level. Sample is 20-year donor-level panel (2000-2019) for all donors to municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in states of Mato Grosso, Rondônia, and Pará. Outcome is indicator of whether $\geq$2 ha. of natural vegetation was lost on donor's aggregated properties in a given year.

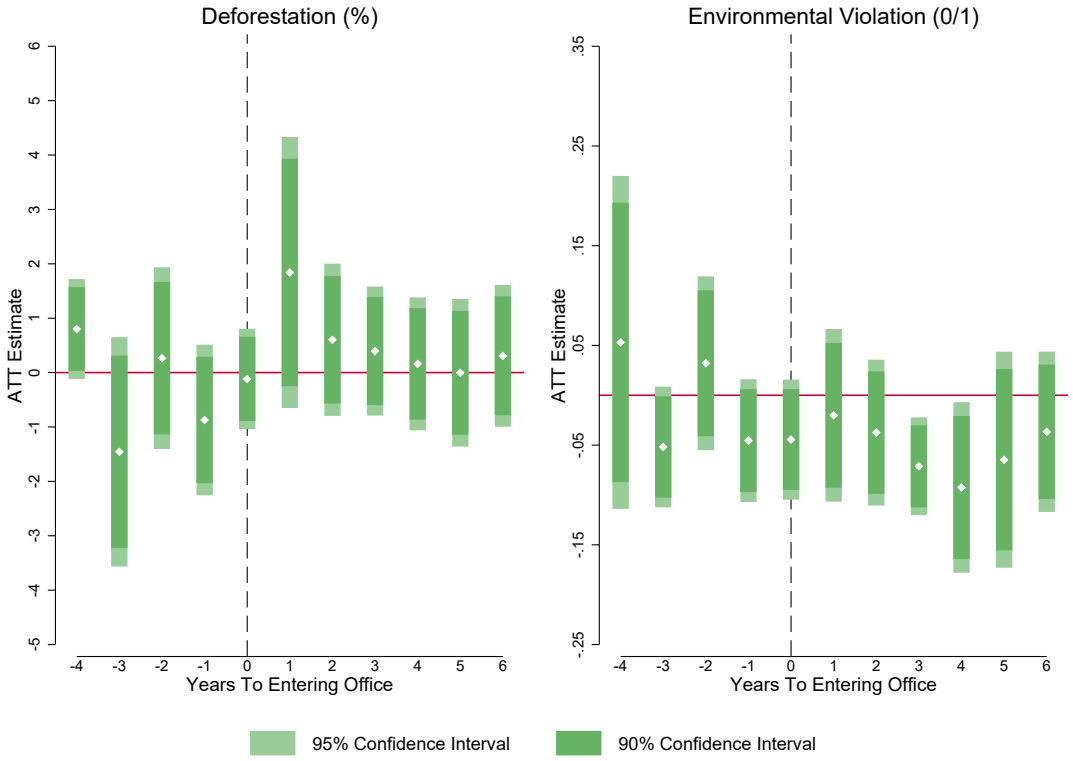
C.3 Candidate/Donor Event Studies in Full Legal Amazon

Figure C9: Candidates: Effects of Entry into Office on Land Use (Sample = Elections with $\leq 5\%$ Win Margin in Full Legal Amazon)



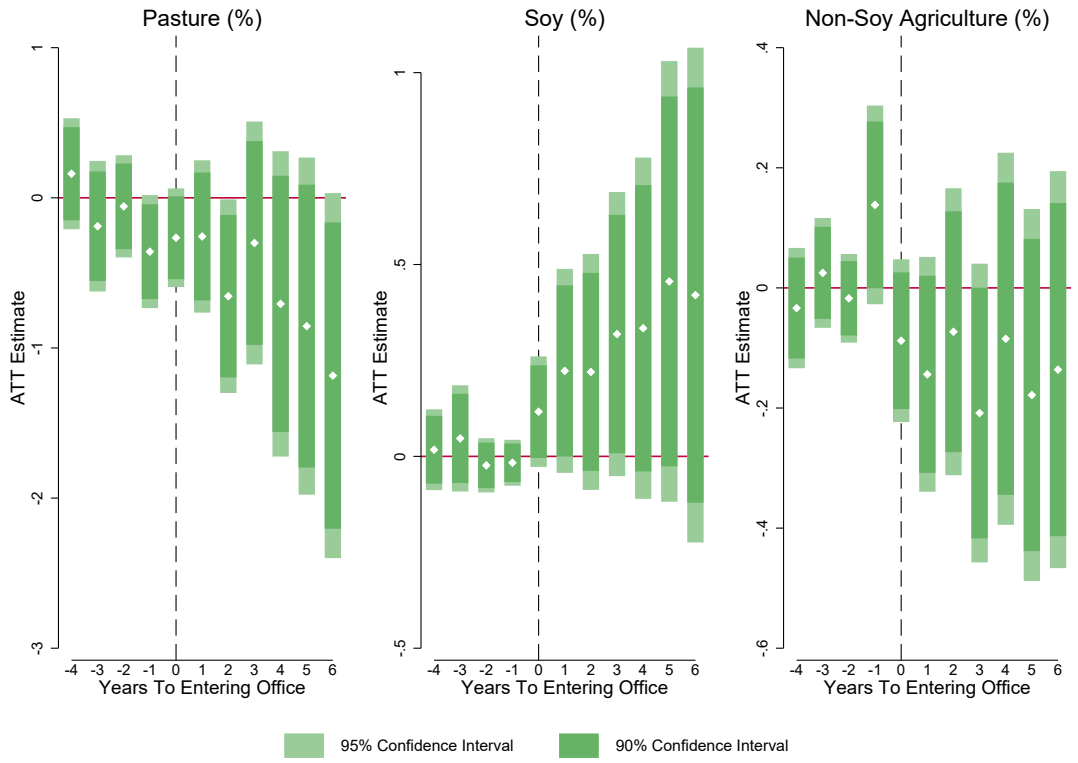
Note: Figures report dynamic event study ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq 5\%$ win margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never treated and not yet treated compose the control group. Candidate and year fixed effects are included, and standard errors are clustered at the candidate level. Sample is 20-year candidate-level panel (2000-2019) for all municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcomes measure hectares in agricultural use (sum of soy, other temporary crops, perennial crops, and sugarcane) and pasture in a given year as a percentage of property area.

Figure C10: Candidates: Effects of Entry into Office on Environmental Outcomes (Sample = Elections with $\leq$ 5% Win Margin in Full Legal Amazon)



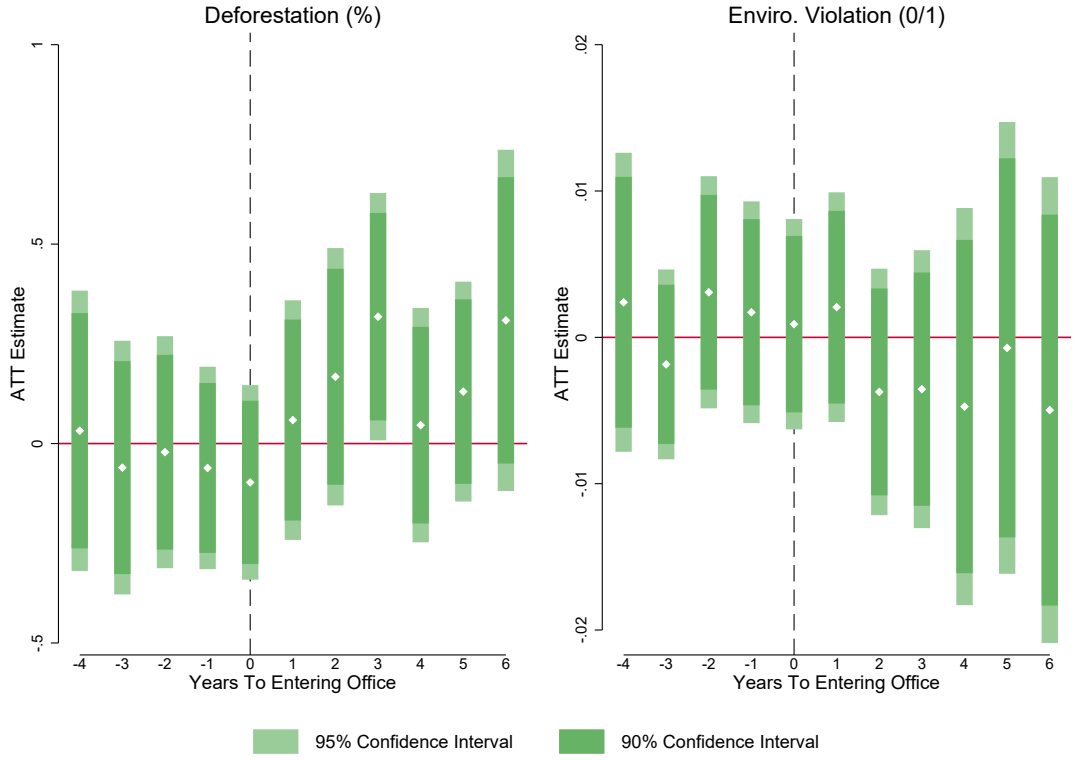
Note: Figure reports dynamic event study ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise candidate-year comparisons between successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win margin). Treatment is defined as a candidate's first entry into mayoral office; candidates never treated and not yet treated compose the control group. Candidate and year fixed effects are included, and standard errors are clustered at the candidate level. Sample is 20-year candidate-level panel (2000-2019) for all municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcome is indicator of whether $\geq$2 ha. of natural vegetation was lost on candidate's aggregated properties in a given year.

Figure C11: Donors: Dynamic Effects of Supported Candidate's Entry Into Office on Land Use (Sample = Elections with $\leq$ 5% Win Margin in Full Legal Amazon)



Note: Figure reports dynamic event study ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated donors. Donor and year fixed effects are included, and standard errors are clustered at the donor level. Sample is 20-year donor-level panel (2000-2019) for all donors to municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcomes measure hectares in agricultural use (sum of soy, other temporary crops, perennial crops, and sugarcane) and pasture in a given year as a percentage of property area.

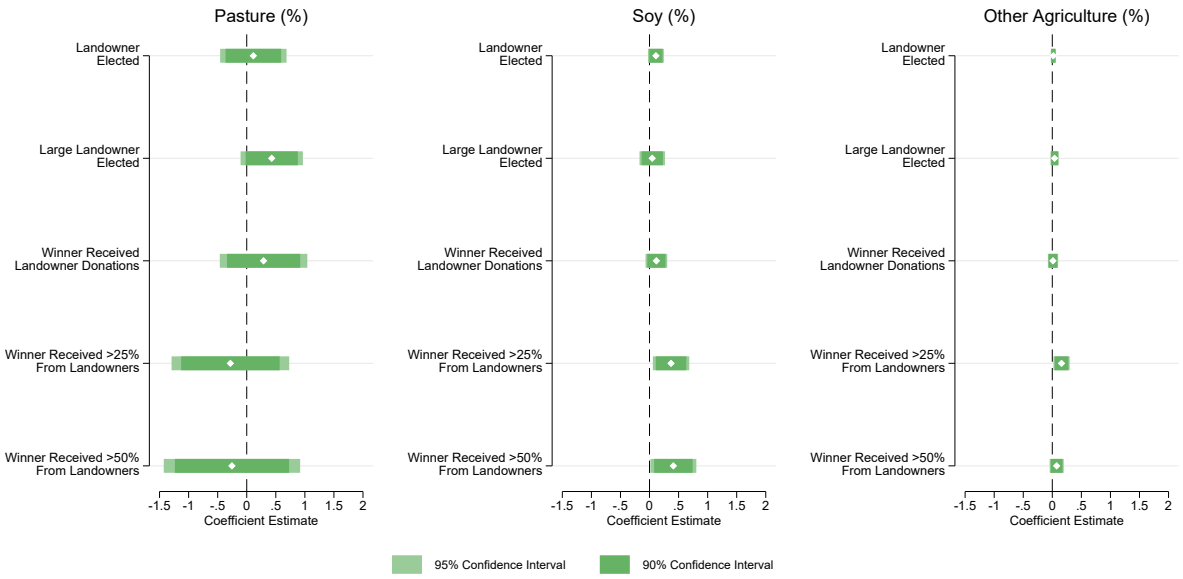
Figure C12: Donors: Dynamic Effects of Supported Candidate's Entry Into Office on Environmental Outcomes (Sample = Elections with $\leq$ 5% Win Margin in Full Legal Amazon)



Note: Figure reports dynamic event study ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. ATTs are aggregated from pairwise donor-year comparisons between donors to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win margin). Treatment is defined as a donor's favored candidate's first entry into mayoral office; controls are restricted to not-yet-treated donors. Donor and year fixed effects are included, and standard errors are clustered at the donor level. Sample is 20-year donor-level panel (2000-2019) for all donors to municipal mayoral candidates in close elections in 2000, 2004, 2008, 2012, and 2016 in the Brazilian Amazon biome. Outcome is indicator of whether $\geq$2 ha. of natural vegetation was lost on donor's aggregated properties in a given year.

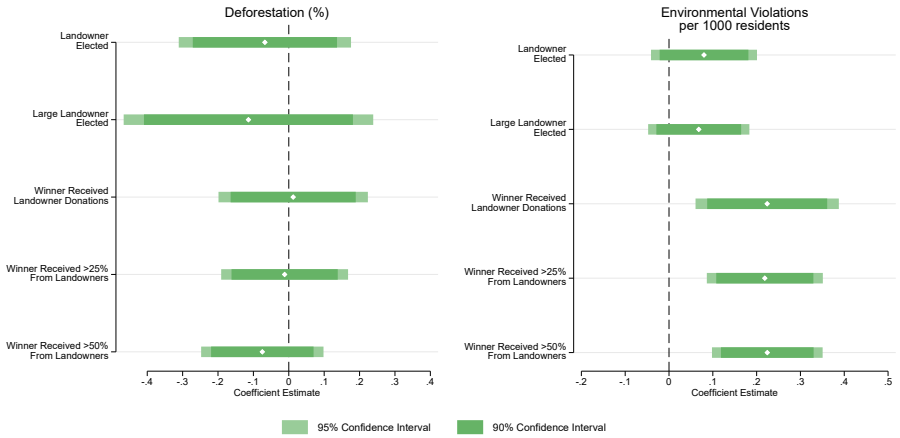
C.4 Municipal-Level Results with Balanced Panel

Figure C13: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Land Use (Sample = Balanced ($\leq$ 10% Win Margin))



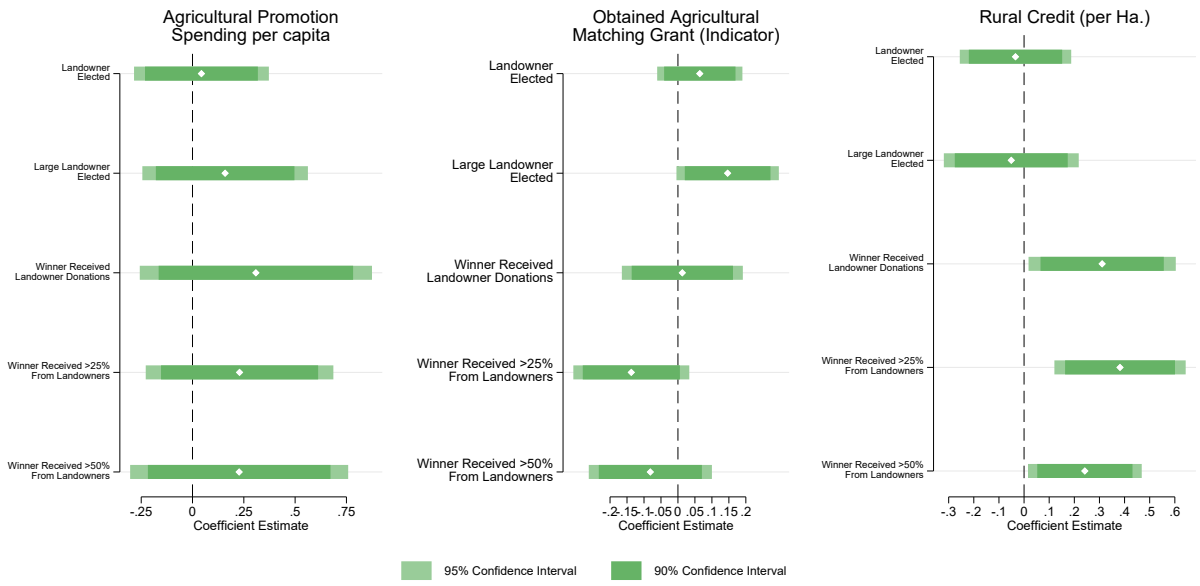
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landowner in office, large landowner ($\geq$ 500 ha.) in office, mayor who received landowner donations in office, mayor who received $\geq$ 25% of their donations from landowners in office, and mayor who received $\geq$ 50% of their donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Left figure reports effects on natural vegetation loss as a percentage of municipality area. The central figure reports effects on land conversion to farming (agriculture and pasture) as a percentage of municipality area. The rightmost figure reports effects on the inverse hyperbolic sine of greenhouse gas emissions from agriculture per hectare of municipality area.

Figure C14: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Environmental Outcomes (Sample = Balanced ($\leq$ 10% Win Margin))



Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landowner in office, large landowner ($\geq$ 500 ha.) in office, mayor who received landowner donations in office, mayor who received $\geq$ 25% of their donations from landowners in office, and mayor who received $\geq$ 50% of their donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Left figure reports effects on natural vegetation loss as a percentage of municipality area. The central figure reports effects on land conversion to farming (agriculture and pasture) as a percentage of municipality area. The rightmost figure reports effects on the inverse hyperbolic sine of greenhouse gas emissions from agriculture per hectare of municipality area.

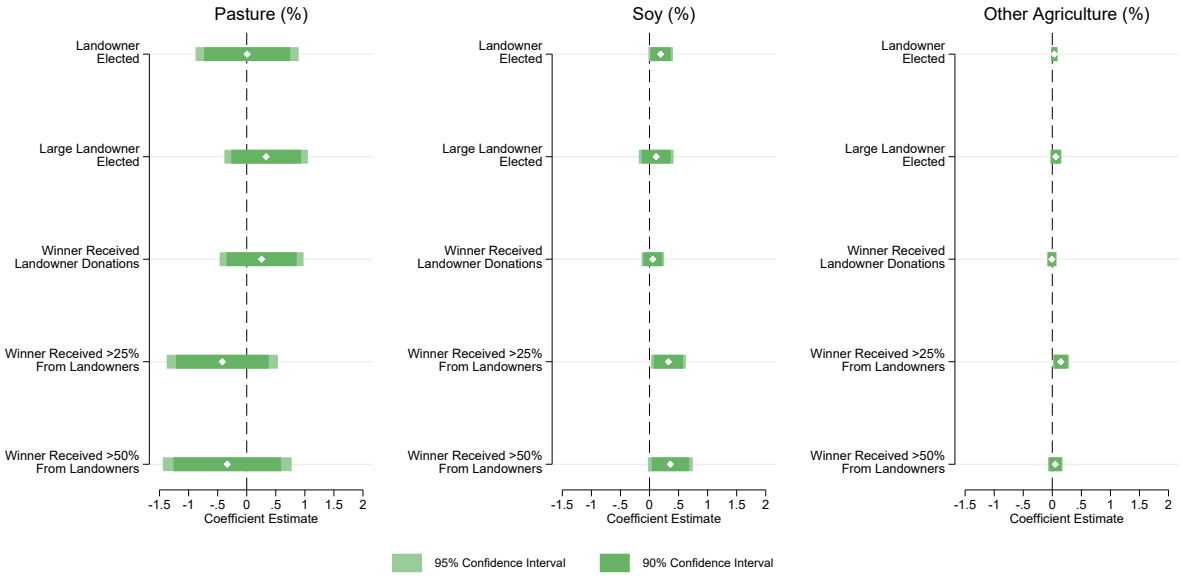
Figure C15: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Mechanisms (Sample = Balanced ($\leq$ 10% Win Margin))



Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landowner in office, large landowner ($\geq$ 500 ha.) in office, mayor who received landowner donations in office, mayor who received $\geq$ 25% of their donations from landowners in office, and mayor who received $\geq$ 50% of their donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Left figure reports effects on municipal spending on Agricultural Promotion (Agriculture, Colonization, Agro-livestock Defense and Sanitation, Rural Extension, Irrigation, Agrarian Organization, Agro-Livestock Promotion, Land Reform, and Other Agricultural Subfunctions); right figure reports effects on municipal spending on Environmental Management (Environmental Control, Management, Preservation and Conservation, Recuperation of Degraded Areas, and Other Environmental Subfunctions). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine.

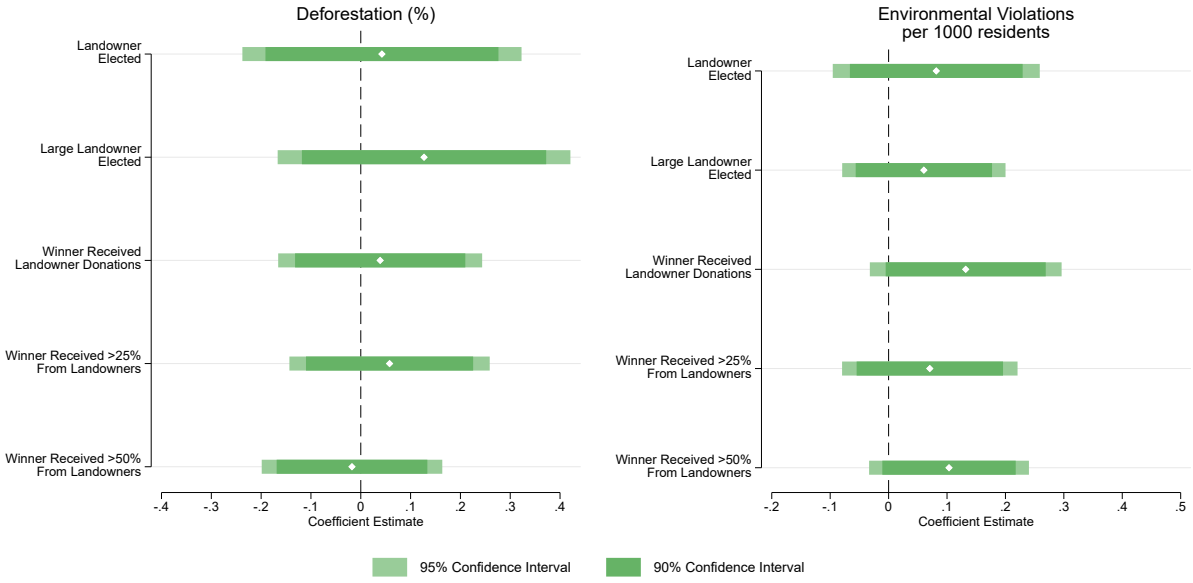
C.5 Municipal-Level Results in Mato Grosso, Rondônia, Pará

Figure C16: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Land Use (Sample = MT/PA/RO ($\leq$ 5% Win Margin))



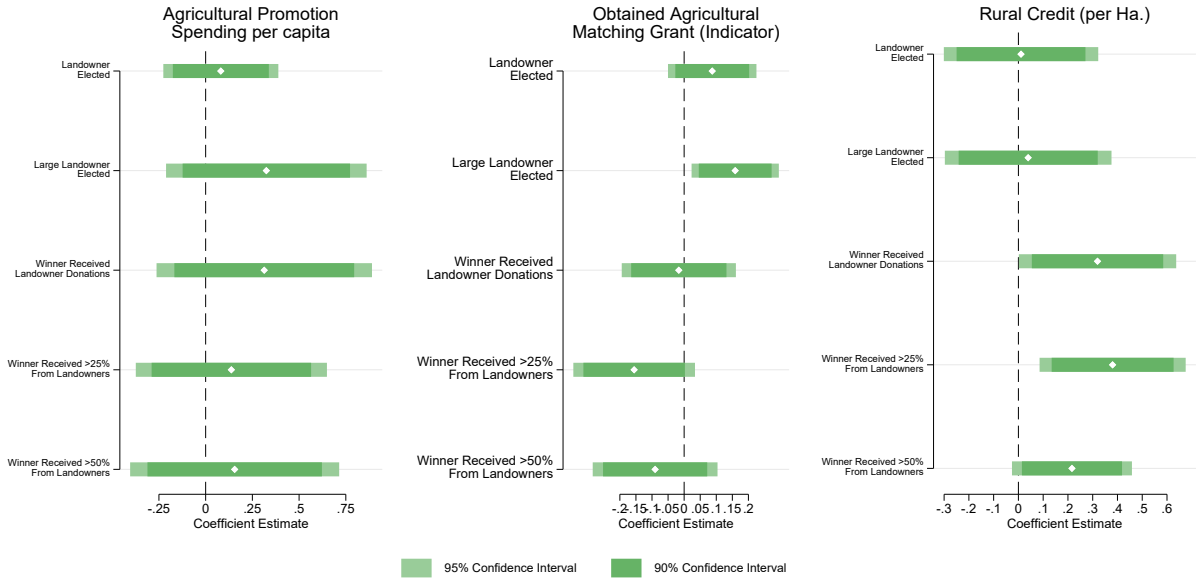
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landowner in office, large landowner ($\geq$ 500 ha.) in office, mayor who received landowner donations in office, mayor who received $\geq$ 25% of their donations from landowners in office, and mayor who received $\geq$ 50% of their donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Outcomes from left to right measure land conversion to pasture, soy, and other agricultural crops as a percentage of municipal area.

Figure C17: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Environmental Outcomes (Sample = MT/PA/RO ($\leq$ 5% Win Margin))



Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landowner in office, large landowner ($\geq$ 500 ha.) in office, mayor who received landowner donations in office, mayor who received $\geq$ 25% of their donations from landowners in office, and mayor who received $\geq$ 50% of their donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Outcome measures annual tree cover loss as a percentage of baseline (2000) natural vegetation.

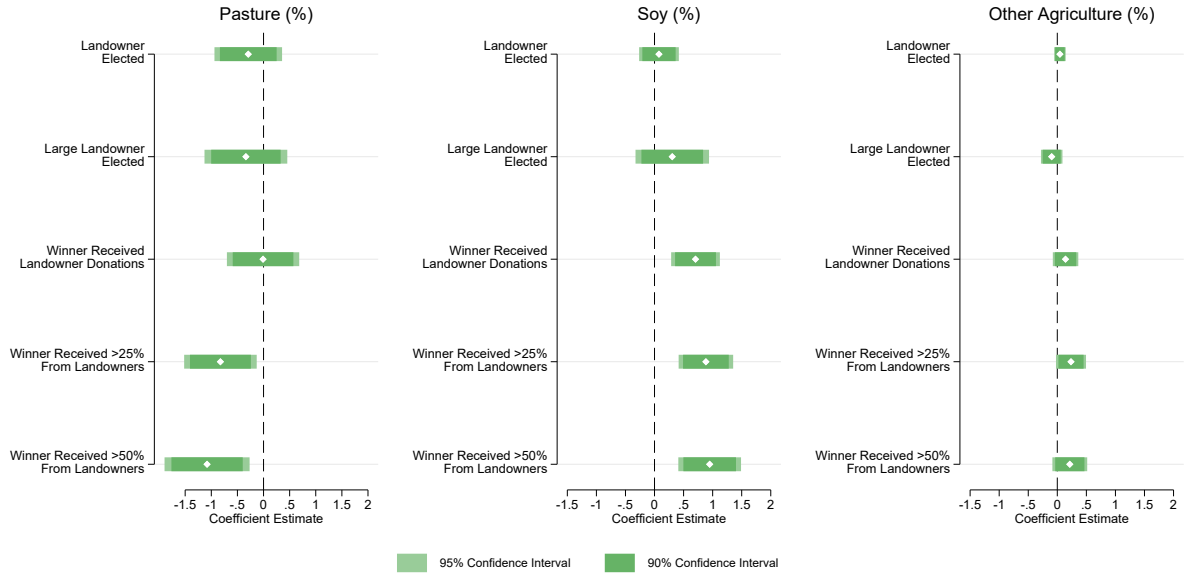
Figure C18: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Mechanisms (Sample = MT/PA/RO ($\leq$ 5% Win Margin))



Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landowner in office, large landowner ($\geq$ 500 ha.) in office, mayor who received landowner donations in office, mayor who received $\geq$ 25% of their donations from landowners in office, and mayor who received $\geq$ 50% of their donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Left figure reports effects on municipal spending on Agricultural Promotion (Agriculture, Colonization, Agro-livestock Defense and Sanitation, Rural Extension, Irrigation, Agrarian Organization, Agro-Livestock Promotion, Land Reform, and Other Agricultural Subfunctions); right figure reports effects on municipal spending on Environmental Management (Environmental Control, Management, Preservation and Conservation, Recuperation of Degraded Areas, and Other Environmental Subfunctions). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine.

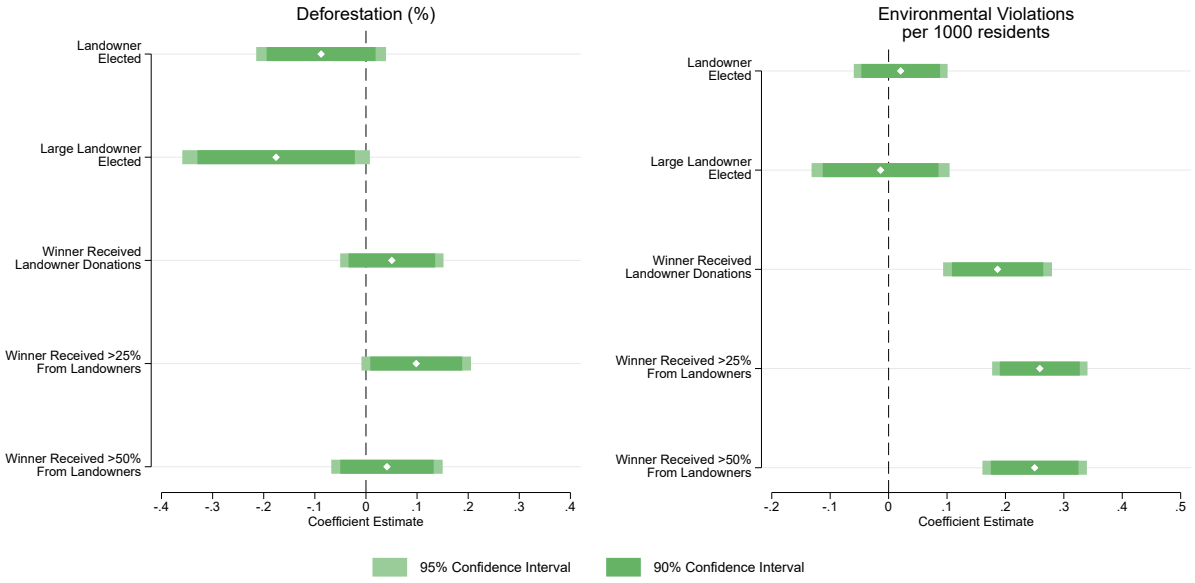
C.6 Municipal-Level Results in Full Legal Amazon

Figure C19: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Land Use (Sample = Full Legal Amazon ($\leq$ 5% Win Margin))



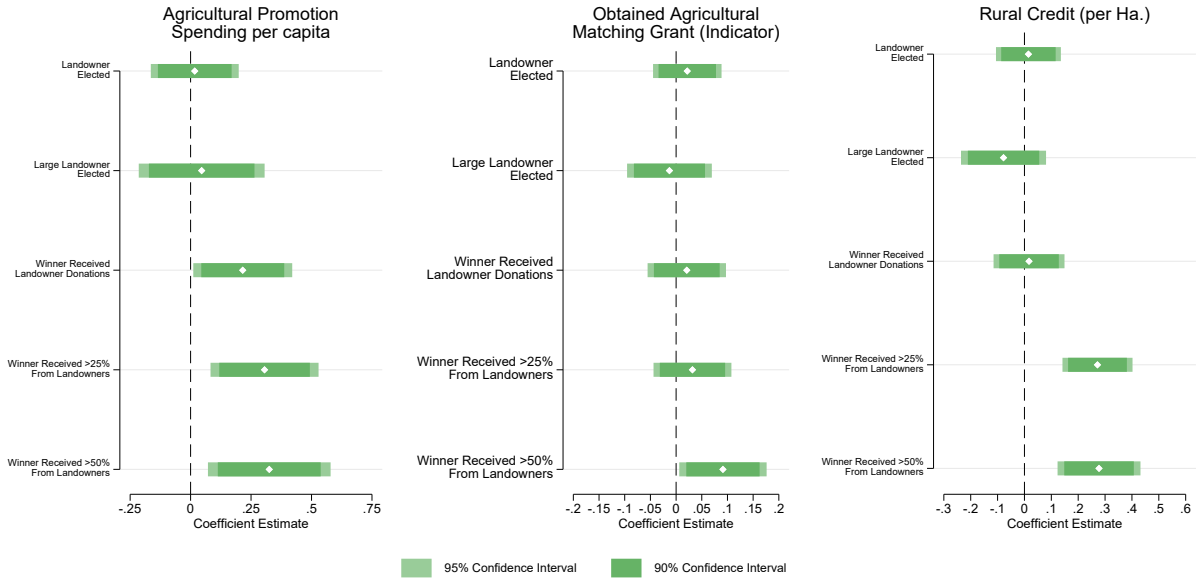
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landowner in office, large landowner ($\geq$ 500 ha.) in office, mayor who received landowner donations in office, mayor who received $\geq$ 25% of their donations from landowners in office, and mayor who received $\geq$ 50% of their donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Outcomes from left to right measure land conversion to pasture, soy, and other agricultural crops as a percentage of municipal area.

Figure C20: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Environmental Outcomes (Sample = Full Legal Amazon ($\leq$ 5% Win Margin))



Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landowner in office, large landowner ($\geq$ 500 ha.) in office, mayor who received landowner donations in office, mayor who received $\geq$ 25% of their donations from landowners in office, and mayor who received $\geq$ 50% of their donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Outcome measures annual tree cover loss as a percentage of baseline (2000) natural vegetation.

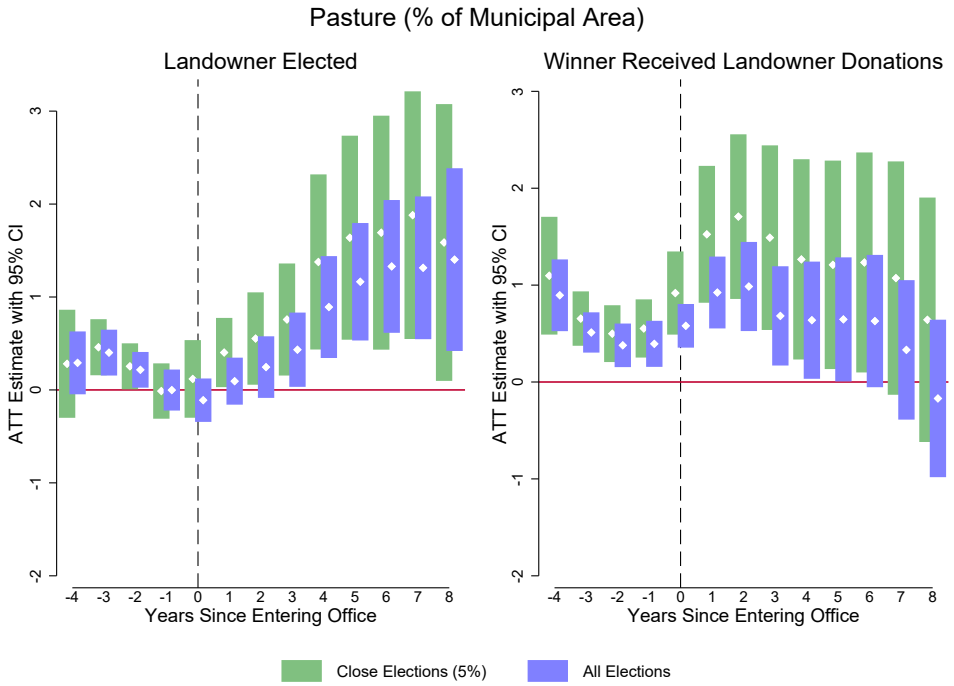
Figure C21: Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Mechanisms (Sample = Full Legal Amazon ($\leq$ 5% Win Margin))



Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landowner in office, large landowner ($\geq$ 500 ha.) in office, mayor who received landowner donations in office, mayor who received $\geq$ 25% of their donations from landowners in office, and mayor who received $\geq$ 50% of their donations from landowners in office). Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq$ 5%. Left figure reports effects on municipal spending on Agricultural Promotion (Agriculture, Colonization, Agro-livestock Defense and Sanitation, Rural Extension, Irrigation, Agrarian Organization, Agro-Livestock Promotion, Land Reform, and Other Agricultural Subfunctions); right figure reports effects on municipal spending on Environmental Management (Environmental Control, Management, Preservation and Conservation, Recuperation of Degraded Areas, and Other Environmental Subfunctions). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine.

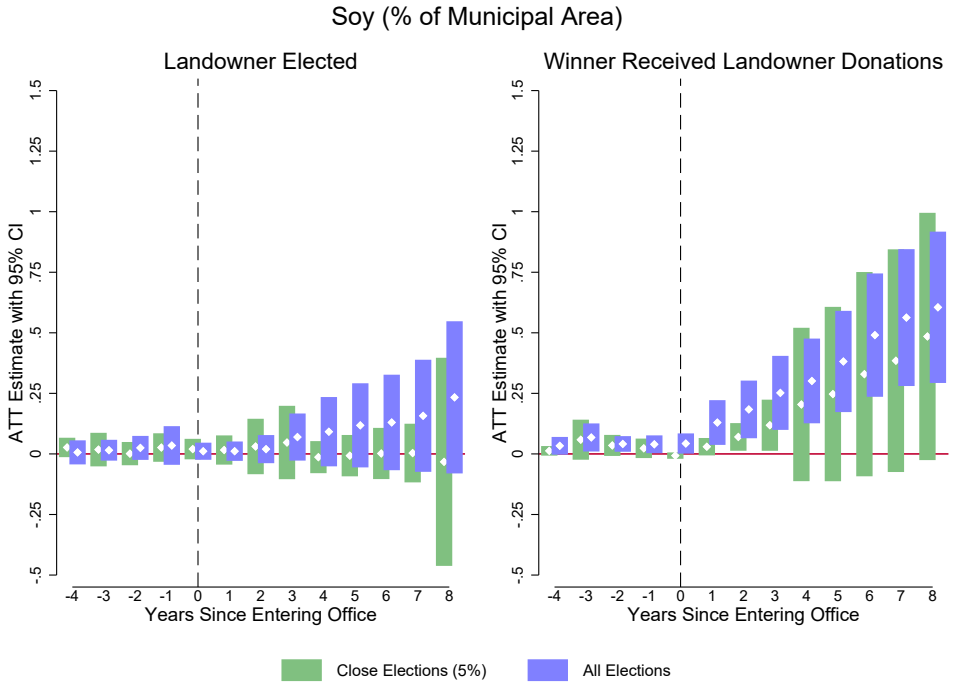
C.7 Municipal-Level Event Studies

Figure C22: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Pasture Land-Use



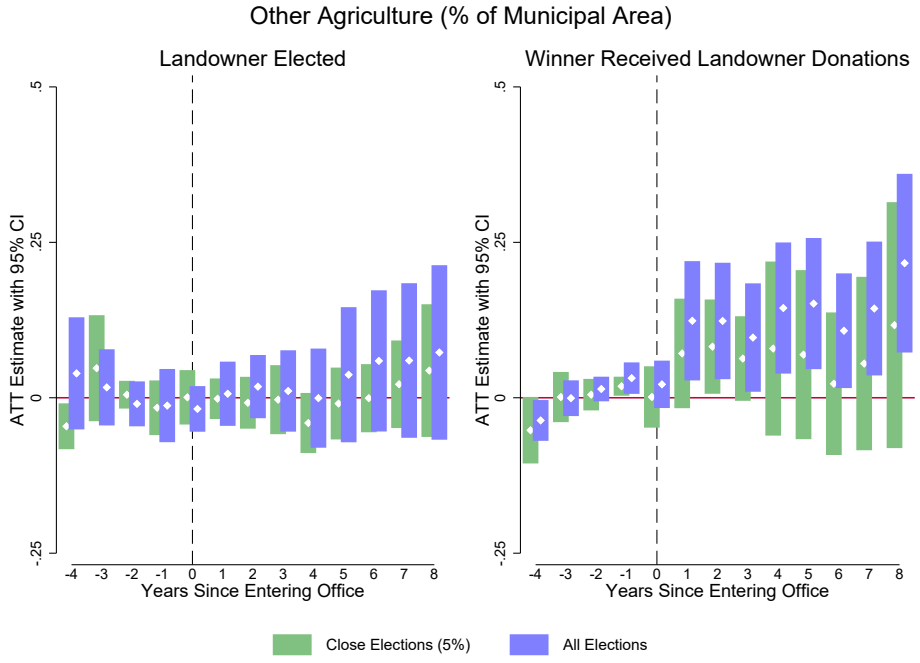
Note: Figures report ATT estimates and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid* estimator. In preferred specification (green), ATTs are aggregated from pairwise municipality-year comparisons between municipalities where (left) a landowner enters office as mayor after winning a close election ($\leq 5\%$ win margin) versus municipalities where a non-landowner won a close election; (right) a mayor who received campaign donations from one or more landowners enters office after winning a close election ($\leq 5\%$ win margin) versus municipalities where a mayor enters office who did not receive landowner donations after winning a close election. In a more inclusive specification (blue), the same comparisons are made but sample is not restricted to close elections. Controls are restricted to not-yet-treated municipalities. Candidate-level controls (mayor's sex and education level) are included and standard errors are clustered at the municipality level. Outcome is land conversion to pasture in a given year as percentage of municipal area.

Figure C23: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Soy Land-Use



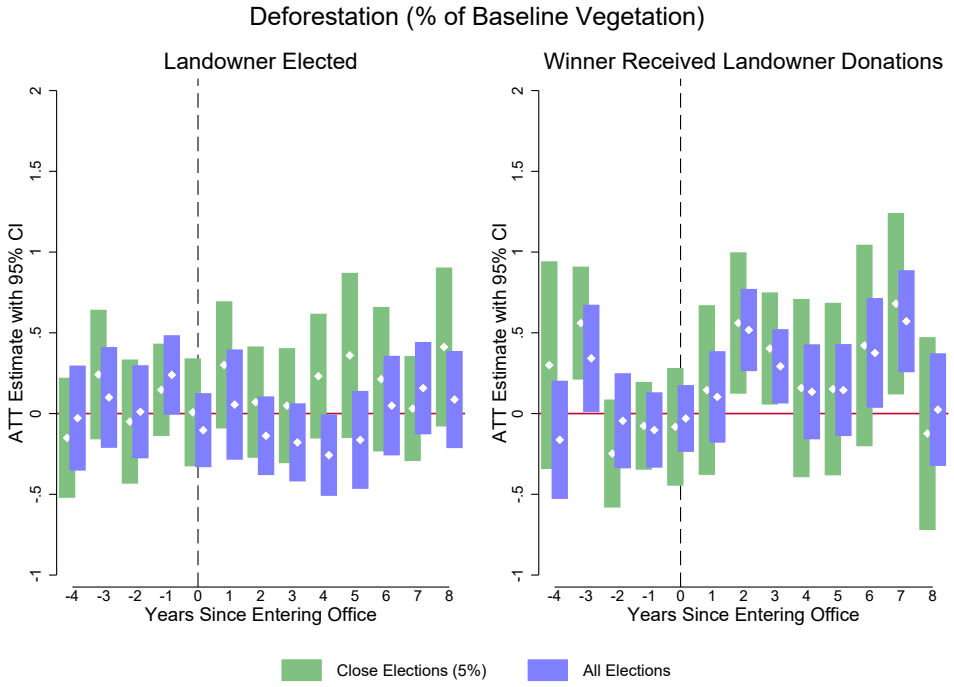
Note: See note in Figure A3. Outcome is land conversion to soy in a given year as percentage of municipal area.

Figure C24: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Other Agriculture Land-Use



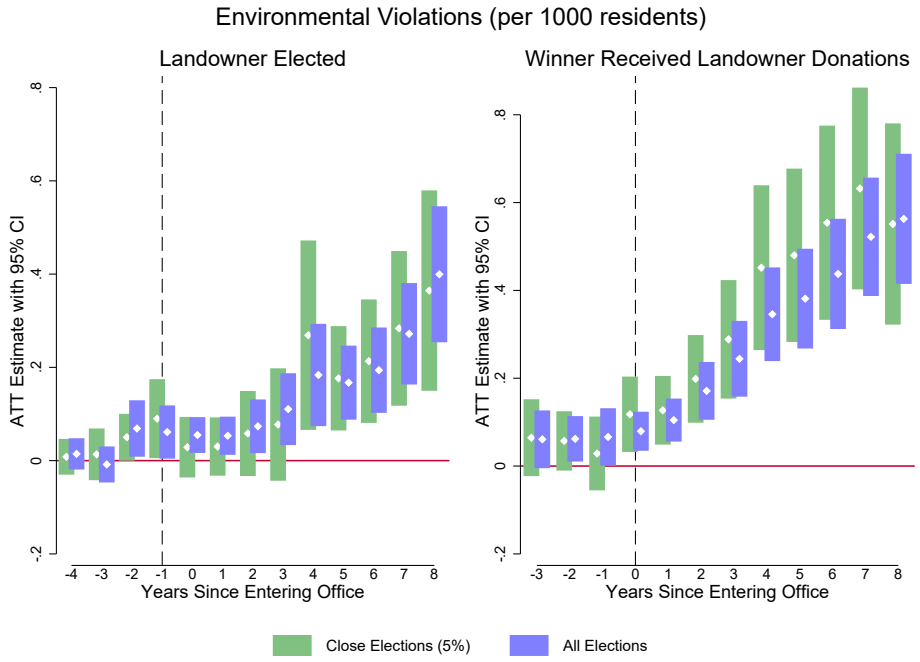
Note: See note in Figure A3. Outcome is land conversion to other crops as percentage of municipal area.

Figure C25: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Deforestation



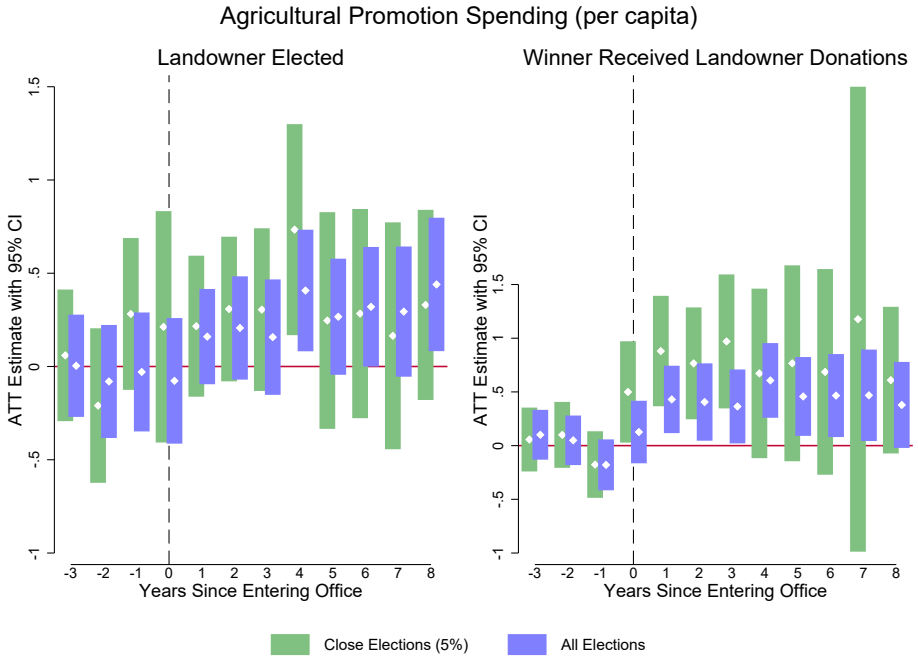
Note: See note in Figure C22. Outcome is defined as natural vegetation lost in a given year as a percentage of municipality baseline vegetation in 2000.

Figure C26: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Environmental Violations



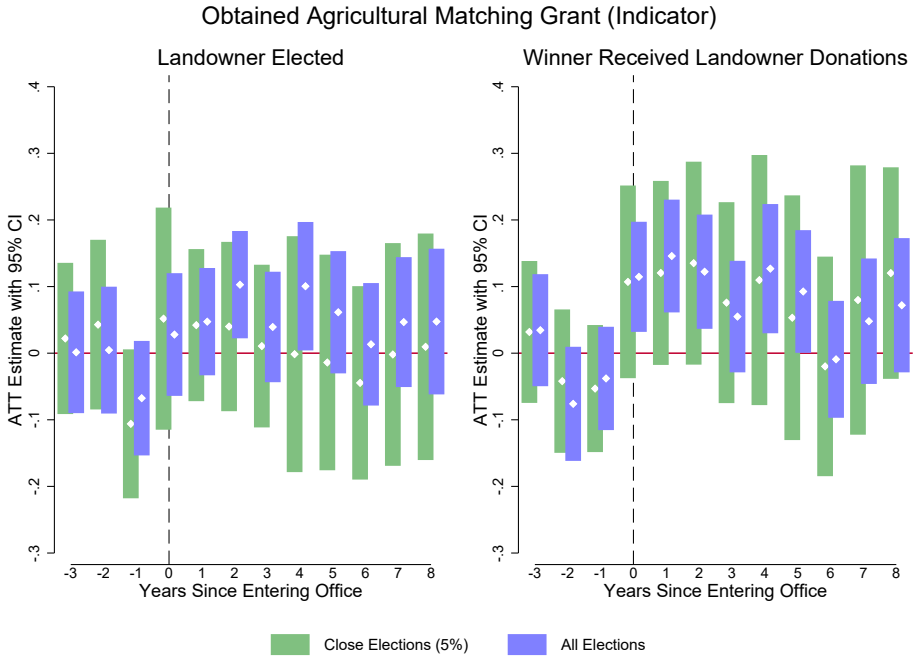
Note: See note in Figure A3. Outcome is the number of environmental violations (IBAMA embargoes) registered per 1000 residents (transformed using inverse hyperbolic sine).

Figure C27: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Spending on Agricultural Promotion



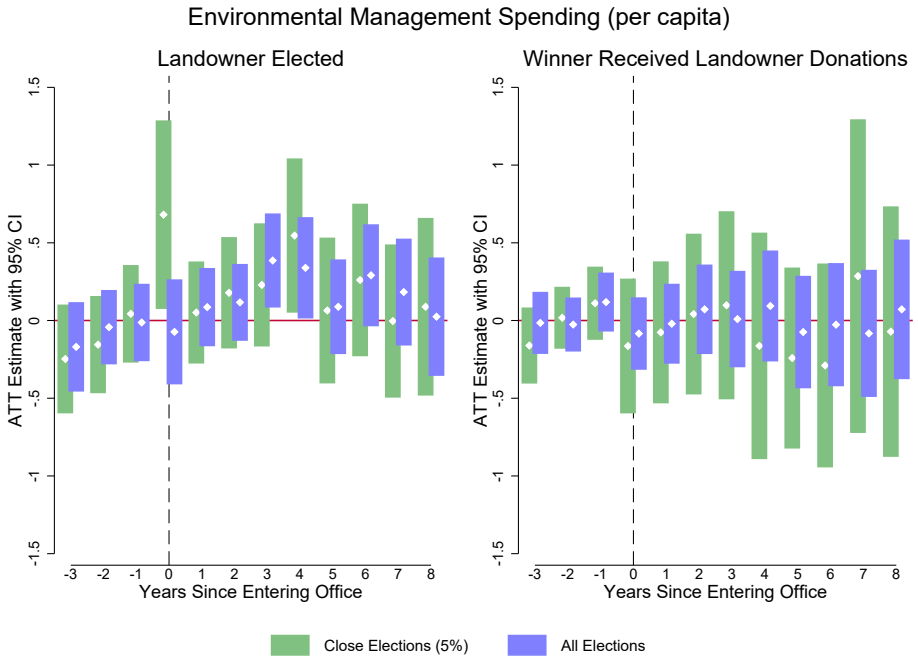
Note: See note in Figure A3. Outcome is the sum of municipal spending on Agricultural Promotion (Agriculture, Colonization, Agro-livestock Defense and Sanitation, Rural Extension, Irrigation, Agrarian Organization, Agro-Livestock Promotion, Land Reform, and Other Agricultural Subfunctions) per capita. Monetary values are deflated to 2010$BRL and transformed using inverse hyperbolic sine.

Figure C28: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Receipt of Federal Matching Grant from Ministry of Agriculture



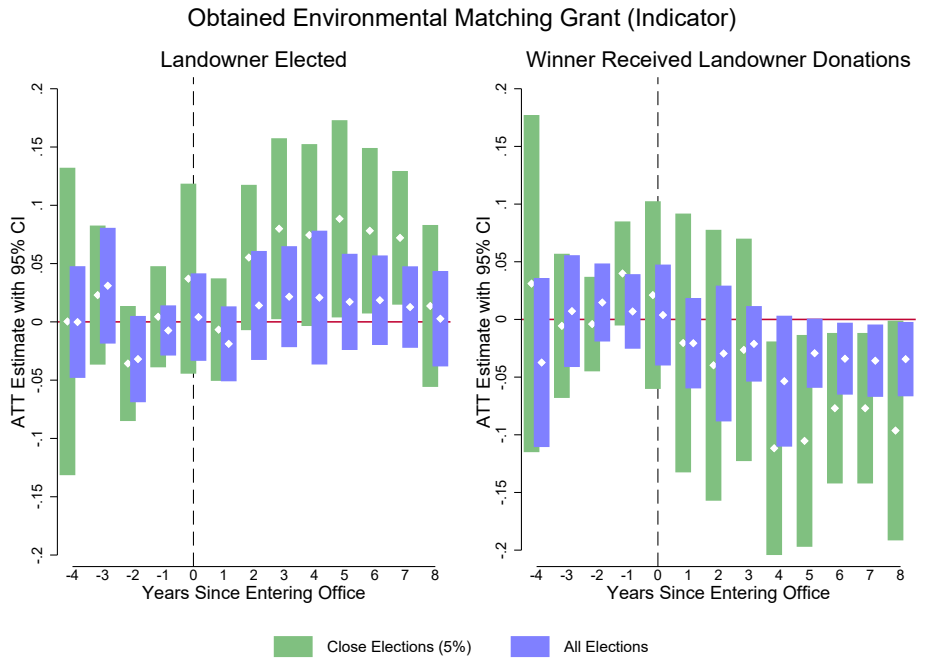
Note: See note in Figure A3. Outcome is an indicator of whether municipality received a federal matching grant from the Ministry of Agriculture in a given year.

Figure C29: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Environmental Management Spending



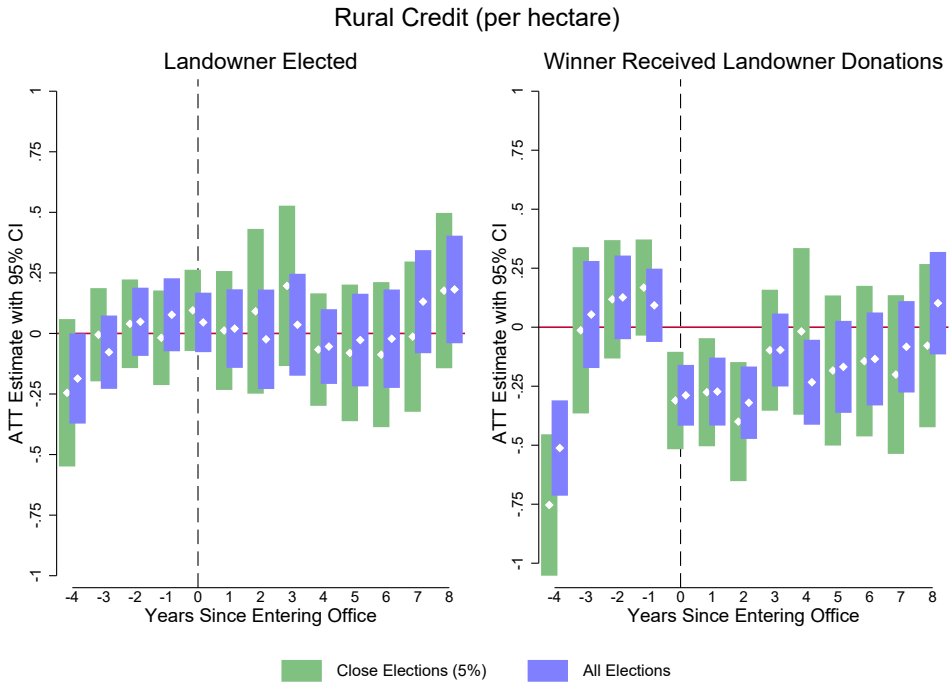
Note: See note in Figure A3. Outcome is the sum of municipal spending on Environmental Management (Environmental Control, Management, Preservation and Conservation, Recuperation of Degraded Areas, and Other Environmental Subfunctions) per capita. Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine.

Figure C30: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Receipt of Federal Matching Grant from Ministry of Environment



Note: See note in Figure A3. Outcome is an indicator of whether municipality received a federal matching grant from the Ministry of the Environment in a given year.

Figure C31: Dynamic Effects of Election of Mayor with Personal or Donor Ties to Land on Municipal Rural Credit



Note: See note in Figure A3. Outcome is the value of rural credit received in the municipality for agriculture (transformed using inverse hyperbolic sine).