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 dataset of land-use changes on the properties of municipal politicians and campaign donors in the Brazilian Amazon to assess channels through which local politics may drive land conversion. Estimating event studies around close mayoral elections, we find that large landholders significantly increase soy cultivation while the candidate they donated to is in office. This suggests landholders invest in political influence to overcome barriers to agricultural intensification. In turn, mayors who receive landholder donations govern in favor of agriculture – increasing spending on agricultural promotion and distribution of rural credit. While agricultural promotion "returns the favor" for mayors' donors, it is not precisely targeted. We document large spillovers onto lands not registered to donors, resulting in increased environmental violations and deforestation in these areas. Results reveal how patronage and special interests drive land-use change in the Amazon.

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

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1 Introduction

> "*The big agricultural producers, the ones with the most capital, are the ones at the front of politics here.*" —Deputy Environment Minister of Pará, quoted in Nolen and Elkaim (2018).

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 and impose environmental damages (Zeppetello et al., 2020; Giam, 2017; van der Werf et al., 2016; 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).

In this paper, we quantify channels through which landholders intervene in local politics to overcome barriers to land conversion in the Brazilian Amazon. Landholders may buy political influence through campaign donations, or participate in local politics as a candidate. In turn, politicians may pay back their campaign donors directly through targeted favors or special treatment (i.e., patronage), or indirectly by governing in favor of donors' special interests. We assess both property-level and policy-level channels of landholder political influence using a novel panel dataset.

We combine individually-identified, geo-referenced land cadasters, registries of political candidates and campaign donors across five municipal elections, and remote sensing data to build a panel dataset measuring land use transitions on properties belonging to municipal political candidates and campaign donors in Brazil's Amazon biome between 2000-2020. This is the most complete accounting of its kind ever assembled, encompassing over 7,000 mayoral candidates, 277,000 donors, and 611,000 properties.

Methodologically, we estimate effects of a mayor's entry into office on agricultural land-use and deforestation on the mayor's personal properties and those of their campaign donors by comparing outcomes on the properties of successful candidates and donors versus runner-up candidates and donors in close mayoral elections (where winning or losing is as-if-random).

Our primary aim is to detect whether mayors precisely target benefits or favors to their landholding donors to facilitate land-use changes on their properties – a dynamic we refer to as "agricultural patronage." This is analogous to the public employment patronage identified in Colonnelli et al. (2020), but may be more relevant in communities dominated by agriculture. To explore dynamic effects before, during, and after mayors' time in office, we estimate event study specifications and implement the Callaway and Sant'Anna (2021) estimator to accommodate staggered treatment timing and heterogeneous treatment effects. To measure whether landholders' participation in local politics (either as donors or candidates) affects municipal policy-making and land-use, we estimate fixed effects specifications comparing outcomes in municipalities where a candidate who is a landholder or who received substantial landholder donations wins or loses a close election.

We find strong evidence of agricultural patronage at the property-level. Landholding campaign donors significantly increase soy cultivation on their properties (+.46 p.p. or +7.2 ha/year – from a baseline mean of .51% of property area) while the candidate they donated to is in office.[1] Land conversion to soy comes from already-cleared pasture – which declines by a proportionate amount – while deforestation and environmental violations remain mostly unaffected. Heterogeneity analysis reveals that donors' significant increase in soy is driven by the largest quartile of properties and by first-time soy adopters. Overall, these findings suggest that large landholders in the Amazon invest in political influence to overcome barriers to *agricultural intensification* – specifically, adoption of high-value soy.[2] Soy cultivation offers higher profitability than pasture-fed livestock, but shifting to soy requires overcoming several barriers to adoption, including credit, technology, training, and labor constraints and access to buyer and supplier networks (Moffette and Gibbs, 2021; Szerman et al., 2022). Political influence may help donors overcome these barriers by giving them preferential treatment by service providers or improved access to factor markets. Absence of effects at the extensive margin (i.e., forest clearing) may be due to mayors' relative lack of power over this dimension, since deforestation is federally regulated and enforced.

[1]Soy cultivation also trends upwards on mayors' personal properties after their entry into office, though effects are not significant at the 5% level. One hectare measures 100m×100m, or 1.9 football fields.

[2]Landholders apparently value political influence highly, and use donations sparingly to facilitate adoption: the average donation to a winning candidate was worth US$5,658 (in constant 2010 USD), and only 19% of successful donors donate again – with subsequent donations averaging just US$1,049.

Furthermore, we find that landholder donations affect municipal governance and land-use. The close election of a mayor who received substantial campaign donations from landholders ($\geq$25% of their total donations) significantly increases distribution of rural credit and weakly increases municipal spending on agricultural promotion. Election of a landholder-financed mayor is also associated with agricultural intensification and adverse environmental consequences: municipal soy cultivation increases by .66 p.p., or 681 ha, and environmental violations increase by 23% during that mayor's time in office. Decomposing these municipal-level effects into changes occurring on the properties of donors, candidates, and other landholders, we find large spillovers in soy cultivation, deforestation, and environmental violations onto lands not registered to donors or candidates, suggesting promotion of agriculture by landholder-financed mayors does pay back donors, but not in a precisely targeted way.[3]

This paper contributes to three main strands of the political economy literature: (i) patronage in local government, (ii) special interest groups and money in politics, and (iii) the effects of politician identity, or type.[4]

By linking candidates and donors to property-level land-use changes, we are the first to identify and quantify a channel of agricultural patronage – through which largeholders engage in *quid pro quos* with mayors to facilitate high-value crop adoption. Individualized transactions of this kind were never previously observable. This finding complements prior studies of public employment patronage (Toral, 2022; Colonnelli et al., 2020) and public contract patronage (Boas et al., 2014) in Brazil. Our findings suggest that mayors target patronage through *feasible* channels. Mayors wield a degree of influence over agricultural promotion and rural credit, making these mechanisms through which they can pay back donors. They have less control over deforestation enforcement, limiting their capacity to reward donors

[3]Properties registered to donors are, on average, significantly larger than properties not registered to donors (averaging 1,538ha versus 462ha) and have lower percentages of baseline forest cover (52.7% versus 58%), enabling economies of scale associated with soy (e.g., mechanization). Thus, agricultural promotion likely affects donors more at the intensive margin (pasture-to-soy), and non-donors at the extensive margin (forest clearing).

[4]Spanning these topics, our study contributes to literature on the political economy of deforestation (Kuusela and Amacher, 2016; Burgess and Olken, 2012; McCarthy and Tacconi, 2011). In Brazil, Pailler (2018) shows mayors may allow deforestation prior to elections to win support from rural voters. Abman (2021) finds deforestation fell further in municipalities where mayors were eligible for reelection after the introduction of a deforestation disincentive policy. Rocha and Bragança (2023) find no effect of left-wing politicians on deforestation in the Amazon. Burgess et al. (2023) show deforestation rose and fell in line with federal anti-deforestation efforts, highlighting the key role of institutions in forest governance.

along this dimension. In rural communities, agricultural favors may be more attractive than public employment or contracts, suggesting patronage dynamics may exhibit regional variations. Further, channels of patronage have varying levels of precision: while public jobs or contracts can be assigned directly, we show that mayors resort to less-targeted agricultural promotion to pay back landholders – generating negative environmental externalities.

Our study connects to the literature on special interests and money in politics (Avis et al., 2022; Bertrand et al., 2020; Chamon and Kaplan, 2013; Grossman and Helpman, 2002) by documenting the extent and influence of landholders as a special interest group. We find that large landholders ($\geq$500ha) are 28 times over-represented among mayors relative to their share of the population; largeholders are 2.6 times over-represented among donors. Harding et al. (2023) show donor-funded mayors in Colombia pay back donors by reducing environmental enforcement. By identifying landholding donors, we refine Harding et al. (2023)'s analysis of aggregate donations. We show *total* donation receipts have no association with environmental governance or land-use in Brazil, but *landholder* donations do.

We contribute to the literature on politician identity by studying land-use changes on candidates' properties and whether landholding mayors govern differently. Studies of politicians' gender (Brollo and Troiano, 2016), ethnicity (Gulzar and Pasquale, 2019; Chin and Prakash, 2011), religion (Bhalotra et al., 2014), and education (de Paola and Scoppa, 2011), have documented significant differences in governing behavior along these dimensions. Bragança and Dahis (2022) show that election of self-identified farmers as mayors led to increased promotion of agriculture and deforestation after Brazil's 2000 elections, but that these effects disappear in later years after federal environmental enforcement increased. Our results corroborate these findings: using an alternative measure of "farmer politicians" (we match 25% of elected mayors to landholdings, versus 12.6% who self-declare as farmers), we find no effects of candidates' landholding status during a period when federal regulation largely took environmental enforcement out of mayors' hands. We extend these findings by analyzing mayors' own land-use and find no measurable evidence of self-enrichment. Our results suggest mayors do not seek office to enable land conversions on their properties and do not set policy based on their identity as landholders, but do respond strongly to donors' interests.[5]

[5]Bragança and Dahis (2022) develop a theoretical model in which mayors maximize expected utility

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). Severe deforestation in the 1990s and early 2000s led Brazil's federal government to implement a series of policies to reduce forest loss in the Amazon, which proved effective: deforestation fell from 27,000 km^2 in 2004 to 7,000 km^2 in 2009 (INPE, 2017).[6] This trend reversed in 2014, when deforestation rates rose again due to a weakening federal commitment to enforcement of environmental regulations (Burgess et al., 2023).

The main drivers of deforestation in the Amazon are cattle ranching and agriculture. Pasture, which covered 14% 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 region in 2020, exhibits higher productivity and more sophisticated production techniques. In the Amazon, most agricultural production is soy (89%), although other commodities such as sugar cane, rice, maize, and cotton are also produced. Brazil is the world's leading exporter of soybean (Panis et al., 2022), and soybean cultivation in the Brazilian Amazon increased from 0.4 million hectares in 2000 to 4.6 million hectares in

across personal and political rents by choosing whether to implement pro-deforestation policies based on their identity (farmer or non-farmer), voters (pro-deforestation and ordinary), and strength of federal environmental enforcement. The model predicts that (i) farmer mayors are more likely to win re-election and enact pro-deforestation policies, and (ii) increased environmental enforcement curtails pro-deforestation incentives. Our data allow us to add two dimensions of nuance to this framework. First, we are able to identify landholding donors, and thus separately analyze effects of mayors' *own landholdings* vs. *landholder donations* on governance. We find that landholder donations have significant effects on governance, while personal landholdings do not. Second, rather than focusing exclusively on deforestation, we study two margins of influence: the *extensive* (forest-to-pasture) margin and the *intensive* (pasture-to-soy) margin. We find that environmental enforcement curtails mayors' political influence at the extensive margin, but not at the intensive margin, where largeholders seek political favors to overcome barriers to soy adoption.

[6]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., 2023). Protected and indigenous areas are effective in preserving natural vegetation and sustainable land uses (Amin et al., 2019). 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).

2019 (Song et al., 2021).[7] While soy 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 production processes (Sauer, 2018; Weinhold et al., 2013). Use of pesticides in Brazilian soy production is high (Garrett and Rausch, 2016) and has been associated with negative health effects (Skidmore et al., 2023).

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, most 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) is an arm of the Brazilian Ministry of the Environment that enforces the Forest Code. 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.

2.2 Local Politics and Environmental Governance

Formal environmental governance in Brazil is set and enforced mostly at federal and state levels, but municipal governments often host environmental secretariats, councils, or other

[7] Following Marin et al. (2022) and Skidmore et al. (2023), we refer throughout this paper to "agricultural intensification" in reference to land-use transitions from livestock pasture to soy. This presents a useful contrast with "extensification," referring to forest clearing for pasture. However, it is also a simplification, given that agricultural intensification can take other forms (e.g., cattle feedlots).

entities that are responsible for preservation, conservation, and recuperation of 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). Municipalities may also apply for matching grants from federal ministries, including the Ministry of Agriculture.

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. Both mayors and councilors serve four-year terms, with mayors eligible to serve up to two consecutive terms, and voting is obligatory (Lavareda and Telles, 2016).[8]

3 Data

In this section, we describe land registries covering the Brazilian Amazon, remote sensing land-use data, political candidate and campaign donor registries, and 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 (National Institute for Settlement and Agrarian Reform), and CAR (Rural Environmental Registry).[9] 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 rural credit.

We combine and harmonize individually-identified property records from Terra Legal,

[8]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. 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).

[9]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 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.

INCRA, and CAR 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 Amazon states due to partial availability of CAR. These combined cadasters constitute the most complete set of individually-identified property maps available for the Brazilian 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 spatial resolution of 30m. Based on MapBiomas' data, we calculate land-use outcomes (deforestation, soy cultivation, non-soy agriculture, and pasture) at both 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.[10] We measure soy and pasture as percentages of property area. We compute analogous measures of deforestation and land-use at the municipal level.[11]

3.3 Candidate and Donor Registries

Brazil's Supreme Electoral Tribunal (TSE) publishes complete registries of political candidates for the 2000, 2004, 2008, 2012, and 2016 municipal elections, as well as complete

[10]The minimum mappable unit in MapBiomas is one hectare. To ensure the detected transition from natural to anthropic land use is not the result of satellite error, we verify that each pixel where deforestation was detected remains under anthropic land use the following year. Normalizing to percentage of property area accounts for large differences in property size to better assess the relative intensity of land-use changes. To measure absolute land-use changes, we also report results using asinh(hectares) in the Appendix. Although forest fires used to deforest would also be an interesting outcome, no dataset thus far can identify and distinguish wildfires from forest fires used to deforest.

[11]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 biome specialists ensuring 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.

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 win margins, we identify municipality-election pairs with close elections ($\leq$5% win margin). Appendix Figure A1 maps the number of close elections between 2000-2016 for each municipality in the Legal Amazon. Competitive mayoral elections are relatively evenly spread across the region and represent 25% of elections over the study period. 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 in October). Thus, their term in office spans the four years after their election year (e.g., 2013-2016 for the 2012 election).

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, which were shared by the Gibbs Land Use and Environment Lab. At the property level, we create an indicator registering when an embargo is associated with a property or property owner in a given year. At the municipal level, we sum embargoes to create an aggregate measure of violations.

To analyze municipal governance, 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 (Agriculture, Colonization, Agro-livestock Defense and Sanitation, Rural Extension, Irrigation, Agrarian Organization, Agro-Livestock Promotion, Land Reform, and Other Ag. Subfunctions) and Environmental Management (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 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/ID number and municipality and (ii) the name/ID number and municipality associated with properties in the union of land registries. Since multiple properties may be associated with an individual, we aggregate property-level data to the candidate/donor level. 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.

Although the quality and coverage of our harmonized land registries are exceptionally high compared to data available in most developing countries, we note two limitations. 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 not correctly identify some politicians as landholders in other Amazon states. Appendix Figure A2 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 potential measurement error introduced by incomplete land registries outside of Mato Grosso, Pará, and Rôndonia, we implement robustness checks wherein we limit our analyses to these three states.[12]

A second limitation of our data is that we do not observe a reliable date 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 2000-2020 period. We thus make a simplifying assumption that land ownership is time-invariant over this period.[13] 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

[12]We focus on the full Amazon biome in our preferred specification to ensure findings are representative of this region (results for Mato Grosso, Pará, and Rôndonia may not be externally valid), and since measurement error should attenuate estimates, making this a conservative choice.

[13]We justify this assumption with recent evidence that land transactions are infrequent in the Amazon region – involving only 0.51% of properties during 2019-2020 (Moffette et al., 2024). 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 (MAPA, 2021).

a close election) landholding 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.

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 municipal elections in the Brazilian Amazon.

Our first takeaway from these data is that *landholding is widespread among politicians and donors*. We match 25% of winning candidates and 14% of runners-up with land registries, as well as 7% of donors. Just 13% of elected mayors self-identify as farmers or ranchers, suggesting there is substantial under-reporting of politicians' true landholding status.[14] In Appendix Figure A3, we plot the share of elected mayors and campaign donors who are landholders or large landholders (>500ha), disaggregated by political party. Landholding is highest among parties associated with agribusiness, with some parties having 27.5% landholder mayors and 18% largeholder mayors. For comparison, landholders account for 3.5% of the total population within Brazil's Amazon biome, and largeholders account for 0.64%.

Our second takeaway is that *mayoral candidates and campaign donors are disproportionately large landholders*. Among the subset of candidates and donors who match with land registries, the average mayoral candidate held 1,678ha across 2.2 properties (2,276ha across 2.4 properties for elected mayors), while the average donor to a mayoral candidate held 1,538ha across 1.5 properties. In Figure 1, we plot histograms of property size held by elected mayors and campaign donors relative to all other Amazon landholders, for whom the average landholding is 462ha across 1.2 properties.

Third, we note that *landholding candidates' and donors' properties experienced significant deforestation between 2000-2019*. Among landholding mayoral candidates, deforestation

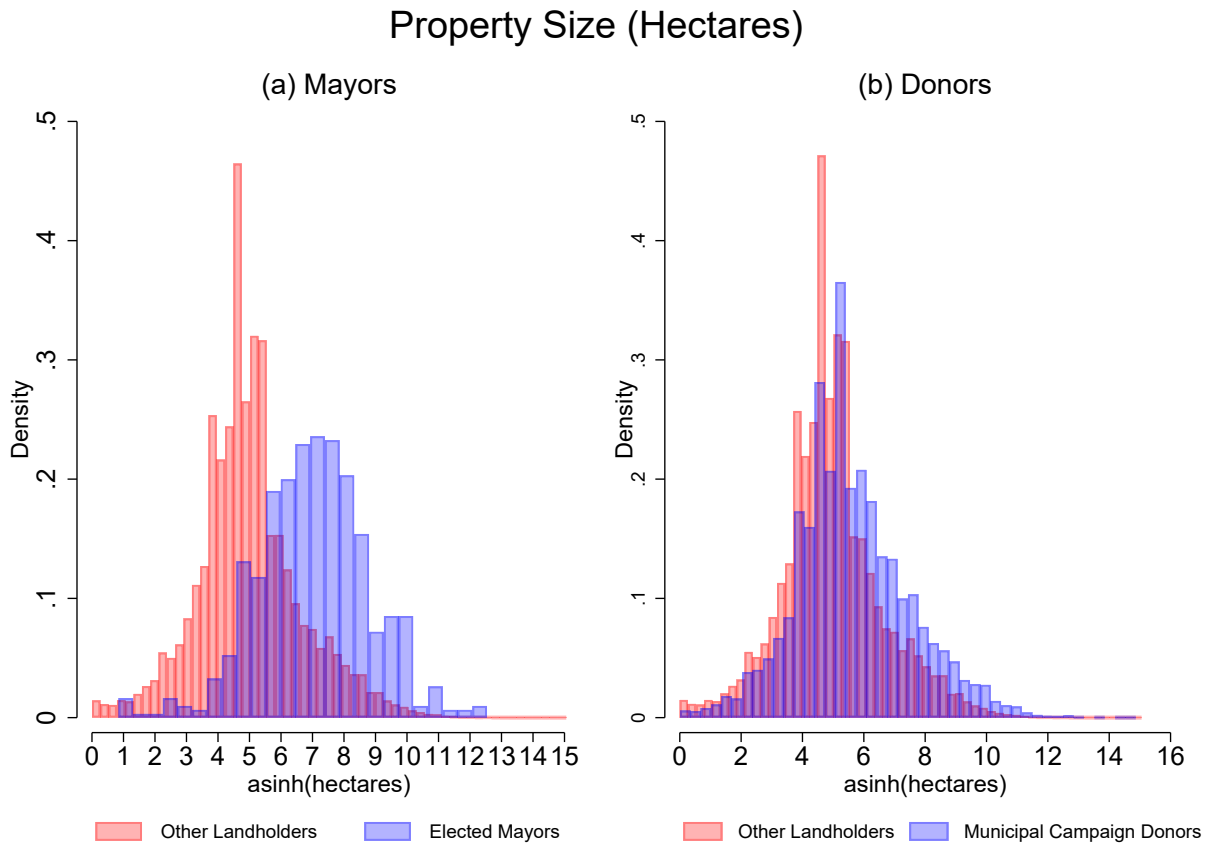
[14]The share of self-declared farmers and ranchers may be lower than values derived from land registries because (i) some politicians may hold small properties or rent out their properties, thus appearing in our classification as landholders despite holding another occupation (though candidates' large 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	7,078	2,066	2,151	277,946	40,887	48,053
No. Landholder Candidates/Donors	1,354	298	545	19,283	3,125	3,222
% Landholders	19.1	14.4	25.3	6.9	7.6	6.7
Full Sample:						
% Land-Linked Declared Occup.	10.8	11.8	12.6	-	-	-
	(31.1)	(32.2)	(33.2)	-	-	-
Age	47.3	47.4	46.7	-	-	-
	(14.4)	(9.7)	(9.7)	-	-	-
% Female	13.4	13.6	11.8	-	-	-
	(34.1)	(34.2)	(32.3)	-	-	-
Years of Schooling	12.4	12.2	12.2	-	-	-
	(3.6)	(3.6)	(3.6)	-	-	-
No. Donations Received/Given	15.8	16.8	21.9	1.9	1.4	1.4
	(39.2)	(35.5)	(39.4)	(3.7)	(1.3)	(1.3)
Val. Donations Received/Given	62,721	70,397	75,087	3,127	4,441	4,607
	(310,604)	(348,548)	(208,144)	(54,239)	(29,533)	(26,550)
Among Landholders:						
Total Landholding (ha.)	1,678	1,403	2,276	1,538	1,592	2,322
	(7,961)	(4,294)	(10,103)	(19,221)	(17,292)	(25,017)
No. Properties	2.2	2.1	2.4	1.5	1.8	1.8
	(2.5)	(2.7)	(2.9)	(1.5)	(2.1)	(2.2)
% Baseline Forest Cover (2000)	51.8	51.7	51.0	52.7	50.7	50.7
	(31.9)	(30.5)	(32.1)	(34.0)	(33.8)	(32.9)
Avg. Yrly Deforest. (% Landholding)	3.5	3.5	3.6	3.8	3.8	3.8
	(2.0)	(2.0)	(1.9)	(1.9)	(1.9)	(1.9)
No. of Years with Deforest. Registered	8.5	8.6	9.2	5.6	6.5	7.0
	(6.6)	(6.6)	(6.7)	(5.9)	(6.5)	(6.5)
% of Landholding Deforested (2000-2019)	63.5	62.4	64.4	68.9	67.6	68.8
	(35.4)	(35.4)	(34.8)	(34.2)	(34.8)	(33.8)
% with Environmental Violation	16.9	13.4	20.9	6.3	9.2	10.8
	(37.5)	(34.1)	(40.7)	(24.3)	(28.9)	(31.1)
Avg. Yrly Pasture (% Landholding)	52.0	52.4	52.8	55.5	55.3	56.4
	(31.3)	(29.9)	(31.0)	(32.1)	(32.5)	(31.4)
% Converted to Pasture (2000-2020)	10.2	9.8	9.8	15.8	12.8	13.3
	(24.4)	(26.1)	(22.8)	(27.2)	(25.5)	(26.2)
Avg. Yrly Soy (% Landholding)	1.0	1.1	1.1	0.6	0.7	0.8
	(5.3)	(5.7)	(5.2)	(4.4)	(4.3)	(4.7)
% Converted to Soy (2000-2020)	2.5	2.4	3.0	1.7	2.1	2.4
	(10.4)	(10.3)	(10.9)	(9.8)	(10.3)	(11.0)
% Land-Linked Declared Occup.	23.3	25.2	25.1	-	-	-
	(42.3)	(43.5)	(43.4)	-	-	-
Age	47.9	48.0	47.4	-	-	-
	(9.7)	(9.5)	(9.4)	-	-	-
% Female	7.4	6.4	7.2	-	-	-
	(26.2)	(24.5)	(25.8)	-	-	-
Years of Schooling	11.6	11.5	11.8	-	-	-
	(3.8)	(3.9)	(3.7)	-	-	-
No. Donations Received/Given	17.2	15.2	23.5	2.5	1.9	2.8
	(33.8)	(29.2)	(43.4)	(4.8)	(2.5)	(7.8)
Val. Donations Received/Given	65,737	68,033	80,027	6,299	10,579	13,870
	(165,560)	(248,149)	(148,276)	(38,464)	(47,311)	(63,747)

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. Monetary donation values are deflated to constant 2010 $BRL. Runner-up and Winner categories represent all runners-up and winners, not only the restricted 5% close election sub-sample. Characteristics such as occupation, age, sex, and schooling are not available for donors.

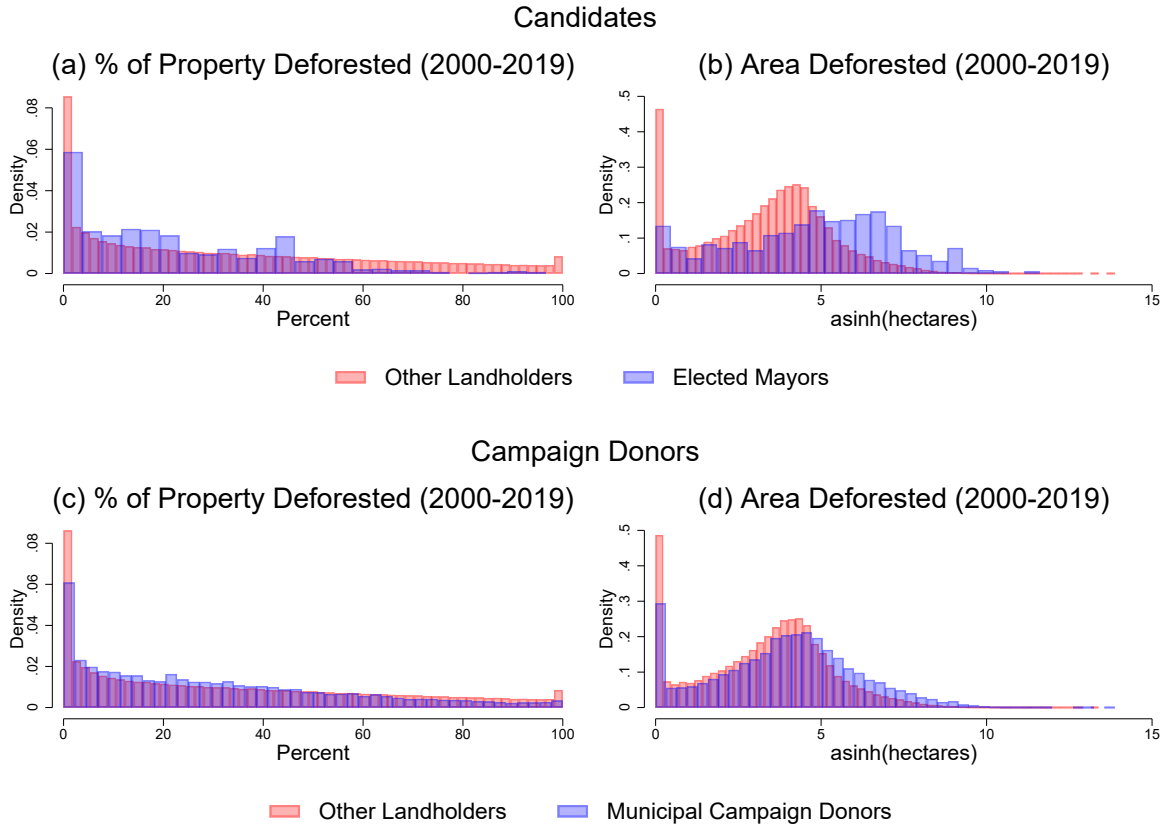
Figure 1: Distributions of Property Size among Mayors, Donors, and Other Landholders



averaged 64% of property area and 17% received at least one environmental violation (21% for elected mayors) during this period. Figure 2 illustrates the distribution of deforestation as a percentage of property area and in total hectares on mayoral candidates' and campaign donors' properties, relative to all other Amazon properties. Both mayoral candidates and donors deforested more in absolute terms than the average landholder, but less as a share of property area due to their larger than average holdings. The average candidate had 52% of their land under pasture and 1.0% under soy during the study period, and converted 2.5% (3.0% for elected mayors) of their land to soy by 2020. On average, donors had 56% of land under pasture, 0.6% under soy, and converted 1.7% to soy by 2020. Appendix Table B2 reports descriptive statistics for elected mayors and campaign donors relative to other landholders.

Finally, we compare landholding and non-landholding candidates and donors and note

Figure 2: Deforestation (2000-2019) on Properties of Candidates, Donors, and Others



that *largeholding mayors and donors differ substantially from other mayors and donors.* As reported in Appendix Table B3, mayors who are large landholders (>500ha) are less often female (7.5% versus 9.3% for non-landholders), less educated, and much less likely to be born locally (11.4% versus 42.5% for non-landholders). Large landholding mayors receive 53% higher donation values and are 29% more likely to win their election than non-landholders. Among donors, large landholders give an average of 3.1 donations (versus 1.8 for non-landholders) and give 570% higher values (R$16,844 vs. R$2,959).

Appendix Table B4 reports means and standard deviations of municipal characteristics for municipalities in the Brazilian Amazon biome. Of 432 municipalities in the Amazon biome, 325 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

In Section 4.1, we present our property-level strategy to identify causal effects of the close election of a mayoral candidate on land use and environmental outcomes on (i) donors' and (ii) mayoral candidates' properties. In Section 4.2, we present a municipal-level strategy to identify effects of election of a mayor with (i) personal landholdings or (ii) who received landholder donations on municipal governance and land-use.

4.1 Property-Level Event Studies

We leverage donor- and candidate-level annual panel datasets spanning 2000-2020 to estimate dynamic event study specifications. Specifically, we compare outcomes on properties held by donors to winning versus runner-up mayoral candidates (separately, we compare outcomes for candidates themselves) in years before and after the candidate's entry into office (i.e., the post-election year). To account for endogeneity of election outcomes, we restrict our sample to close elections ($\leq$5% win margin), where the outcome was plausibly random.[15] For each candidate or donor, we re-center yearly outcomes using relative time indicators around their first year of treatment. To avoid bias introduced by staggered treatment timing and heterogeneous treatment effects (Goodman-Bacon, 2021), we implement Callaway and Sant'Anna (2021)'s group-time average treatment effect estimator with never-treated and not-yet treated controls.[16]

For donor i in year t, let E_i be the year in which the candidate supported by i 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. We control for individual and year fixed effects, and cluster standard errors at the donor-level (Abadie et al., 2022):

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

[15] 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).

[16] 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 Callaway and Sant'Anna (2021).

This specification flexibly identifies dynamic effects of entry into office and enables evaluation of pre-trends. Controlling for individual fixed effects identifies treatment effects off within-individual variation over time. Year fixed effects absorb changes that affect all units in specific years, such as commodity price changes or policy changes at the national level. In Section 6.1, we test robustness of property-level findings to alternative close election cutoffs, sample definitions, inclusion of municipality-election fixed effects and candidate covariates, and flexibly controlling for the win-margin running variable.

The identifying assumption in our property-level analysis is that, absent an as-if-random election result, outcomes on properties of successful versus unsuccessful donors would have evolved in parallel.[17] One threat to identification could come from spatial spillovers between treated and control properties. Spatial spillovers are unlikely at the property-level, given that municipalities in the Brazilian Amazon are large (averaging 9,218 km^2) and properties of winners and runners-up are unlikely to abut.

4.2 Municipality-Level Fixed Effects

We use a fixed effects strategy to measure effects of landholders' participation in local politics on municipal governance and land-use. 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 more than 25% of their total value of donations from landholders, and (iv) received more than 50% of their total value of donations from landholders.[18] We regress outcomes y_{me} separately on these treatment indicators, including municipality and election-period fixed effects and a vector of time-

[17] We opt for event-studies with a close election cutoff over a regression discontinuity (RD) approach for four reasons. First, event studies allow inclusion of individual fixed effects, which absorb unobservable property characteristics that could strongly shape land-use, including slope, soil type, and accessibility, as well as owner characteristics insofar as these are time-invariant. Second, event studies fully leverage our property-level panel, while RD is cross-sectional and requires a significantly larger sample size to achieve the same level of statistical power (McKenzie, 2012; Schochet, 2009). Third, our data exhibit covariate imbalance on some variables, which violates RD assumptions but does not compromise our fixed effects approach. Fourth, pre-trends are more parallel in municipalities with close elections due to the quasi-random nature of treatment in these places. As a robustness check, we estimate a specification with a flexibly-defined win-margin running variable, following the RD-DID approach in Colonnelli et al. (2020). We restrict our sample to donors since selection-into-donor-status could make donors non-comparable to other landholders.

[18] We report descriptive statistics for landholder-financed mayors versus others in Appendix Table B5. The main takeaway from this table is that landholder-financed candidates are more likely to be landholders themselves (76.6% versus 18% for non-landholder-financed) and receive substantially more donations.

varying controls for the winning mayor (sex and education level) as follows:

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

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. Municipal outcomes of interest include land-use (pasture, soy, and deforestation) as a percentage of municipal area, environmental violations, and governance mechanisms, including municipal spending on agricultural promotion, municipal receipt of federal matching grants, and the value of rural credit. We do not implement Callaway and Sant'Anna (2021) 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 frequently, while Callaway and Sant'Anna (2021) assume treated units remain treated. To evaluate the identifying parallel pre-trends assumption prior to municipalities' first treated period, we estimate municipality-level event studies for key outcomes using Callaway and Sant'Anna (2021) in Appendix Figures C55-C61. We implement a battery of municipal-level robustness checks in Section 6.2. Spatial spillovers between treated and control municipalities are unlikely, given that municipalities with both close elections and treated mayors are not often adjacent in space and coincident in time. Furthermore, governance mechanisms (e.g., public spending) are use-restricted to within a municipality's boundaries.

5 Results

We report property-level results in Section 5.1 and municipal-level results in Section 5.2. As motivating evidence, we plot mean levels of soy cultivation and deforestation on properties of never-treated donors and each treated cohort between 2000 and 2020 (Appendix Figures A4 and A5). Levels and trends of soy cultivation are largely similar between never-treated donors and each cohort of treated donors prior to treatment, after which treated cohorts' soy cultivation increases notably, with treated donors exhibiting substantially higher levels of soy cultivation relative to never-treated donors by 2020. On average, landholding donors (both treated and control) exhibited high levels of deforestation in the early 2000s, a sharp

reduction in deforestation after 2004, and a renewed increase in deforestation from 2014 onward, paralleling overall trends in the region.

5.1 Property-Level

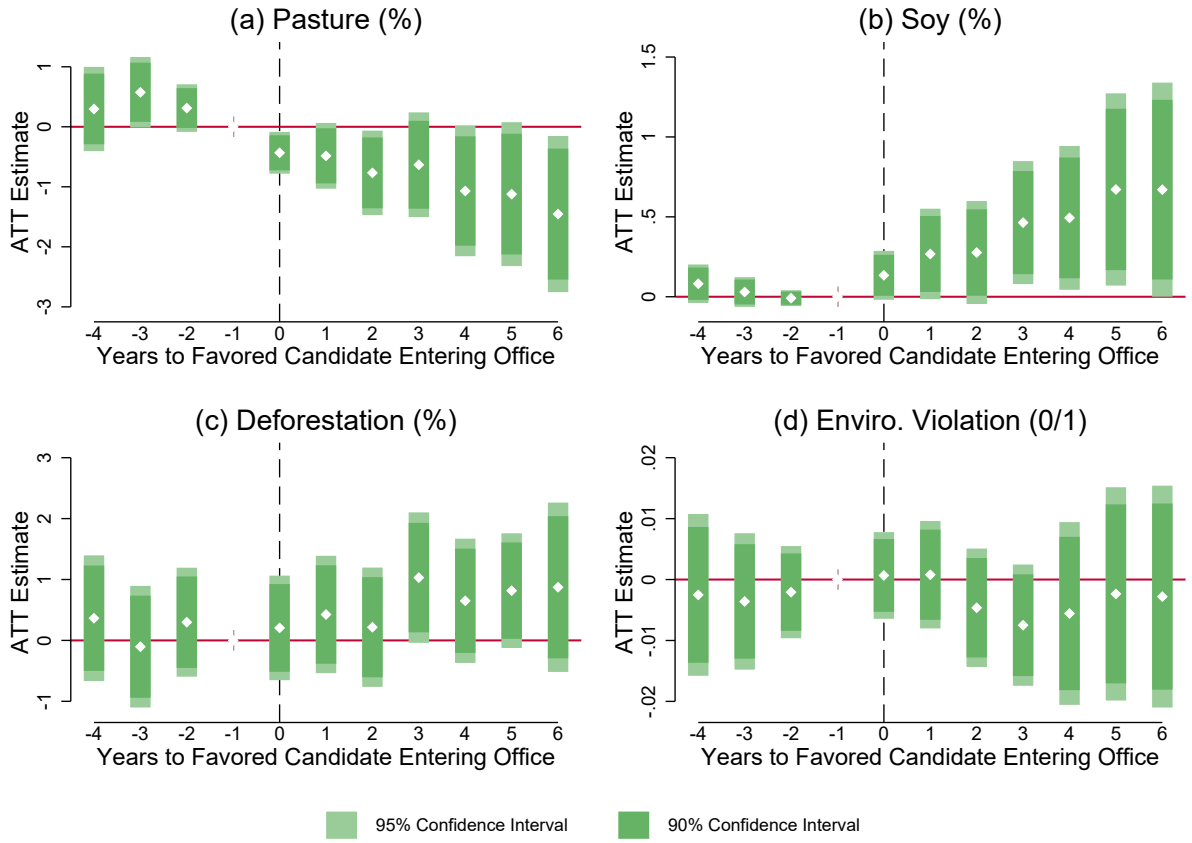
Turning from descriptive evidence to our main event study specifications, we first compare outcomes on properties of donors to candidates who win a close election ($\leq$5% win-margin) relative to donors to candidates who lose a close election, around the year of the candidate's entry into office. Figure 3 reports results. Appendix Table B.2 reports corresponding point estimates, standard errors, and sample statistics.

As shown in Figure 3, donors' soy cultivation increases significantly upon their favored candidate's entry into office (+.46 p.p. three years after entry and +.67 p.p. five years after, from a baseline mean of .51% of property area). This constitutes a 91% increase over baseline during the mayoral mandate, and represents a cumulative increase of 46ha six years on. Donors' shift to soy appears to come mostly from existing pasture, which declines by .43 to 1.45 p.p. from a baseline mean of 54.6 % of property area.[19] Deforestation weakly increases in several years following candidates' entry into office (+1.03 p.p. in $t+3$), though effects are not significant at the 5% level. Environmental violations remain unchanged.[20]

[19] While the t-3 coefficient for pasture is weakly positive, it is not significant at the 5% level and does not trend in a way that compromises our interpretation of a significant post-treatment effect.

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

Figure 3: Donors: Effects of Supported Candidate's Entry Into Office

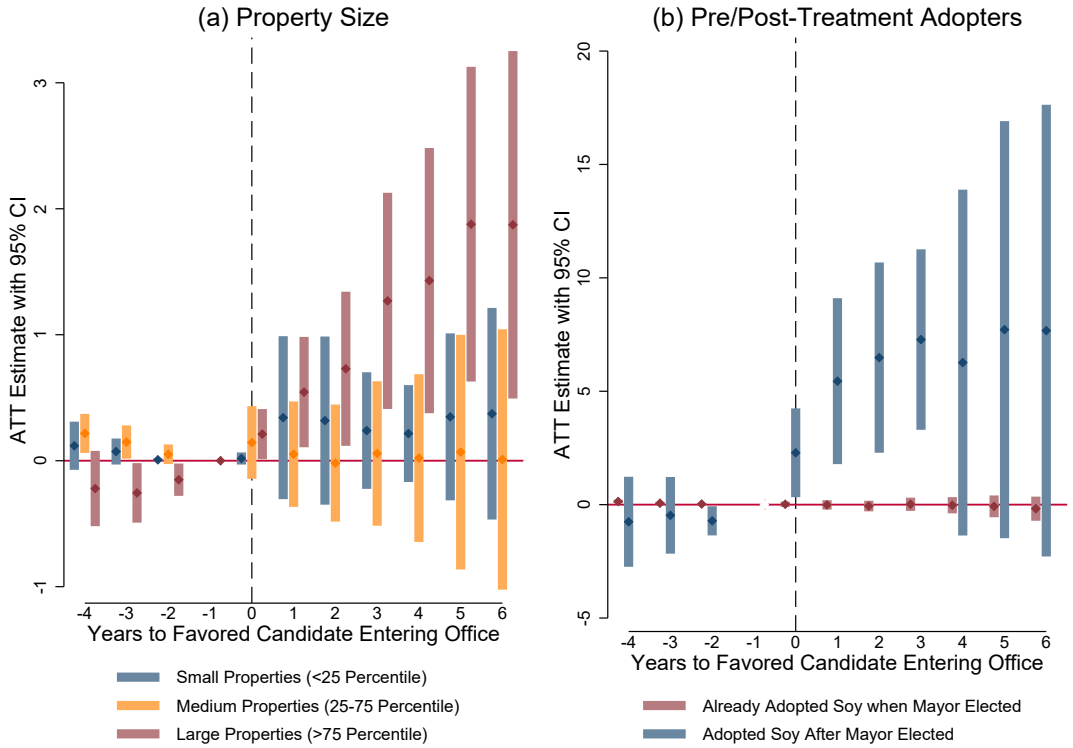


Note: Figure reports dynamic ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) estimator. Sample is restricted to close mayoral elections ($\leq$ 5% win-margin). Donor and year fixed effects are included and standard errors are clustered at the donor-level. Outcomes measure hectares of (a) pasture, (b) soy, and (c) deforestation as a percentage of property area and (d) a binary indicator of whether a property or owner have any environmental violation in a given year. Donor event studies include 29,400 (donor×year) observations for pasture/soy, 25,362 for deforestation (fewer due to a data quality procedure), and 20,736 for environmental violations (available post-2004).

In Figure 4, we re-estimate effects on donors' soy cultivation separately for (a) small (1st quartile), medium (2nd and 3rd quartile), and large (4th quartile) landholders, and (b) landholders who previously cultivated soy versus those who adopt soy for the first time after their candidate enters office. Results suggest that donors' shift to soy is driven by the largest quartile of properties and by first-time adopters. Soy is much more profitable than raising livestock on pasture, but also involves substantial up-front investments that may present barriers to adoption for landholders (Moffette and Gibbs, 2021). Further, soy cultivation enjoys economies of scale and is more viable on large properties. Political influence with the mayor may enable large landholders to overcome these barriers to soy adoption.[21]

[21] We report results from two additional heterogeneity analyses in Appendix Figures A6 and A7. In the

Figure 4: Soy (%): Heterogeneity by Property Area and Adoption Status



Note: Effects estimated separately for each treated sub-sample (small, medium, and large properties; pre- and post-adopters) relative to never-treated and not-yet treated controls of the same sub-sample.

We also examine effects of mayoral candidates' entry into office on land-use and environmental violations on their own properties. Results are reported in Appendix Figure A8, with corresponding point estimates, standard errors, and sample statistics reported in Appendix Table B7. In general, sample sizes for candidates are much smaller than for donors, leading to less precise estimates. Soy cultivation weakly increases on candidates properties after their entry into office, though estimates are not significant at the 5% level. Point estimates suggest soy weakly increases by 0.68p.p. (+11.1ha/year) – from a baseline mean of 4.8%

first, we estimate effects on donors' soy cultivation separately for donors to (i) landholding mayors, (ii) mayors who received more than 25% of their total donations from landholders, and (iii) other mayors. Results show that donors' shift to soy is concentrated on the properties of donors to landholding and landholder-financed mayors, suggesting mayors with personal or political ties to land are the ones engaged in agricultural patronage. In the second analysis, we estimate effects separately for competitive ($\leq$5% win margin), semi-competitive (5-15% win margin), and non-competitive elections (>15% win margin). Results show that positive treatment effects on soy cultivation occur both in places with competitive and non-competitive elections, but not in semi-competitive places. Drivers of agricultural patronage may be different in competitive elections (where mayors pay back donors to eke out support) and non-competitive elections (where mayors pay back donors because they face little political risk of doing so).

of property area – by the end of their mandate. Environmental violations weakly decrease during the same period, suggesting mayors may enjoy political cover from environmental enforcement on their properties, or may limit illegal activities due to public scrutiny.

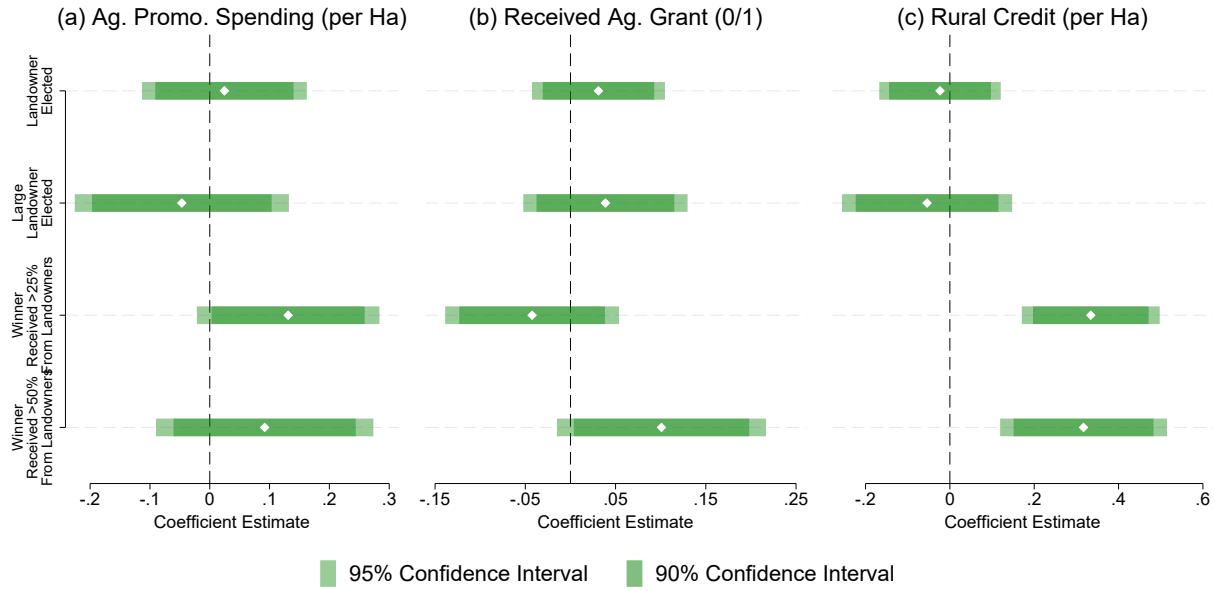
5.2 Municipal-Level

In this section, we report municipal-level effects of the close election of a landholding or landholder-financed mayor on governance, land-use, and environmental outcomes. Figure 5 reports results for municipal governance indicators related to agricultural promotion. The corresponding table is reported in Appendix B8. Each column in Figure 5 reports coefficient estimates and 90 and 95% confidence intervals for separate estimations of the specific treatment variable on an outcome of interest. Close election of a mayor with personal landholdings has no significant effect on municipal spending on agricultural promotion, receipt of federal matching grants from the Ministry of Agriculture, or distribution of rural credit. In contrast, close election of a mayor who received 25% or more of their total campaign donations from landholders weakly increases agricultural promotion spending (+13%) and significantly increases distribution of rural credit (+33%) per hectare.[22] Election of a mayor who received 50% or more of their donations from landholders is associated with a weak increase in likelihood of receiving a matching grant from the Ministry of Agriculture and a 32% increase in rural credit. 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. In 2021, 14% of rural credit was allocated to small producers, 11% to medium producers, and 75% to large producers, suggesting large landholders are major beneficiaries of increases in rural credit (MAPA, 2022).[23]

[22] As reported in Appendix Figure A9, election of landholder-financed mayors leads to increased spending on environmental management and has no effects on environmental grants or total municipal spending.

[23] 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. Souza and Albuquerque (2023) find that rural credit is scarce in the Brazilian Amazon relative to other parts of the country. It is received by a smaller share of farmers and in far lower values per hectare (R$83/ha in the Northern region versus R$1,451/ha in the South), and is most intensively used for investments in soy.

Figure 5: Effects of Election of a Landholding or Landholder-Financed Mayor on Governance

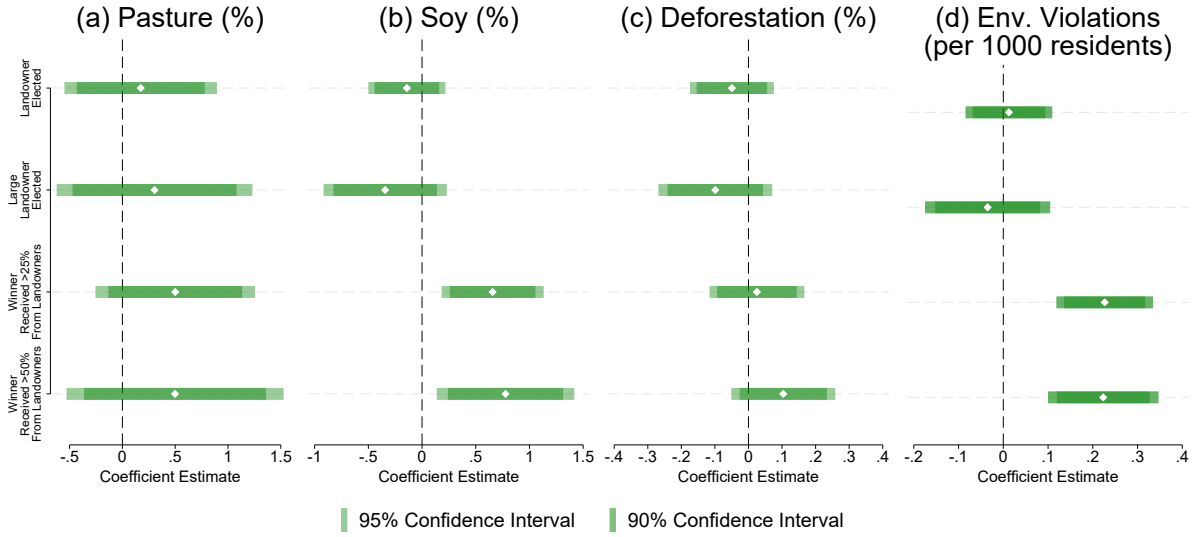


Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies: (i) landholder in office, (ii) large landholder ($\geq$ 500 ha.) in office, (iii) mayor who received $\geq$ 25% of their donations from landholders in office, and (iv) 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 the 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%. Panel (a) reports estimated effects on municipal spending on Agricultural Promotion per hectare; (b) reports estimated effects on an indicator for receiving a matching grant from the Federal Ministry of Agriculture; (c) reports estimated effects on the total value of rural credit for agriculture and livestock per hectare of municipal area (asinh). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

Does landholder-financed mayors' promotion of agriculture affect municipal land-use and environmental outcomes? Figure 6 reports municipal results for pasture, soy, deforestation, and environmental violations. Close election of a mayor with personal landholdings has no significant effect on land-use, deforestation, or violations at the municipal level. In contrast, election of a *landholder-financed* mayor is associated with significant increases in soy (+.66 p.p. or +681 ha, from a baseline mean of .51% of municipal area)[24] and environmental violations (+23%). In Appendix Figure A10, we estimate effects on specific land-use transitions (forest-to-pasture, forest-to-soy, and pasture-to-soy) and find that increased soy cultivation under landholder-financed mayors comes mostly from conversion of existing pasture.

[24]Effects on *hectares* are estimated separately using outcomes defined as asinh(hectares) under that particular land-use in the municipality. These results are reported in Appendix Table B10.

Figure 6: Effects of Election of a Landholding or Landholder-Financed Mayor on Land-Use

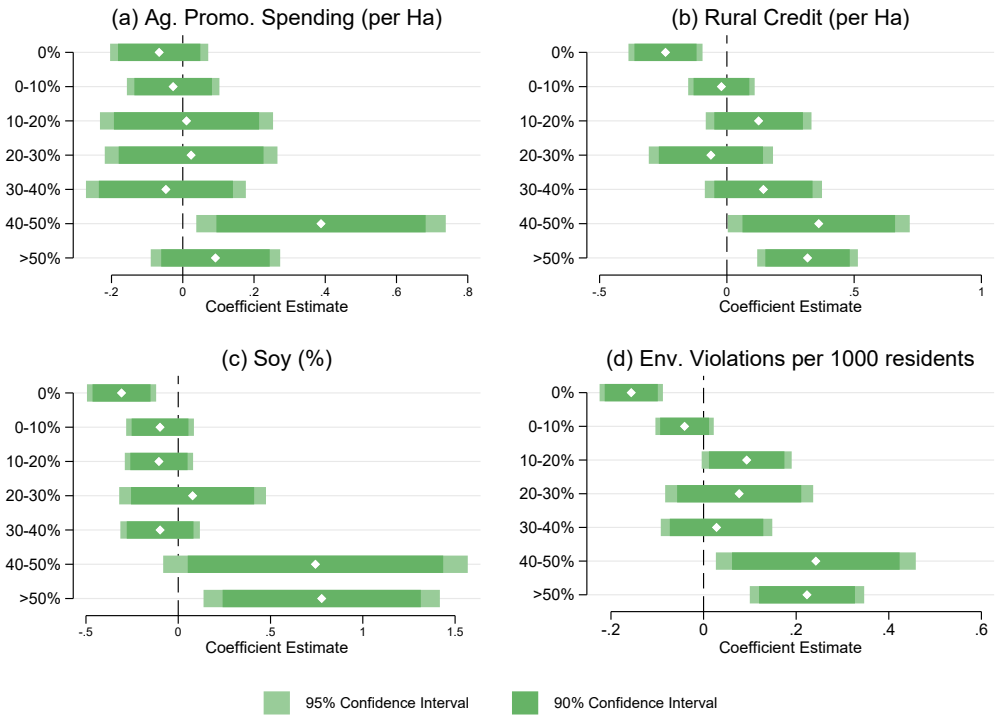


Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% 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 estimated effects on (a) pasture, (b) soy, and (c) deforestation as percentages of municipality area, and (d) environmental violations (asinh) per 1,000 municipal residents.

We next estimate the effects of landholder donations on municipal outcomes for different intensities of landholder support. Results, reported in Figure 7, show roughly monotonic increases in distribution of rural credit, municipal spending on agricultural promotion, soy cultivation, and environmental violations as the percentage of mayors' donations coming from landholders rises.[25] These binned estimates reveal approximate levels of influence required to "buy" the support of local politicians. Across outcomes, it appears that landholder donations begin to exert a significant effect on municipal outcomes when candidates receive more than 40% of their campaign finance from this group.

[25]For brevity, results for the other outcomes are presented in Appendix Figure A12.

Figure 7: Effects of Landholder-Financed Mayor, by % of Donations from Landholders



Note: Figure reports coefficient estimates and 90 and 95% confidence intervals from regression of outcomes in the four years following an election on municipality-election level treatment dummies, where dummies are defined by whether the candidate received 0%, 0.01 to 10%, 10.01 to 20%, 20.01 to 30%, 30.01 to 40%, 40.01 to 50%, or greater than 50% of their campaign donations from landholders. Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at the 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%.

In Figure 8, we decompose aggregate municipal treatment effect estimates for the *landholder-financed mayors* treatment ($\geq$25% of total donations) into changes that occurred on the properties of three landholder groups (mayoral candidates, campaign donors, and all other properties). Our aim is to assess whether aggregate effects are driven by precise targeting of agricultural promotion to donors, or whether there are spillovers onto properties not registered to donors. It is important to note that this decomposition shows *absolute* changes on each group's landholdings as a percentage of *total municipal property area*, and does not reflect relative intensity of effects. Since there are far fewer candidates and donors than other landholders, effect magnitudes for these groups appear smaller. Furthermore, coefficient estimates for candidates and donors reflect effects of landholder-financed mayors on those groups *as a whole*, while property-level event studies reported in Section 5.1 reflect

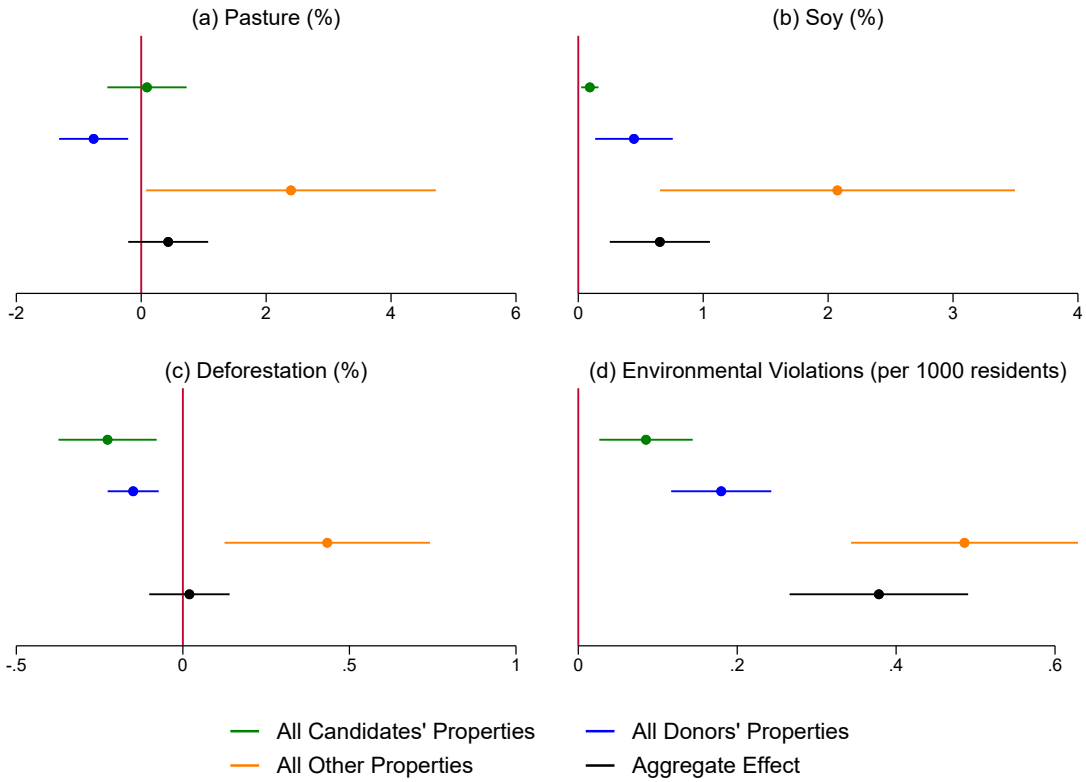
differences *within* each group.

Results of this decomposition reveal substantial spillovers of electing a landholder-financed mayor onto lands that are not directly registered to donors. In particular, negative environmental consequences of agricultural promotion (e.g., deforestation and environmental violations) are concentrated on these properties, with deforestation significantly increasing by .43 p.p., or 23.8% on properties not directly registered to donors or candidates during the mandate of landholder-financed mayors.

There are several possible explanations for this finding. First, spillovers could indicate that agricultural promotion was not precisely targeted to donors, either because targeting is not feasible (e.g., the mayor builds a road to help their donor, but it also passes by non-donor properties) or because landholder donations represent landholders as a collective special interest group. In this interpretation, broad-stroke agricultural promotion exerts heterogeneous effects by property size, enabling soy adoption on large donor properties – where soy's economies of scale prevail – while prompting deforestation on smaller non-donor properties. Another explanation could be that landholders use campaign donations to lobby for (legal) land conversion to soy on their registered properties and (illegal) deforestation on unregistered lands or properties held in someone else's name. Furthermore, if there are under-the-table campaign donations, landholders could appear to be "non-donors" even though they might be receiving political favors. Given large differences in property sizes (1,538ha versus 462ha) and baseline cleared areas (52.7% versus 57.7%) between donors and other properties, we believe imperfect targeting of patronage and heterogeneous effects of agricultural promotion by property size is a likely explanation for much of the observed spillovers. However, we are unable to fully disentangle these possibilities due to the incomplete nature of land records in the Amazon.[26]

[26]Both property-level and municipal-level results are robust to restricting our sample to Amazon states where CAR records are complete, reducing concerns over donors lobbying for deforestation on lands that do not appear in our registries. Further, scope for under-the-table donations is limited because penalties for irregular donations are severe (e.g., the candidate can be removed from office), accounting requirements for candidates' finances are relatively strict, and there was no strong incentive to hide donations during this period.

Figure 8: Decomposition of Municipal-Level Effects of Electing a Landholder-Financed Mayor (>25% of Total Donations), by Landholder Group



Note: Effects are estimated separately on outcomes decomposed by group (mayoral candidates, campaign donors, and other properties). Outcomes for figures (a), (b), and (c) are created by dividing the total hectares in the given land-use for each landholder group by the area of the municipality and the outcome for figure (d), is created by taking the asinh transformation of total environmental violations by thousand residents. Point estimates with 90% confidence intervals are reported. Decomposed effect estimates may be compared to the aggregate effect in black.

6 Robustness

We implement a battery of robustness checks to test the sensitivity of property- and municipal-level findings to alternative specifications and sample definitions. We summarize these exercises below. For property-level checks, we focus on donor results for brevity.

6.1 Property-Level Robustness Checks

Alternative Win-Margin Cutoffs: We assess the sensitivity of property-level results to alternative win-margin cutoffs by re-estimating specifications using (i) a 10% cutoff and (ii) no cutoff, retaining all municipality elections in sample. While the stricter 5% cutoff makes the

as-if-random election results more plausible, it also drops non-competitive elections, where patronage dynamics may be more prevalent. Results with alternative close election cutoffs are reported in Appendix Figures C1-C4. Results for donors at the 10% level follow the same patterns as our preferred specification: estimates for soy are larger, though they lose significance at conventional levels, and estimates for pasture are negative. With no close election cutoff, effects on soy are significant and positive, effects on pasture are significant and negative, and there is a significant and positive effect on deforestation for the last year of the candidate's mandate. Overall, alternative win-margin cutoffs do not substantively change our main findings.

Restrict to States with Complete CAR Registries: We re-estimate our preferred specification in the sub-sample of municipalities located in Mato Grosso, Pará, and Rondônia, where CAR land registries are most complete – minimizing measurement error. Results are reported in Appendix Figures C5-C6. Results are strongly robust to this restriction.

Broaden Sample to Legal Amazon (including Cerrado biome): We re-estimate our preferred specification on a broader sample encompassing the entire Legal Amazon region, which includes many municipalities that are in the Cerrado, rather than Amazon biome. Results reported in Appendix Figures C7-C8 show the same patterns as our main results, though estimates become less precise. This loss of precision is likely because legal restrictions on deforestation, biophysical characteristics, and agricultural dynamics differ substantially between Amazon and Cerrado biomes, increasing variance.

Alternative Outcome Normalization: We re-estimate our preferred specification with land-use outcomes defined as the inverse hyperbolic sine of hectares under each land use. While normalizing land-uses to percentage of property area better accommodates large differences in property sizes and reflects changes in land-use intensity, this alternative definition gives a better measure of absolute land-use impacts. Results, reported in Appendix Figures C9-C10, are strongly robust to this change.

Control for Candidate Characteristics: To account for potential imbalances in characteristics of winner and runner-up mayors in close elections, we re-estimate event studies with candidates' age, sex, and education-level as covariates. Results are robust, with improved pre-trends and even larger point estimates on soy (Appendix Figure C11).

Include Municipality-Election Fixed Effects: This specification uses the same Callaway and Sant'Anna (2021) estimator as our preferred event study approach, but adds municipality-election indicators as covariates, thus restricting comparisons to donors to winner versus runner-up mayors *within* the same municipality-election period.[27] Results are reported in Appendix Figure C12. Our main finding that soy cultivation increases on treated donors' properties is strongly robust to this more restrictive specification. We also re-estimate event studies with municipality-election fixed effects and controls for candidate characteristics (Appendix Figure C13). Results are also robust to this specification – while there are minor pre-trend violations, these are substantially smaller than post-treatment effects.

Flexibly Control for Win-Margin Running Variable: Following Colonnelli et al. (2020), we re-estimate property-level event studies controlling for the win-margin interacted with year fixed effects to allow effects of the running variable to vary across candidates' time in office. This specification represents a "RD-difference-in-differences" approach. Results, reported in Appendix Figures C14-C15, are strongly robust to this specification.[28]

6.2 Municipal-Level Robustness Checks

Ruling out the Possibility that Landholder-Financed Effects are Spurious: If receipt of landholder donations is correlated with total donation receipts, could it be that we are finding a spurious effect of landholder donations, while the real effect is driven by large donations receipts (of any origin)? To exclude this possibility, we re-estimate an analogous specification with an alternative treatment: municipalities are classified as treated if a mayor who received more than the median total donation value – but no donations from landholders –

[27] While this restriction makes comparisons between treated and control donors more credible, it is also very demanding on our relatively small sample – requiring that, within the sub-sample of municipalities with close elections, we match land records with donors to both winning *and* runner-up mayors. We thus apply this restriction to donor-level results but not to candidates, since there are many municipality-election pairs with only a winner or runner-up landholder candidate, but not both.

[28] We also check robustness to iterations of these modifications, including the 10% and full samples for Mato Grosso, Pará, and Rondonia and the full Legal Amazon, with and without the asinh transformation and municipality-election fixed effects. Results for these robustness iterations are reported in Appendix Figures C16-C40. While levels of significance and point estimates for non-soy outcomes vary to some degree across specifications, signs and magnitudes are stable and our main finding of a positive treatment effect on donors' soy cultivation is strongly robust. At the municipal level, we also estimate regressions controlling for the mayor's total number and value of donations and find that results remain unchanged. These results are available upon request.

wins a close election. The intention of this exercise is to isolate the effect of receiving large donation values. Results, presented in Appendix Figure C41, show that simply receiving large donation values does not reproduce the main municipality-level 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 environmental violation. Evidently, politicians who receive substantial donations from non-landholding donors govern on behalf of non-landholding special interest groups (e.g., urban or commercial), which may desire less promotion of agriculture relative to alternative investments.

Alternative Win-Margin Cutoffs: We re-estimate municipal-level results using (i) an alternative 10% win-margin cutoff to define close elections, and (ii) no win-margin cutoff. Results, reported in Appendix Figures C42-C45, are strongly robust to these alternative cutoffs.

Restrict to States with Complete CAR Registries: We restrict the sample to municipalities with more complete land registries (Mato Grosso, Pará, and Rondônia) to minimize measurement error. Results are reported in Appendix Figures C46-C47. Results are strongly robust to this restriction with the exception of agricultural promotion spending, which becomes statistically insignificant but exhibits similar sign and magnitude.

Broaden Sample to Legal Amazon: We re-estimate preferred specifications on a broader sample of all municipalities in the Legal Amazon, which includes many municipalities in the Cerrado biome. Results, in Appendix Figures C48-C53, are mostly robust, including across alternative win-margin cutoffs. Estimated effects on agricultural promotion spending become insignificant at conventional levels, but signs and magnitudes are stable.

Alternative Outcome Normalization: In place of percentage outcomes, we use the inverse hyperbolic sine of hectares of soy, pasture, and deforestation. Results, reported in Appendix Figure C54, are robust to this alternative normalization.

Event Studies: Finally, to assess the identifying parallel pre-trends assumption, we estimate municipal-level event studies using annual panel data and the Callaway and Sant'Anna (2021) estimator. Results are reported in Appendix Figures C55-C61. This approach faces the limitation of only registering the first time a municipality is treated, while in practice treatment turns on and off frequently within municipalities. Event study results confirm

that pre-trends are parallel and effects are robust to the Callaway and Sant'Anna (2021) estimator for pasture, soy, deforestation, agricultural promotion spending, matching grants, and rural credit.[29]

7 Discussion

We construct a novel panel dataset measuring land-use changes on the properties of municipal politicians and campaign donors across five elections in the Brazilian Amazon. These data reveal previously unobservable connections between landholders and politics in the world's largest tropical forest. We document extensive involvement of landholders in local politics – both as candidates and donors – and show that these landholders are disproportionately largeholders engaged in significant deforestation on their properties.

We are the first to document "agricultural patronage," whereby mayors pay back large landholding donors by facilitating high-value crop adoption on their properties. We also provide novel evidence that donations from landholders shift mayors' policy-making in favor of agriculture, but that they are not able to target this support to donors precisely – leading to spillovers of deforestation and environmental violations onto lands not registered to donors. Findings suggest that rural producers face barriers to agricultural intensification in the Amazon, and turn to buying political influence through campaign donations to overcome these barriers. Conversion of pasture to soy requires significant up-front investments and rural credit is available to fewer farmers and in lower values in the Amazon relative to other parts of the country (Souza and Albuquerque, 2023). While unconditional disbursement of rural credit can increase deforestation (Assunção et al., 2019), more equitable and sustainability-oriented access to credit, inputs, and alternative development opportunities could reduce landholders' demand for political influence – in turn reducing distortions of local governance in favor of landholders as an interest group.

What to make of this revealed demand for agricultural intensificaiton? Cattle ranching on pasture in the Amazon is notoriously unproductive (Bragança et al., 2022), and conversion of

[29]For the landholder-financed mayors' treatment ($\geq$25% of total donation value), effects on environmental variations are significantly negative and trend slightly upwards in pre-periods, but exhibit a large jump and sharp upward trend after treatment begins.

pasture to soy can increase land productivity substantially – with concomitant contributions to local economic development (Marin et al., 2022). On the other hand, soy production in the Amazon leads to increased agro-chemical use, which has been linked to elevated rates of childhood cancer (Skidmore et al., 2023). Previous studies have also highlighted the risk of indirect land-use change, whereby conversion of pasture to soy in one location provokes deforestation for new pasture elsewhere (Gollnow et al., 2018). Our results reveal a political mechanism underlying indirect land-use change: political pressure to help large landholders convert pasture to soy leads politicians to promote agriculture broadly, providing funds that enable deforestation on other properties.

Finally, land inequality in the Amazon is extreme, and our results show that it is the largest landholders who benefit from agricultural patronage. This dynamic could exacerbate local inequalities and contribute to a self-reinforcing cycle wherein politicians favor large landholders, empowering this group and 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 in the region.

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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

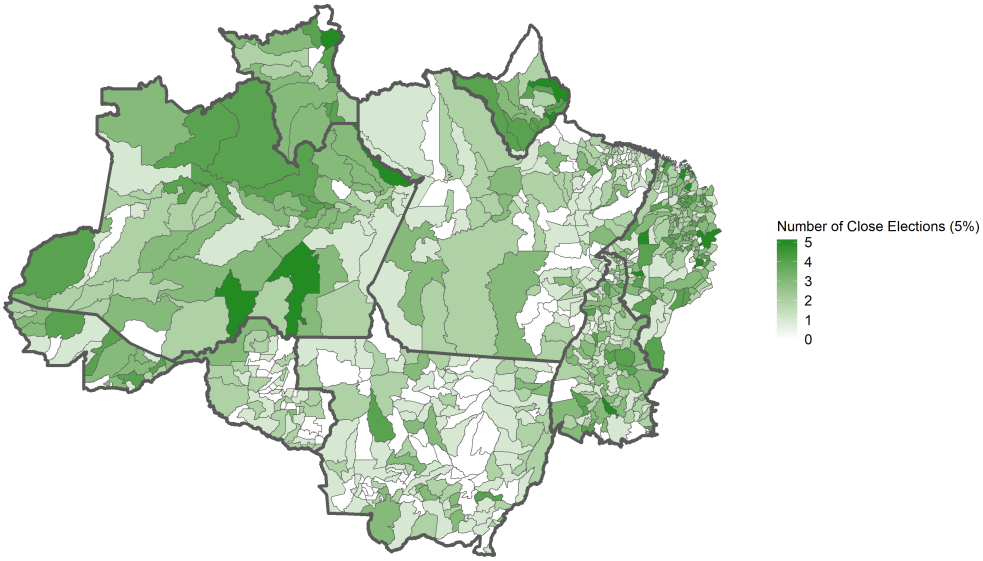
August 1st, 2024

Table of Contents

A Supplementary Figures

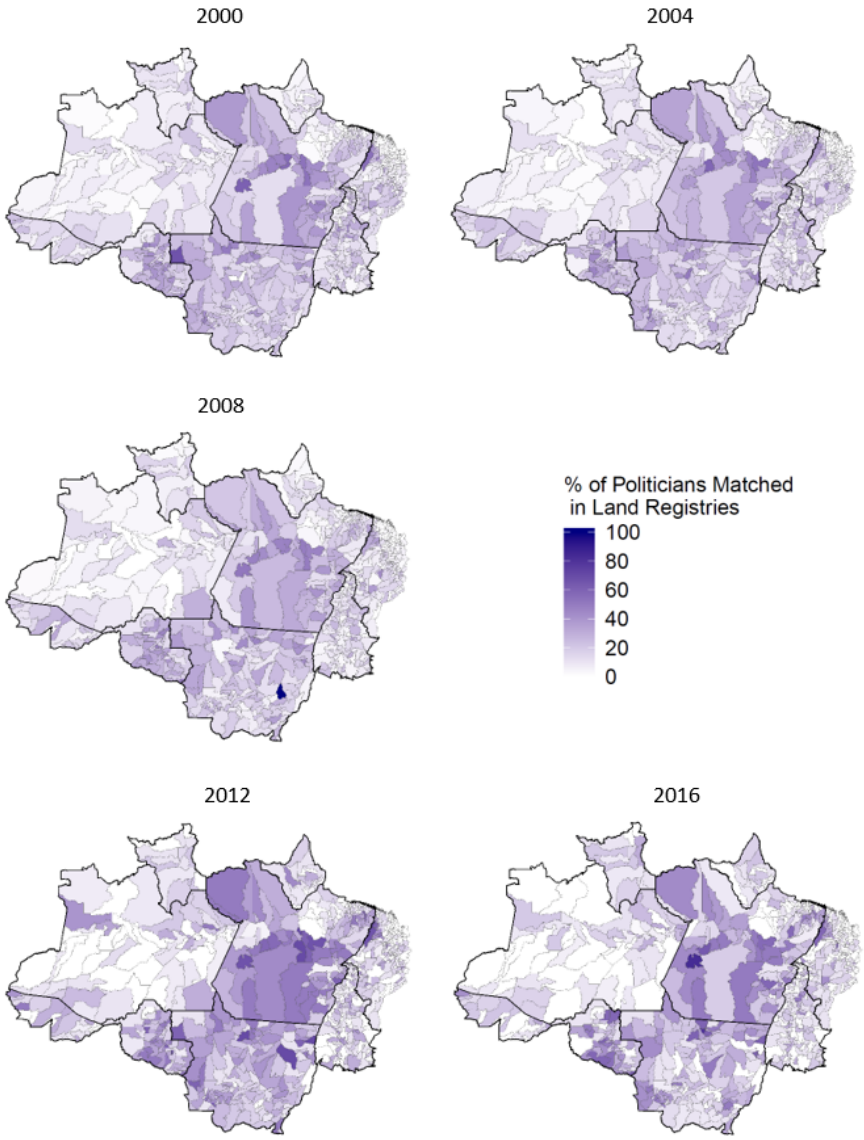
A.1 Descriptive Figures

Figure A1: 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.

Figure A2: 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.

Figure A3: Share of Elected Mayors and Campaign Donors Matching with Landholder Registries, by Party

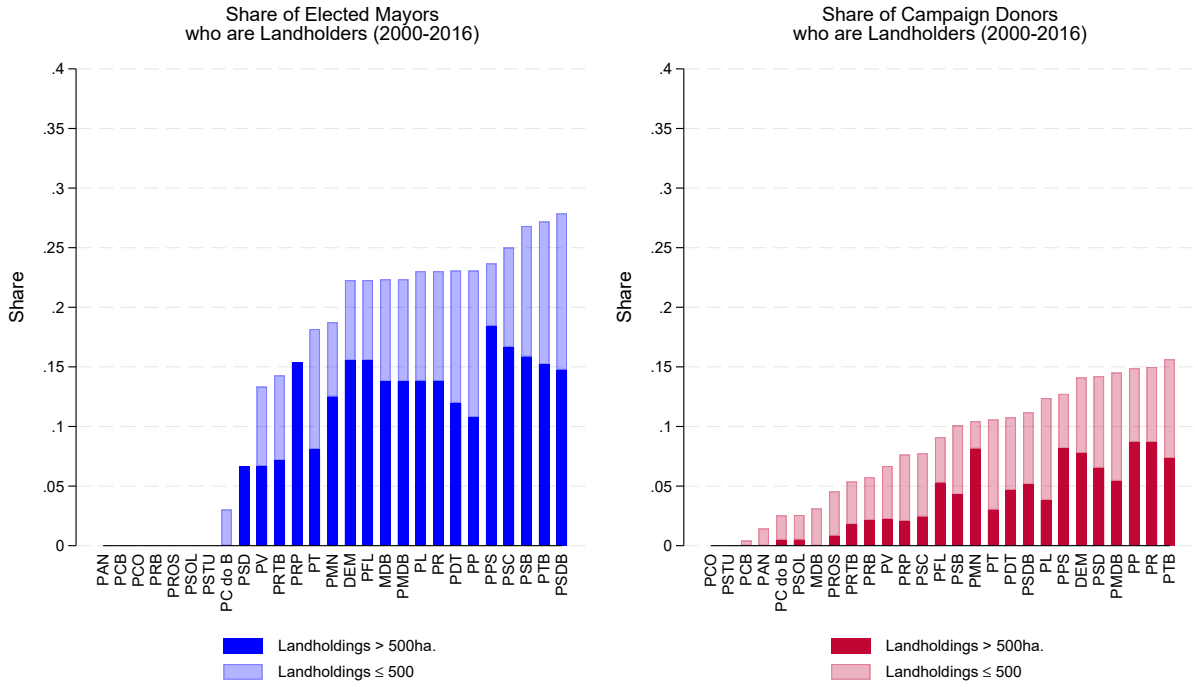


Figure A4: Mean Levels of Soy Cultivation for Treated and Control Properties (2000-2020)

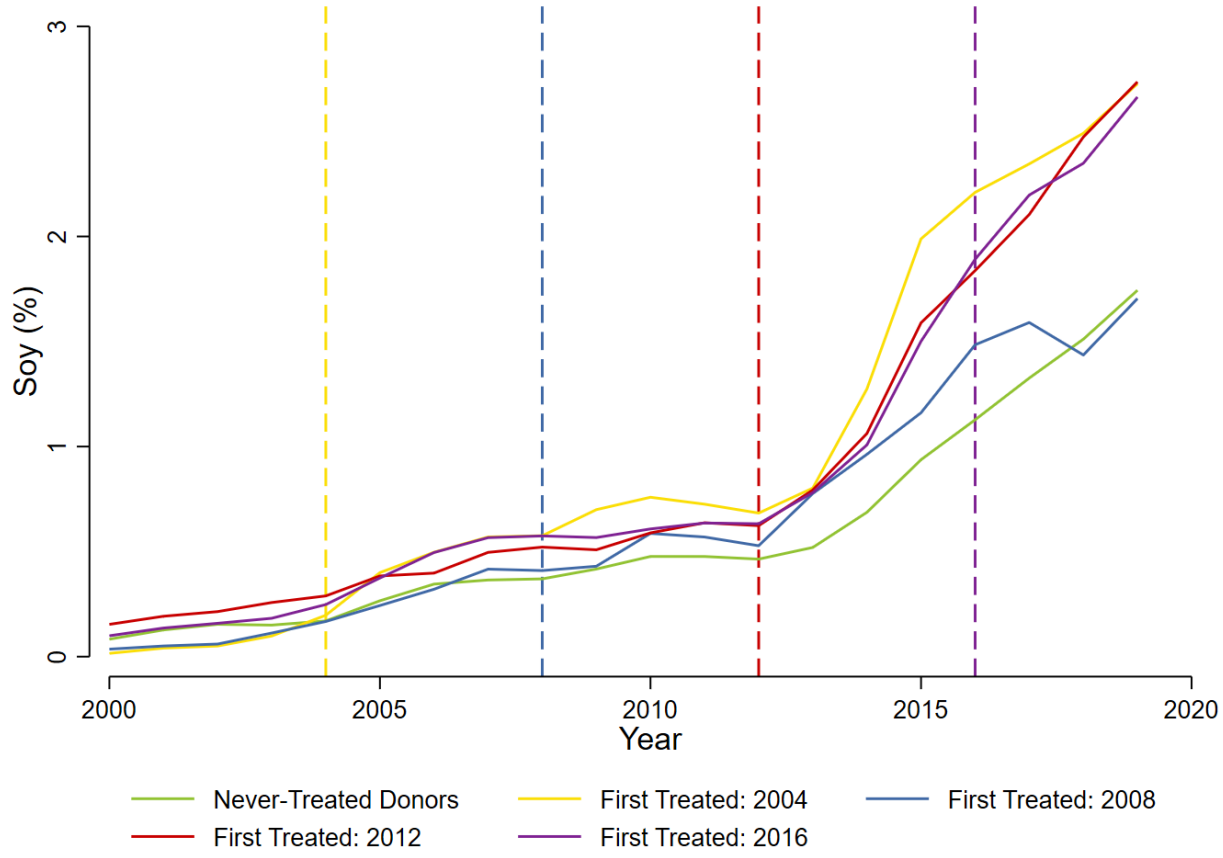
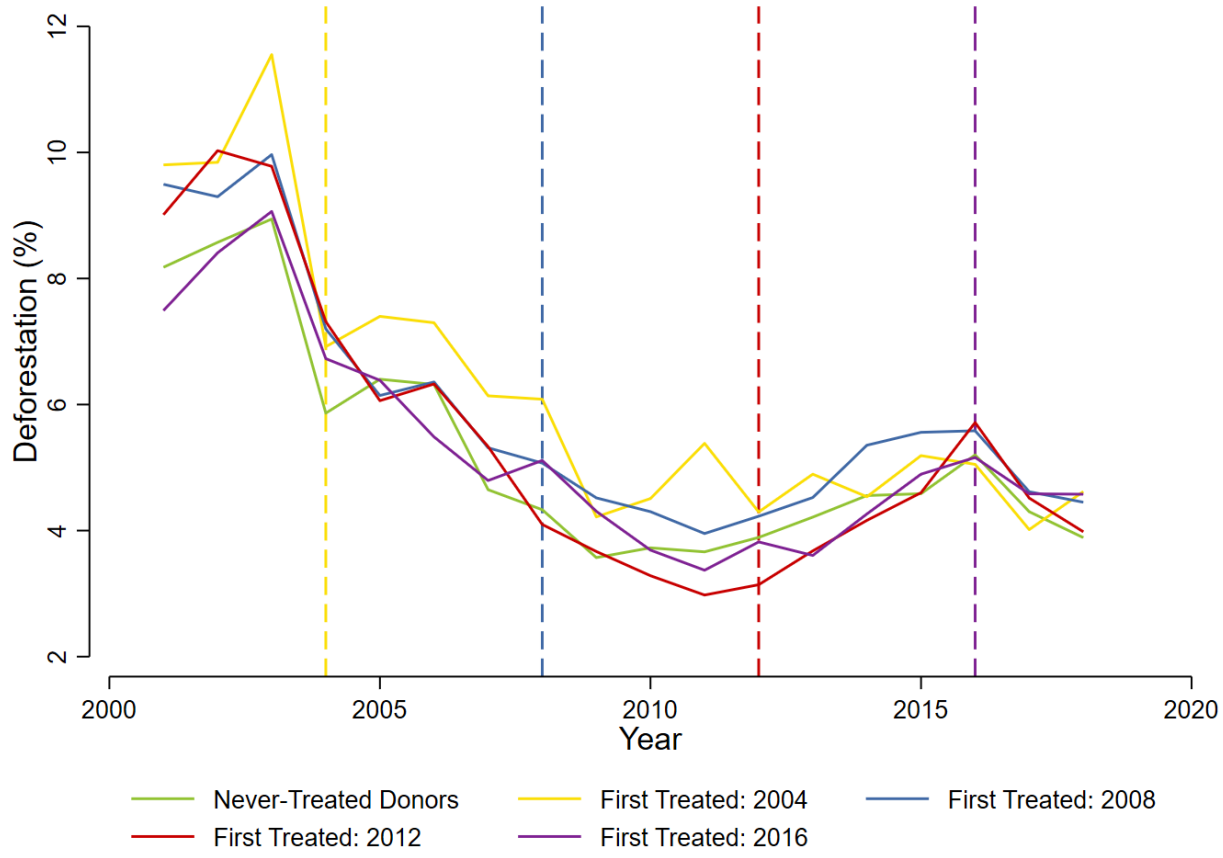
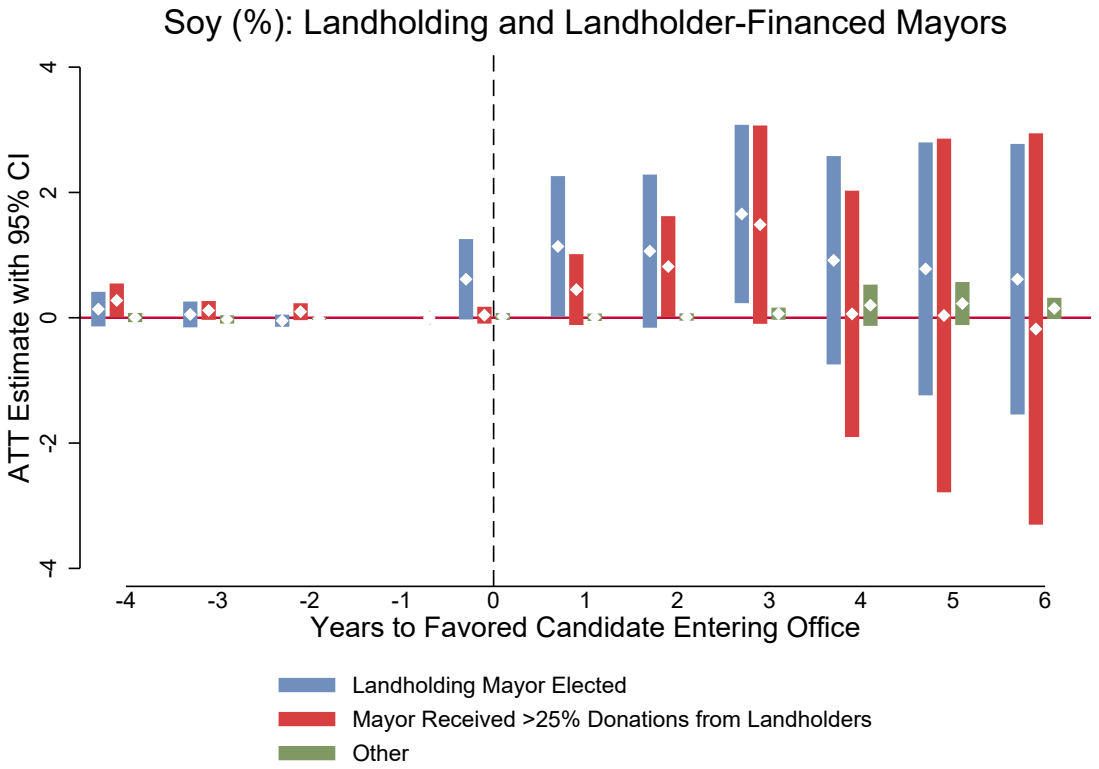


Figure A5: Mean Levels of Deforestation for Treated and Control Properties (2000-2019)



A.2 Additional Results: Property-Level

Figure A6: Donors: Heterogeneity by Mayor's Landholding or Landholder-Financed Status



Note: Effects estimated separately for donors to (i) mayors who are themselves landholders, (ii) mayors who received more than 25% of their total donations from landholders, and (iii) other mayors, each relative to never-treated and not-yet treated controls of the same sub-sample.

Figure A7: Donors: Heterogeneity in Treatment Effects in Competitive, Semi-Competitive, and Non-Competitive Elections

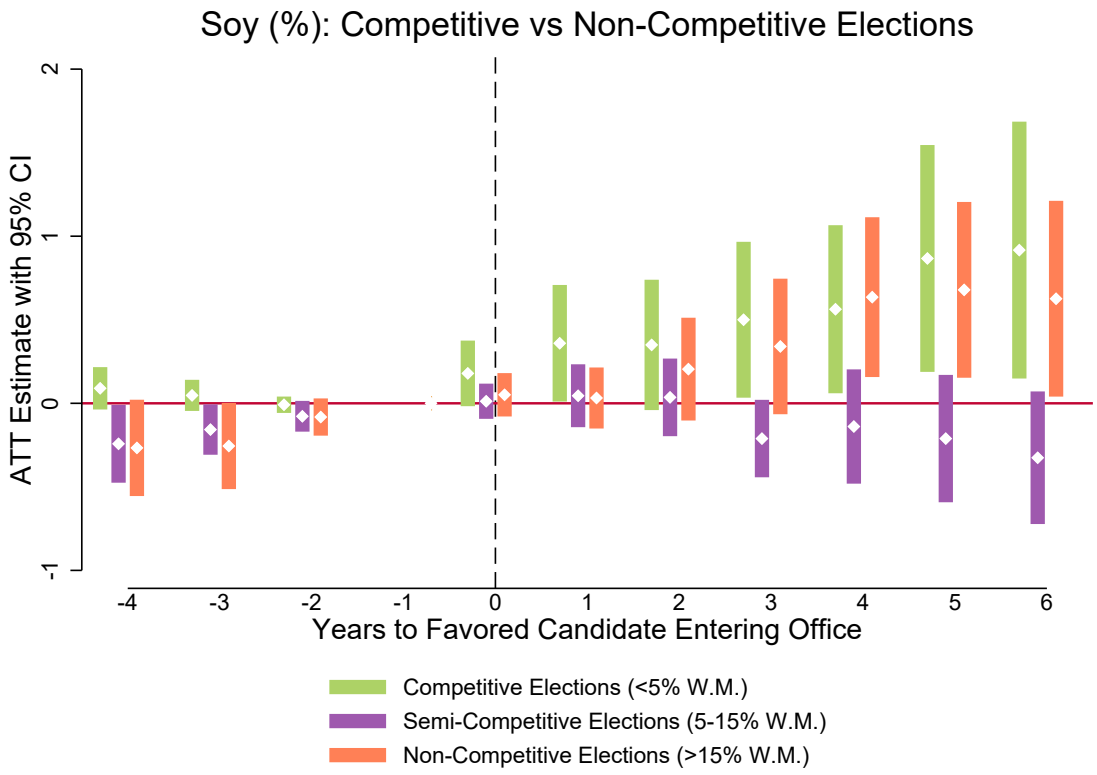
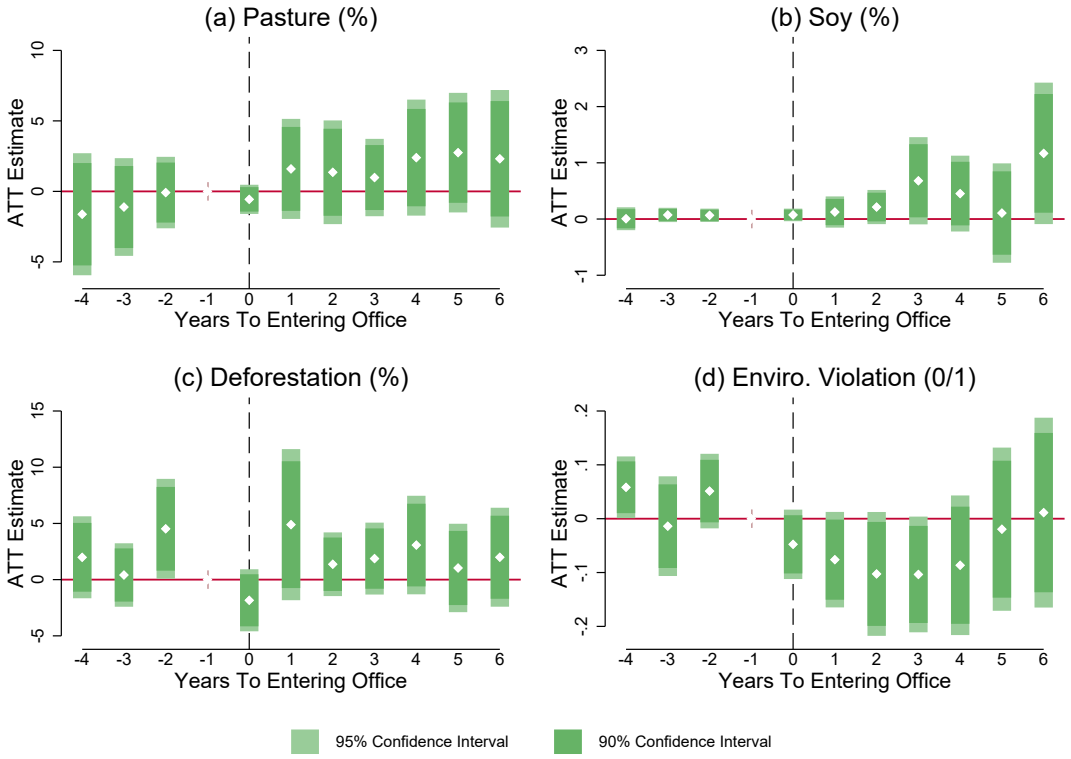


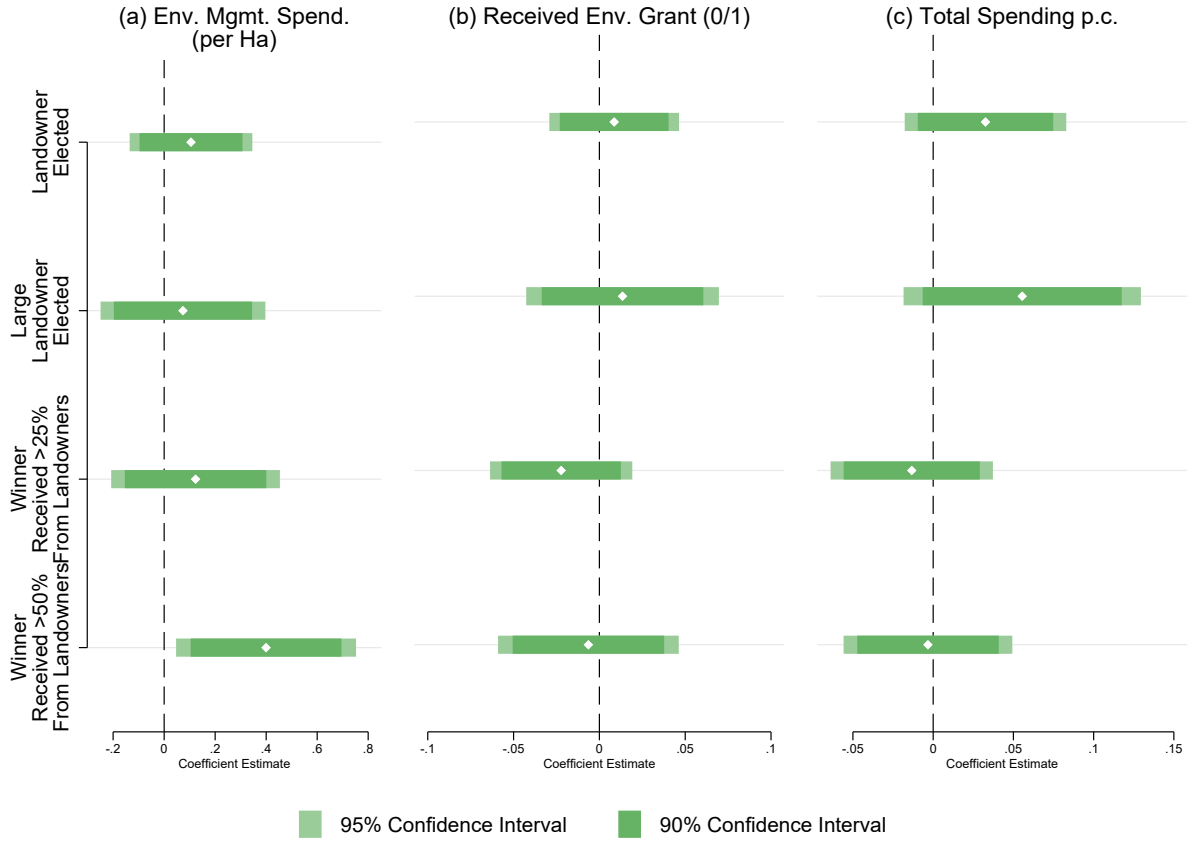
Figure A8: Candidates: Effects of Entry into Office on Own-Property Outcomes



Note: Figure reports dynamic ATT estimates and 90 and 95% confidence intervals from Callaway and Sant'Anna (2021) *csdid2* estimator. Sample is restricted to successful and runner-up mayoral candidates in close mayoral elections ($\leq$ 5% win-margin) in the Brazilian Amazon biome. Candidate and year fixed effects are included and standard errors are clustered at the candidate level. Outcomes measure hectares of (a) pasture, (b) soy, and (c) deforestation as a percentage of property area, and (d) an indicator of whether an environmental violation is reported for the property/owner in a given year.

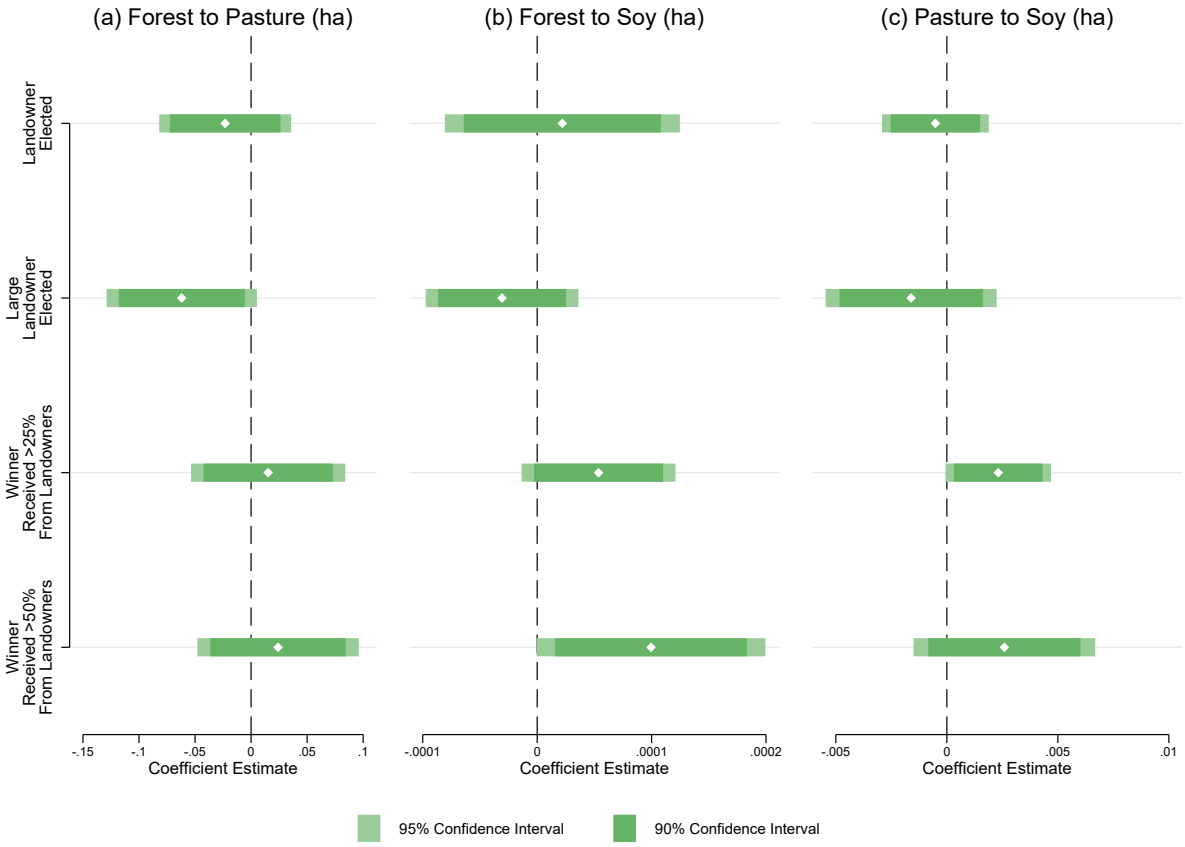
A.3 Additional Results: Municipal-Level

Figure A9: Effects of Election of Mayor with Personal or Donor Ties to Land on Other Outcomes



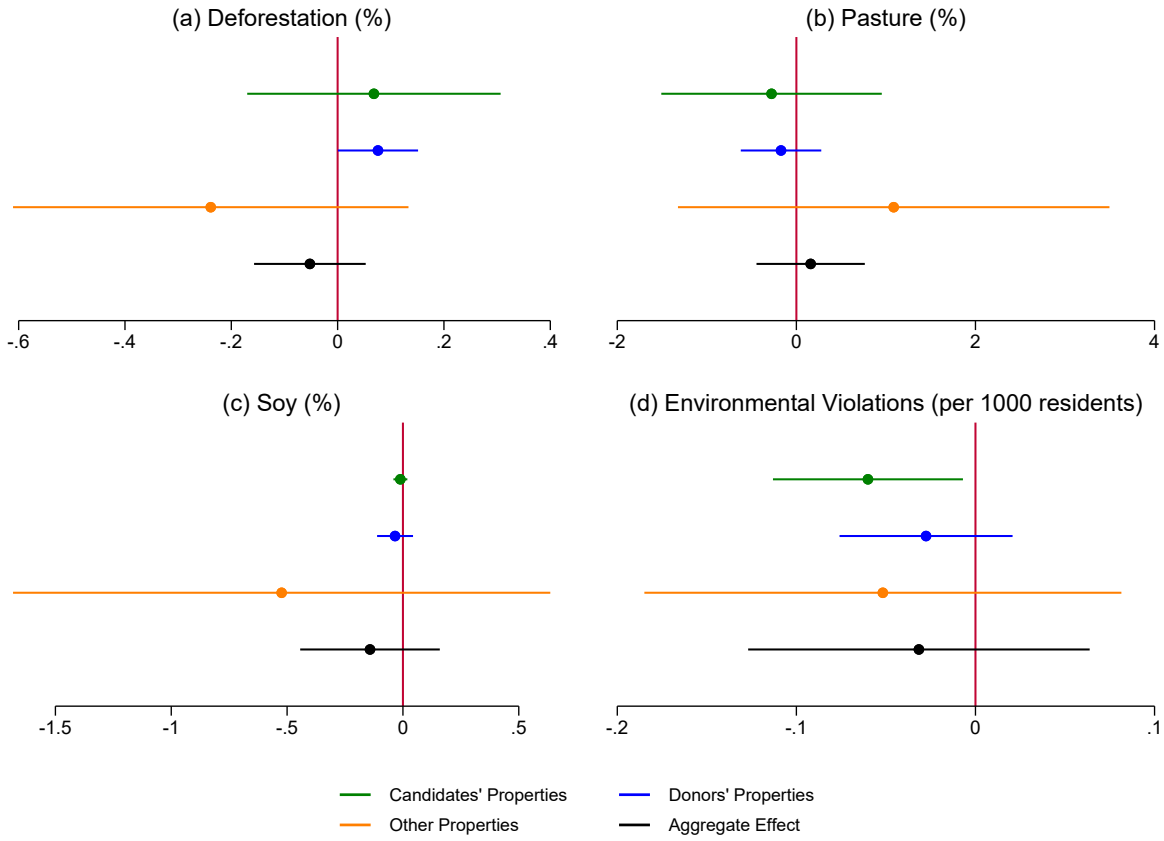
Note: Figure is organized analogously to Figure 5. Left sub-figure presents estimated effects on municipal environmental spending per capita; central sub-figure presents estimated effects on an indicator of whether the municipality received a matching grant from the Ministry of the Environment. Right sub-figure presents estimated effects on total municipal spending per capita. Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

Figure A10: Effects of Election of a Landholding or Landholder-Financed Mayor on Specific Land Transitions



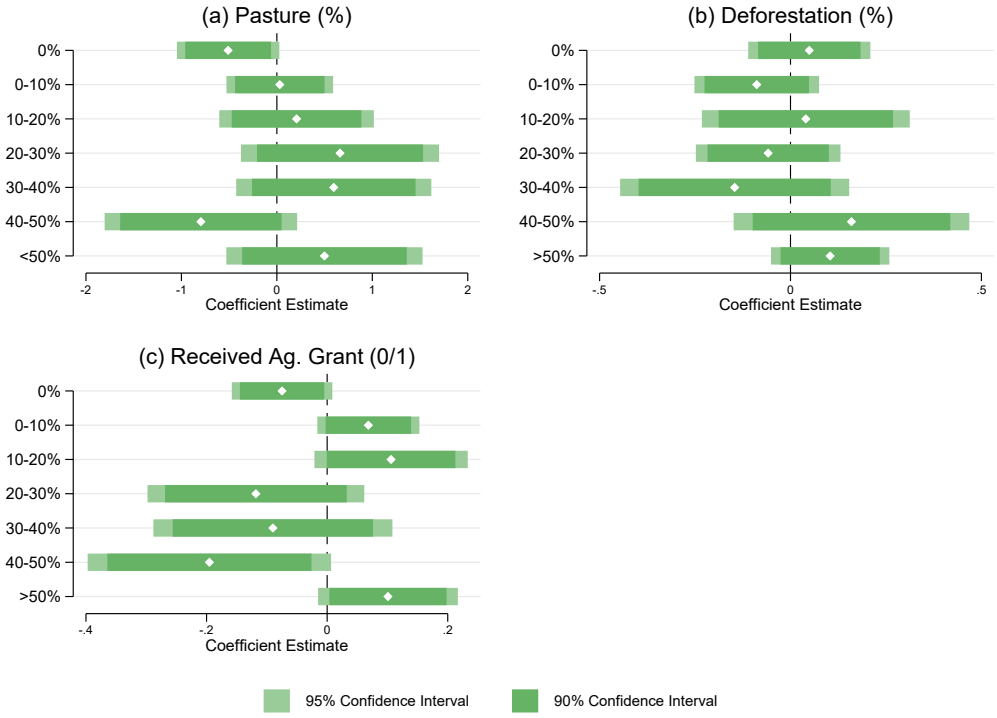
Note: Figure is organized analogously to Figure 6. Left sub-figure presents estimated effects on hectares that transitioned from forest to pasture as a percentage of municipal area; center sub-figure presents analogous results for hectares transitioned from forest to soy; right sub-figure presents analogous results for hectares transitioned from pasture to soy.

Figure A11: Decomposition of Municipal-Level Effects by Landholder Group (Landholder Mayor Elected)



Note: Effects are estimated separately on outcomes decomposed by group (mayoral candidates, campaign donors, and other properties). Outcomes for figures (a), (b), and (c) are created by dividing the total hectares in the given land-use for each landholder group by the area of the municipality and the outcome for figure (d), is created by taking the asinh transformation of total environmental violations by thousand residents. Point estimates with 90% confidence intervals are reported. Decomposed effect estimates may be compared to the aggregate effect in black.

Figure A12: Effects of Landholder-Financed Mayor, by % of Donations from Landholders



Note: Figure reports coefficient estimates and 90 and 95% confidence intervals from regression of outcomes in the four years following an election on municipality-election level treatment dummies, where dummies are defined by whether the candidate received 0%, 0.01 to 10%, 10.01 to 20%, 20.01 to 30%, 30.01 to 40%, 40.01 to 50%, or greater than 50% of their campaign donations from landholders. Specifications include municipality and election FEs, candidate-level controls (mayor's sex and education level), and cluster standard errors at the municipality level. Sample is panel of municipality-election periods (2001-2005 through 2016-2019) where win-margin between winner and runner-up mayor was $\leq 5\%$.

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
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: Landholding Mayors and Donors vs. Other Landholders

	Elected Mayors	Campaign Donors	Other Landholders
Mean Property Size (ha.)	2,276	1,538	462
	(10,103)	(19,221)	(5,948)
No. Properties	2.4	1.5	1.2
	(2.9)	(1.5)	(2.2)
% Baseline Forest Cover	51.0	52.7	57.7
	(32.1)	(34.0)	(35.9)
# of Years with Deforestation Registered	9.2	5.6	3.9
	(6.7)	(5.9)	(4.7)
% of Property Deforested (2000-2019)	64.4	68.9.0	36.0
	(34.8)	(34.2)	(32.3)
% with Environmental Violation	20.9	6.3	1.0
	(40.7)	(24.3)	(5.0)
% Converted to Pasture (2000-2020)	9.8	15.8	20.4
	(22.8)	(27.2)	(32.1)
% Converted to Soy (2000-2020)	3.0	1.7	2.0
	(10.9)	(9.8)	(10.7)
Number (Total)	2,151	277,946	556,645

Note: Table reports sample means with standard deviations in parentheses. Data column 1 and 2 repeat statistics from Table 1 for winning mayors and all campaign donors. Data column 3 reports analogous statistics for all other landholders in the Brazilian Amazon biome for comparison.

Table B3: Descriptive Statistics: Landholding vs. Non-Landholding Mayors and Donors

	Elected Mayors		
	>500ha Land	≤500ha Land	No Land
% Female	7.5	7.8	9.3
	(26.3)	(26.8)	(29.1)
Schooling (Years)	11.8	11.7	13.0
	(3.7)	(3.6)	(3.5)
Age	47.6	46.4	47.8
	(9.4)	(9.2)	(43.7)
% Born Locally	11.4	22.8	42.5
	(31.8)	(42.1)	(49.4)
Value of Donations Received	83,260.9	67,998.1	54,564.4
	(151,364.5)	(137,152.1)	(236,226.7)
Num. of Donations Received	22.0	23.3	18.8
	(44.8)	(42.1)	(62.4)
Winning % of Candidates	45.5	35.6	35.4
	Campaign Donors		
	>500ha Land	≤500ha Land	No Land
Value of Donations Given	16,844.0	3,674.3	2,960.2
	(71,307.6)	(25,342.2)	(55,198.7)
Num. of Donations Given	3.1	2.2	1.8
	(7.3)	(3.8)	(3.6)

Table B4: Descriptive Statistics: Municipalities in Amazon Biome

	Close Election (≤ 5% Win Margin)	Close Election (≤ 10% Win Margin)	All Municipalities
Size (sq. km)	10,742.8	10,241.1	9,218.4
	(20,522.9)	(20,088.8)	(17,605.5)
Dist. from State Capital (km)	310.3	309.0	323.0
	(280.4)	(270.0)	(266.8)
% Forest Cover Loss (to 2020)	39.9	40.7	43.1
	(32.5)	(32.7)	(32.8)
Population (2000)	35.0	36.8	33.2
	(103.3)	(119.7)	(100.8)
GDP in Millions of 2010 BRL (2002)	164.0	198.7	177.9
	(698.7)	(1,119.0)	(1,007.2)
Mun. Development Index (2000)	0.44	0.45	0.45
	(0.09)	(0.08)	(0.08)
% of Population Urban	0.51	0.51	0.51
	(0.23)	(0.24)	(0.23)
Income Gini Coefficient (2000)	0.59	0.59	0.59
	(0.06)	(0.07)	(0.07)
% of Population in Poverty (2000)	63.28	63.17	61.63
	(16.84)	(16.77)	(17.50)
% Workers Empl. in Agriculture (2000)	49.40	49.91	49.88
	(18.97)	(18.71)	(18.48)
No. of Donations/1000 ppl.	18.49	19.18	19.84
	(18.88)	(19.81)	(19.19)
Value Donations/1000 ppl.	21,587	21,967	21,437
	(16,503)	(17,914)	(17,787)
No. Municipalities	325	409	432

Note: Table reports sample means with standard deviations in parentheses. Column 1 reports values for the sub-sample of municipalities in the Amazon biome which experienced one or more elections with 5% win margin or less between 2000 and 2016. Column 2 reports values for municipalities with 1 or more elections with a 10% or less win margin during this period. Column 3 reports values for all municipalities in Brazil's Amazon biome.

Table B5: Descriptive Statistics: Landholder-Financed Mayoral Candidates

	Mayoral Candidates in Amazon Biome (2000-2016)	
	Received ≥25% Donations from Landholders	Received <25% Donations from Landholders
Number (Total)	465	6,613
Number (Landholders)	356	1,191
% Landholders	76.6	18.0
Full Sample:		
Age	47.3	47.3
	(9.6)	(14.8)
% Female	16.3	13.2
	(37.0)	(33.9)
Years of Schooling	12.5	12.4
	(3.4)	(3.6)
Num. of Donations Received	28.6	14.9
	(43.3)	(38.7)
Value of Donations Received	83,057.2	61,291.4
	(126,441.3)	(319,541.4)
Among Landholders:		
Total Landholding (ha.)	1,735.8	1,571.3
	(4,380.1)	(7,715.4)
No. Properties	2.5	2.1
	(3.2)	(2.4)
% Baseline Forest Cover (2000)	50.3	53.0
	(28.3)	(32.4)
Avg. Yrly Deforest. (% Landholding)	3.8	3.5
	(1.8)	(2.0)
No. of Years with Deforest. Registered	9.5	8.2
	(6.6)	(6.6)
% of Landholding Deforested (2000-2019)	67.9	62.9
	(32.7)	(35.8)
% with Environmental Violation	0.2	0.2
	(0.4)	(0.4)
Avg. Yrly Pasture (% Landholding)	55.1	51.2
	(28.0)	(31.8)
% Converted to Pasture (2000-2020)	10.8	10.6
	(24.0)	(25.1)
Avg. Yrly Soy (% Landholding)	1.2	0.9
	(5.8)	(5.0)
% Converted to Soy (2000-2020)	3.3	2.3
	(11.9)	(9.9)
Age	49.2	48.5
	(9.4)	(9.9)
% Female	9.0	7.7
	(28.7)	(26.7)
Years of Schooling	12.1	11.7
	(3.6)	(3.7)
No. Donations Received	30.6	18.8
	(48.0)	(32.9)
Val. Donations Received	117,889.9	71,365.9
	(172,261.5)	(179,129.4)

B.2 Results Tables: Property-Level

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

Relative Year	**Pasture (%)**		**Soy (%)**		**Deforestation (%)**		**Env. Violation (0/1)**	
	Coef.	*(St. Err.)*	*Coef.*	*(St. Err.)*	*Coef.*	*(St. Err.)*	*Coef.*	*(St. Err.)*
-4	.297	(.358)	.081	(.061)	.364	(.526)	-.003	(.007)
-3	.574	(.3)	.03	(.047)	-.103	(.509)	-.004	(.006)
-2	.311	(.202)	-.009	(.025)	.299	(.457)	-.002	(.004)
-1								
0	-.433	(.178)	.134	(.078)	.205	(.438)	.001	(.004)
1	-.484	(.279)	.268	(.144)	.426	(.491)	.001	(.004)
2	-.768	(.359)	.277	(.164)	.217	(.5)	-.005	(.005)
3	-.633	(.445)	.464	(.196)	1.031	(.546)	-.007	(.005)
4	-1.07	(.554)	.493	(.23)	.65	(.521)	-.006	(.008)
5	-1.122	(.612)	.671	(.307)	.817	(.48)	-.002	(.009)
6	-1.454	(.664)	.67	(.342)	.873	(.709)	-.003	(.009)
n =	29400		29400		25362		20736	
Baseline DV Mean	54.644		.507		5.278		.053	
Donor FE	YES		YES		YES		YES	
Year FE	YES		YES		YES		YES	

Note: Table reports dynamic ATT coefficient estimates and standard errors from Callaway and Sant'Anna (2021) estimator. Sample is restricted 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 hectares under pasture, hectares under soy, and hectares that transitioned from natural vegetation (Forest and Savannah Formations) to anthropic use as percentages of property area, as well as 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 B7: Candidates: Dynamic Effects of Entry into Office (Sample = Elections with $\leq 5\%$ Win Margin)

Relative Year	**Pasture (%)**		**Soy (%)**		**Deforestation (%)**		**Env. Violation (0/1)**	
	Coef.	*(St. Err.)*	*Coef.*	*(St. Err.)*	*Coef.*	*(St. Err.)*	*Coef.*	*(St. Err.)*
-4	-1.621	(2.208)	.005	(.104)	1.987	(1.86)	.058	(.029)
-3	-1.109	(1.768)	.073	(.065)	.412	(1.439)	-.014	(.047)
-2	-.084	(1.293)	.066	(.061)	4.523	(2.265)	.051	(.035)
-1								
0	-.565	(.528)	.073	(.057)	-1.838	(1.408)	-.048	(.033)
1	1.595	(1.81)	.125	(.142)	4.891	(3.429)	-.076	(.045)
2	1.355	(1.877)	.213	(.155)	1.37	(1.445)	-.103	(.059)
3	.983	(1.4)	.681	(.396)	1.872	(1.632)	-.104	(.055)
4	2.395	(2.099)	.453	(.344)	3.077	(2.236)	-.086	(.066)
5	2.749	(2.163)	.106	(.451)	1.038	(2.006)	-.019	(.077)
6	2.312	(2.489)	1.168	(.642)	1.994	(2.245)	.011	(.09)
n =	1700		1700		1258		883	
Baseline DV Mean	47.886		.786		4.783		.06	
Donor FE	YES		YES		YES		YES	
Year FE	YES		YES		YES		YES	

Note: Table reports dynamic ATT coefficient estimates and standard errors from Callaway and Sant'Anna (2021) estimator. Sample is restricted to successful and runner-up mayoral candidates in close mayoral elections ($\leq 5\%$ win-margin) in the Brazilian Amazon biome. 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 are hectares under pasture, hectares under soy, and hectares that transitioned from natural vegetation (Forest and Savannah Formations) to anthropic use as percentages of property area, as well as 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 B8: Effects of Election of Landholder or Landholder-Financed Mayor on Municipal Governance

	Ag. Spending p/ha	**Ag Grant (0/1)**	**Rural Credit p/ha**
Land	0.024	0.031	-0.023
	(0.070)	(0.037)	(0.073)
Large Land	-0.047	0.039	-0.054
	(0.091)	(0.046)	(0.103)
25% Land Donations	0.131*	-0.043	0.334***
	(0.078)	(0.049)	(0.083)
50% Land Donations	0.092	0.101*	0.317***
	(0.092)	(0.059)	(0.101)
N	1,239	1,259	1,196
Baseline DV Mean	0.67	0.70	2.74
Municipality FE	YES	YES	YES
Election FE	YES	YES	YES
Candidate Controls	YES	YES	YES

Note: Table reports coefficient estimates and standard errors in parentheses from regression of outcome on one of four treatment indicators: (i) mayor is landholder, (ii) mayor is large landholder, meaning more than 500ha, (iii) mayor received more than 25% of their total donations from landholders, and (iv) mayor received more than 50% of their total donations from landholders. Specifications include municipality and election fixed effects and candidate controls (sex and education level). Baseline means are computed as averages in 2000. Outcomes are (i) municipal spending on agricultural promotion (Agriculture, Colonization, Agro-livestock Defense and Sanitation, Rural Extension, Irrigation, Agrarian Organization, Agro-Livestock Promotion, Land Reform, and Other Ag. Sub-functions) per hectare of municipal area, (ii) an indicator of whether the municipality received a matching grant from the federal Ministry of Agriculture, and (iii) the value of rural credit per hectare of municipal area. * p< 0.10, ** p<0.05, *** p<0.01.

Table B9: Effects of Election of Landholder or Landholder-Financed Mayor on Municipal Land Use and Environmental Outcomes

	Pasture (%)	**Soy (%)**	**Deforestation (%)**	**Env. Viol./1000 res.**
Land	0.174	-0.141	-0.049	0.013
	(0.368)	(0.183)	(0.064)	(0.049)
Large Land	0.305	-0.344	-0.099	-0.035
	(0.471)	(0.292)	(0.086)	(0.071)
25% Land Donations	0.500	0.657***	0.025	0.227***
	(0.384)	(0.242)	(0.072)	(0.055)
50% Land Donations	0.498	0.777**	0.104	0.223***
	(0.523)	(0.326)	(0.079)	(0.063)
N	1,259	1,259	1,259	961
Baseline DV Mean	27.05	0.07	1.71	0.32
Municipality FE	YES	YES	YES	YES
Election FE	YES	YES	YES	YES
Candidate Controls	YES	YES	YES	YES

Note: Table reports coefficient estimates and standard errors in parentheses from regression of outcome on one of four treatment indicators: (i) mayor is landholder, (ii) mayor is large landholder, meaning more than 500ha, (iii) mayor received more than 25% of their total donations from landholders, and (iv) mayor received more than 50% of their total donations from landholders. Specifications include municipality and election fixed effects and candidate controls (sex and education level). Baseline means are computed as average levels in 2000 for pasture, soy and deforestation, and in 2004 for embargoes. Outcomes are (i) hectares of pasture as a percentage of municipal area, (ii) hectares of soy as a percentage of municipal area, (iii) hectares converted from natural vegetation to anthropic land uses as a percentage of municipal area, and (iv) IBAMA environmental violations (asinh) per 1000 municipal residents. * p< 0.10, ** p<0.05, *** p<0.01.

Table B10: Effects of Election of Landholder or Landholder-Financed Mayor on Municipal Land Use (asinh outcomes)

	Pasture (ha)	**Soy (ha)**	**Deforestation (ha)**
Land	0.009	-0.104	0.001
	(0.016)	(0.125)	(0.026)
Large Land	0.032	-0.108	-0.011
	(0.023)	(0.155)	(0.033)
25% Land Donations	-0.026	0.526***	0.047
	(0.021)	(0.161)	(0.031)
50% Land Donations	-0.043*	0.606***	0.007
	(0.026)	(0.216)	(0.034)
N	1,259	1,259	1,259
Baseline DV Mean (asinh)	12.50	1.23	8.00
Baseline DV Mean (untransformed)	314,461	1,295.67	9,791.47
Municipality FE	YES	YES	YES
Election FE	YES	YES	YES
Candidate Controls	YES	YES	YES

Note: Table reports coefficient estimates and standard errors in parentheses from specifications analogous to those described in Appendix Table B9 above, but with outcomes defined as the inverse hyperbolic sine of hectares under that particular land-use. For pasture and soy, this value reflects the average number of hectares over the election period. For deforestation, it reflect cumulative hectares of deforestation over the election period. * p< 0.10, ** p<0.05, *** p<0.01.

C Robustness Checks

C.1 Robustness Checks: Property-Level

Figure C1: Donors: Alternative 10% Close Election Cutoff

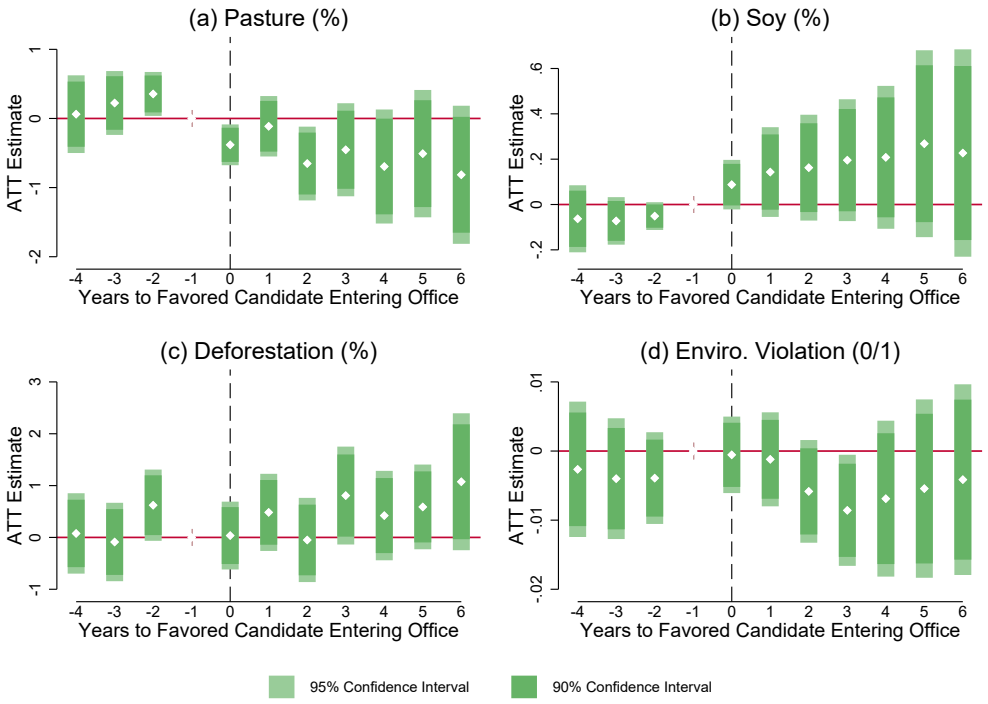


Figure C2: Candidates: Alternative 10% Close Election Cutoff

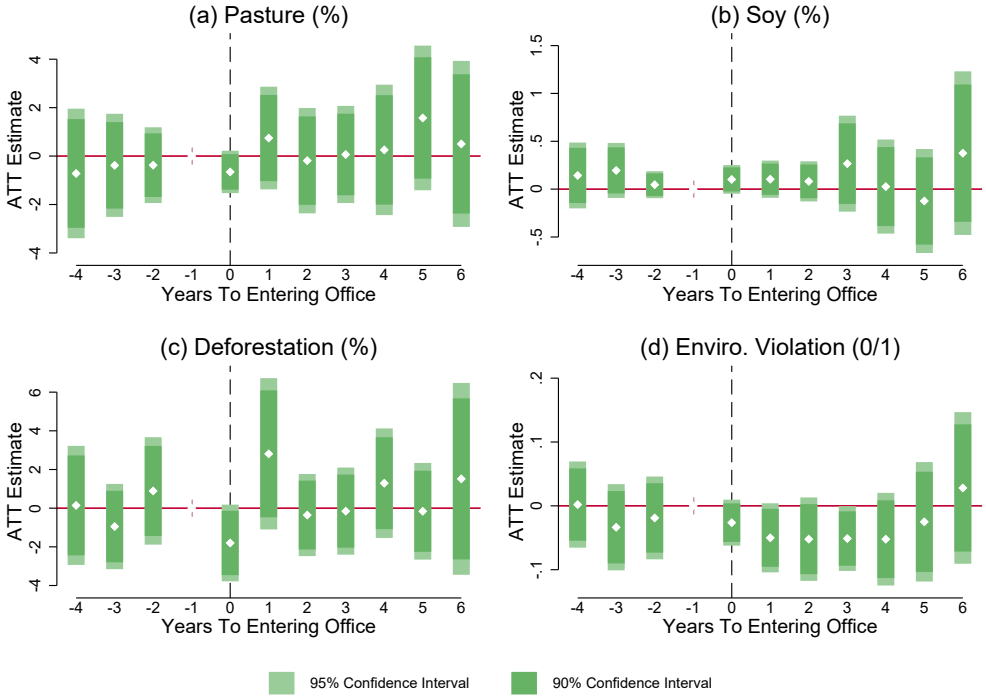


Figure C3: Donors: No Election Cutoff

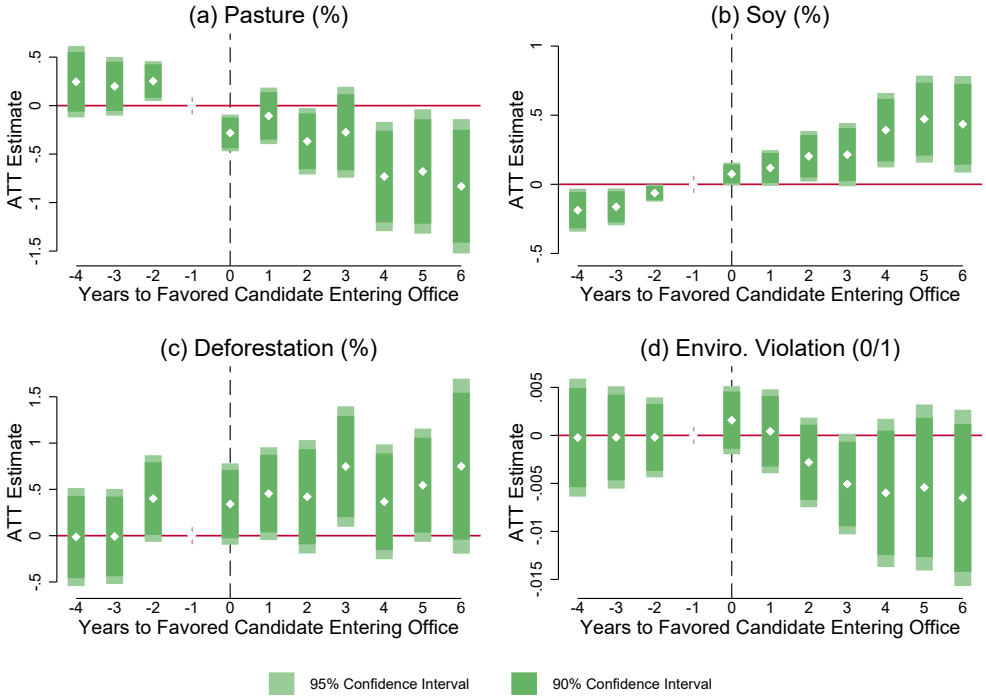


Figure C4: Candidates: No Election Cutoff

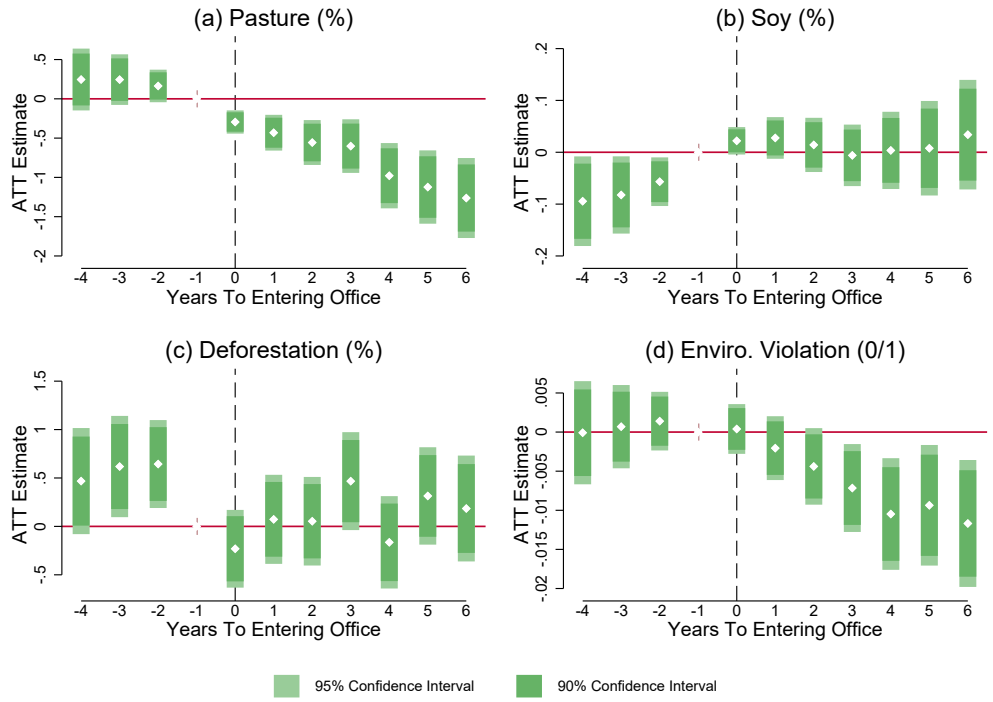


Figure C5: Donors: Sample Restricted to Mato Grosso, Pará, and Rondônia

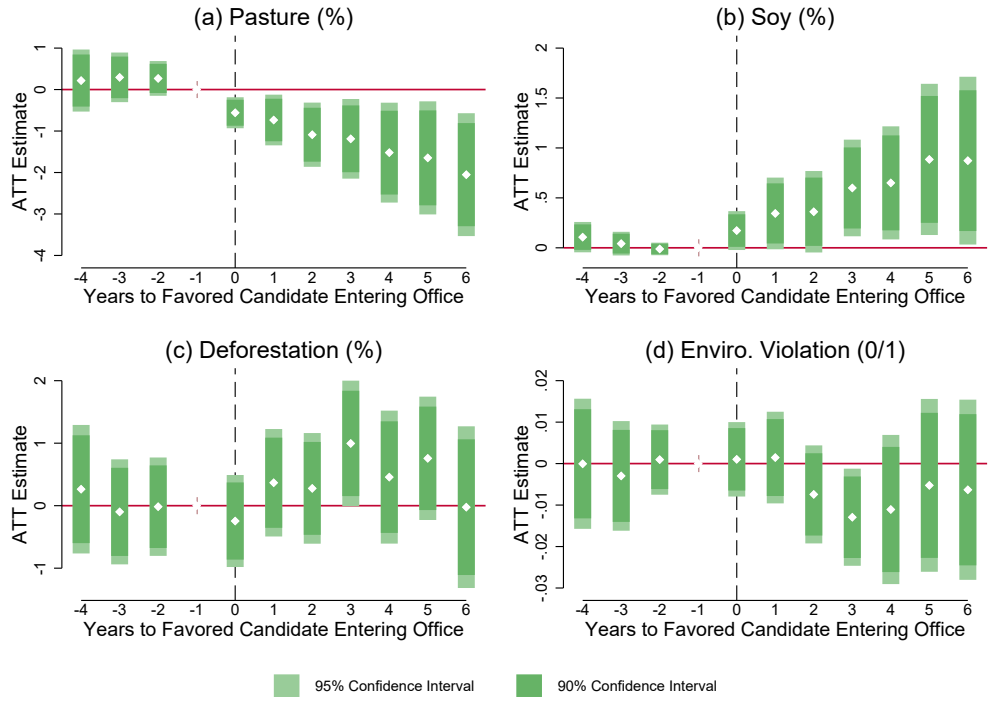


Figure C6: Candidates: Sample Restricted to Mato Grosso, Pará, and Rondônia

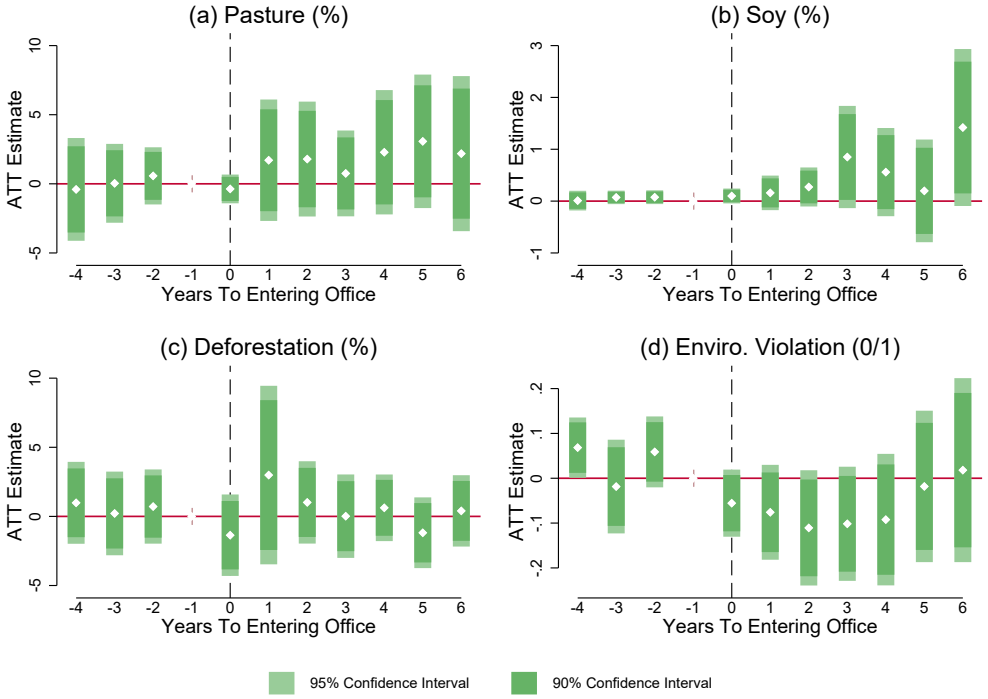


Figure C7: Donors: Full Legal Amazon Sample

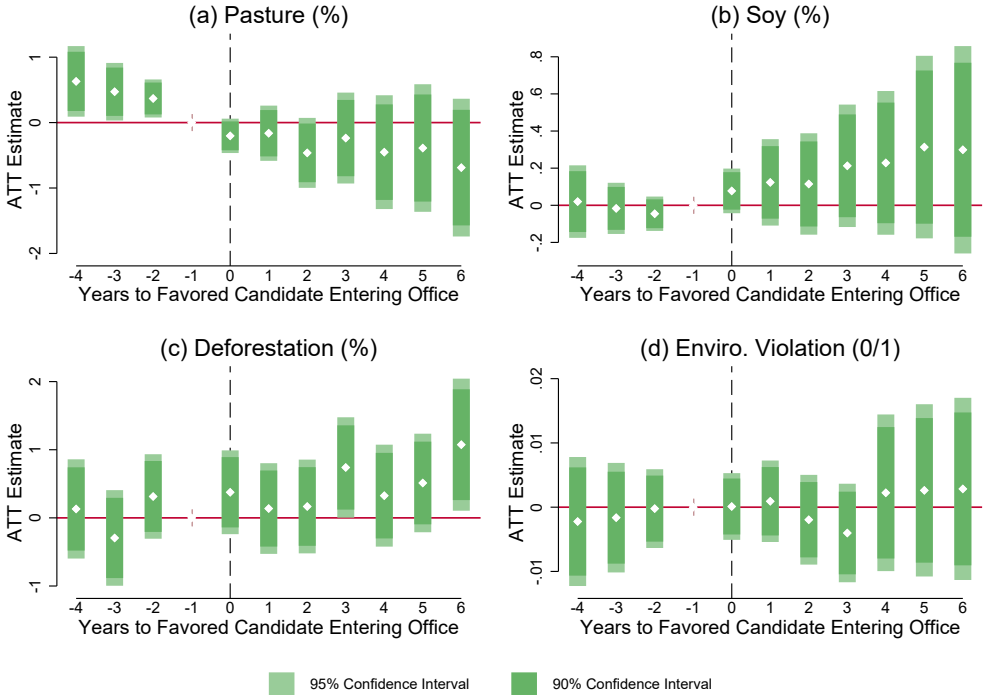


Figure C8: Candidates: Full Legal Amazon Sample

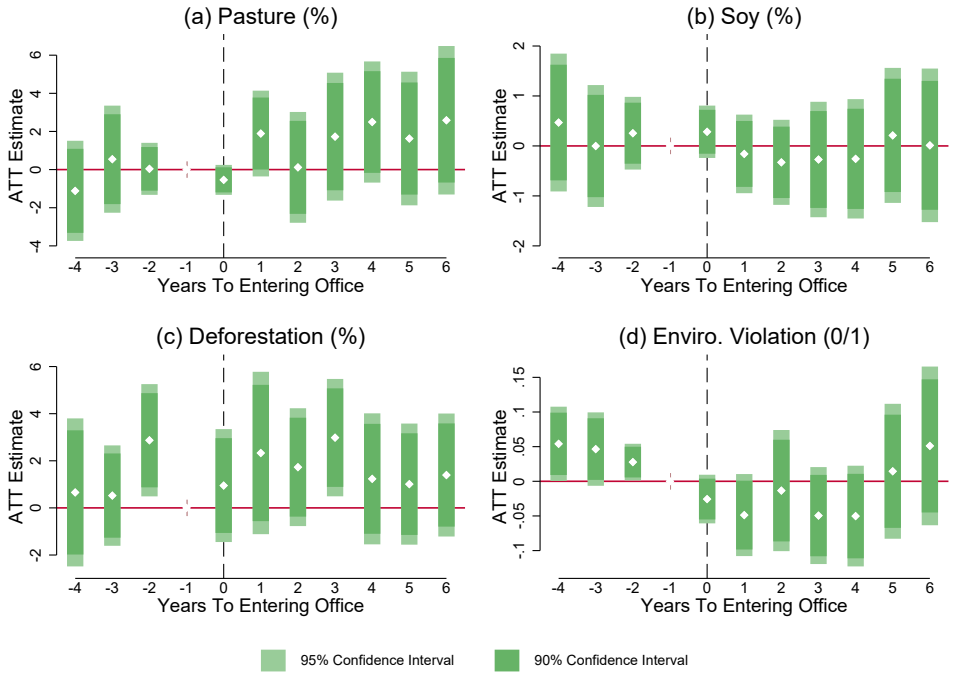


Figure C9: Donors: Effects of Supported Candidate's Entry Into Office with asinh Transformation

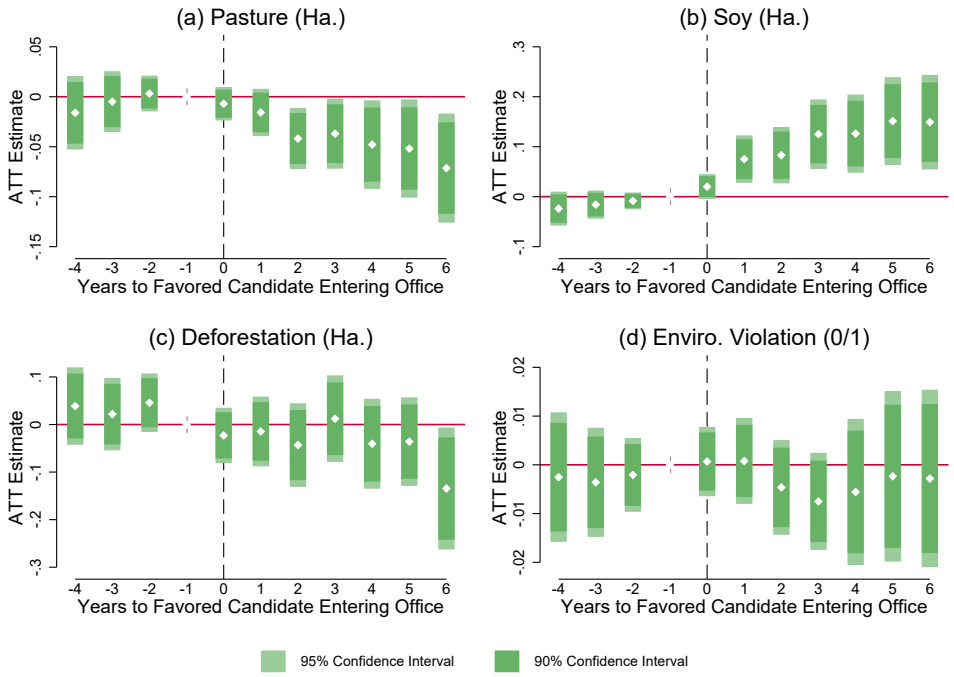


Figure C10: Candidates: Effects of Supported Candidate's Entry Into Office with asinh Transformation

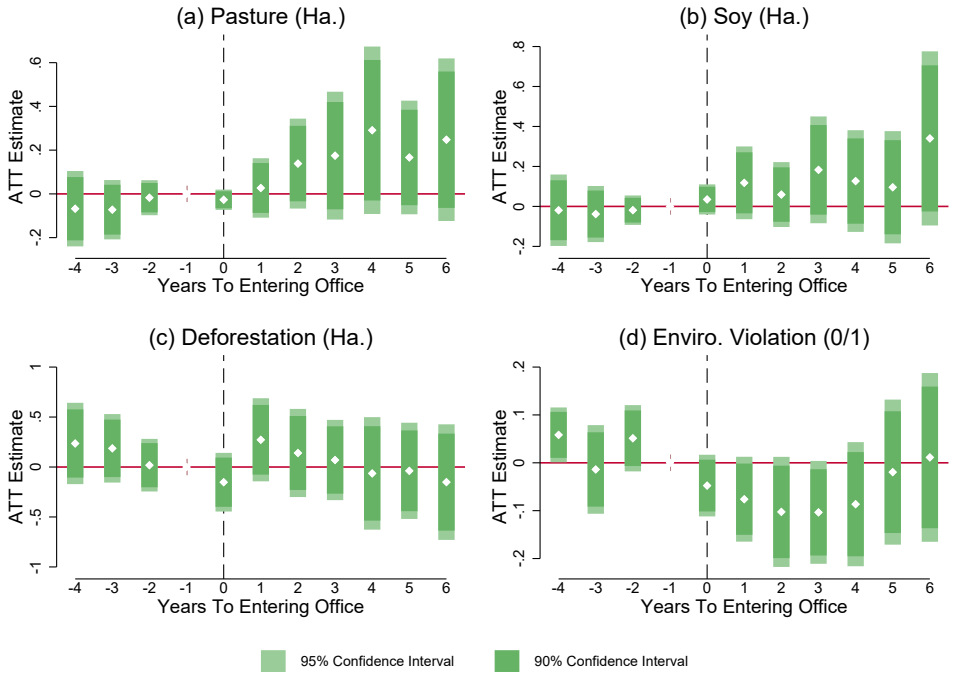


Figure C11: Donors: Effects of Supported Candidate's Entry Into Office Controlling for Candidate Covariates

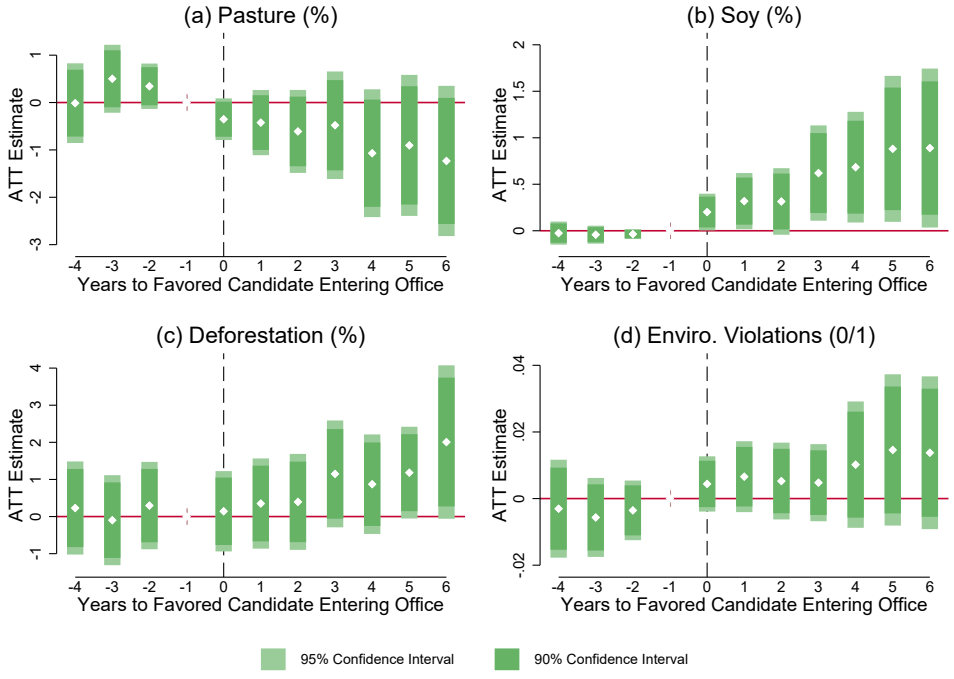


Figure C12: Donors: Effects of Supported Candidate's Entry Into Office with Municipality-Election Fixed Effects

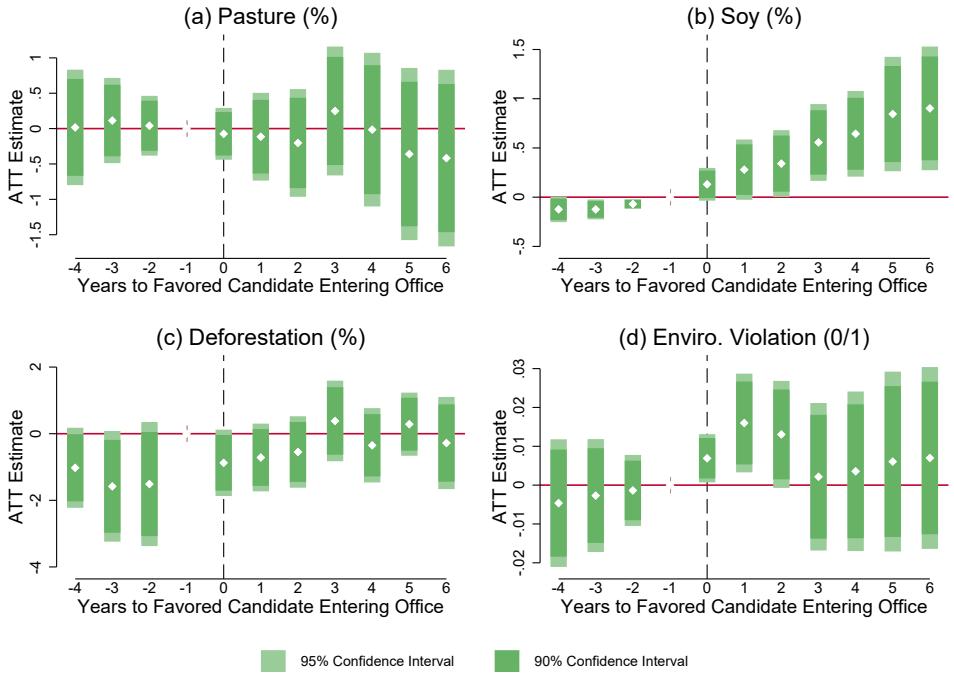


Figure C13: Donors: Effects of Supported Candidate's Entry Into Office with Municipality-Election Fixed Effects and Controlling for Candidate Covariates

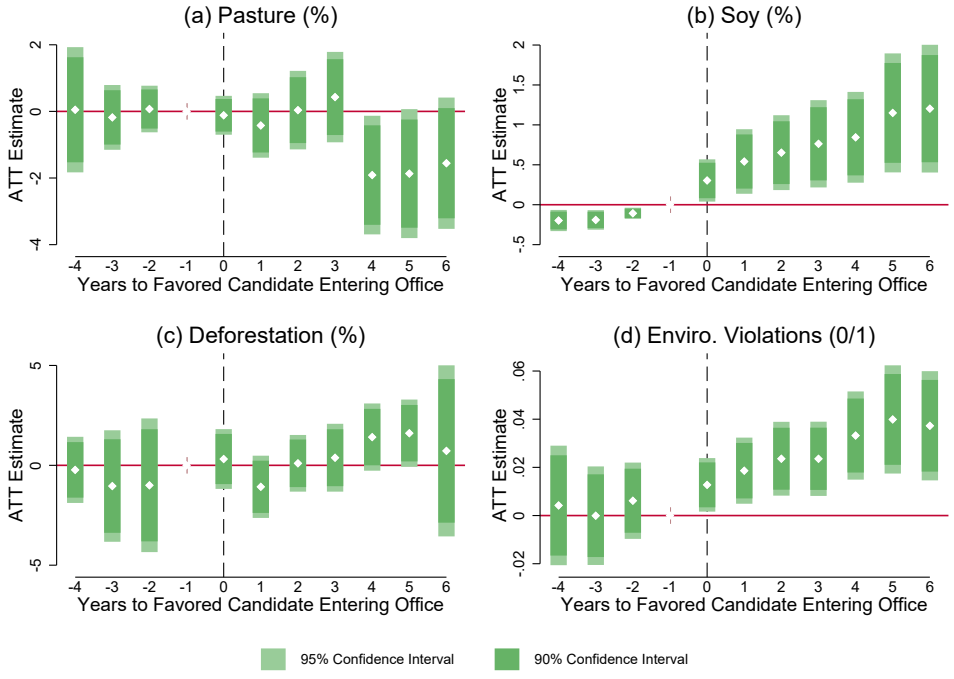


Figure C14: Donors: Inclusion of Win-Margin Running Variable

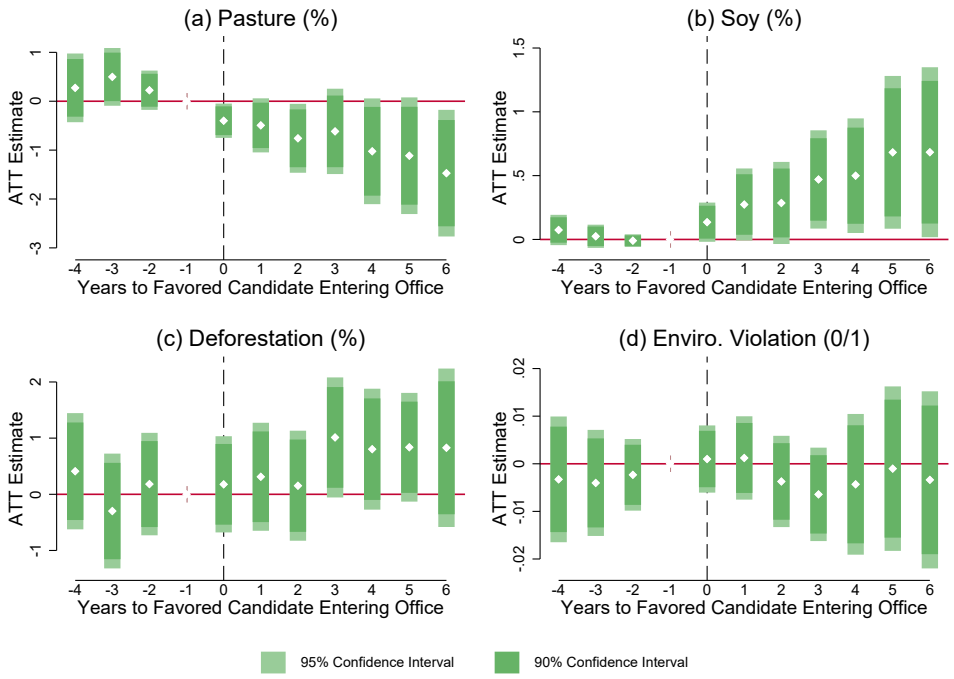


Figure C15: Candidates: Inclusion of Win-Margin Running Variable

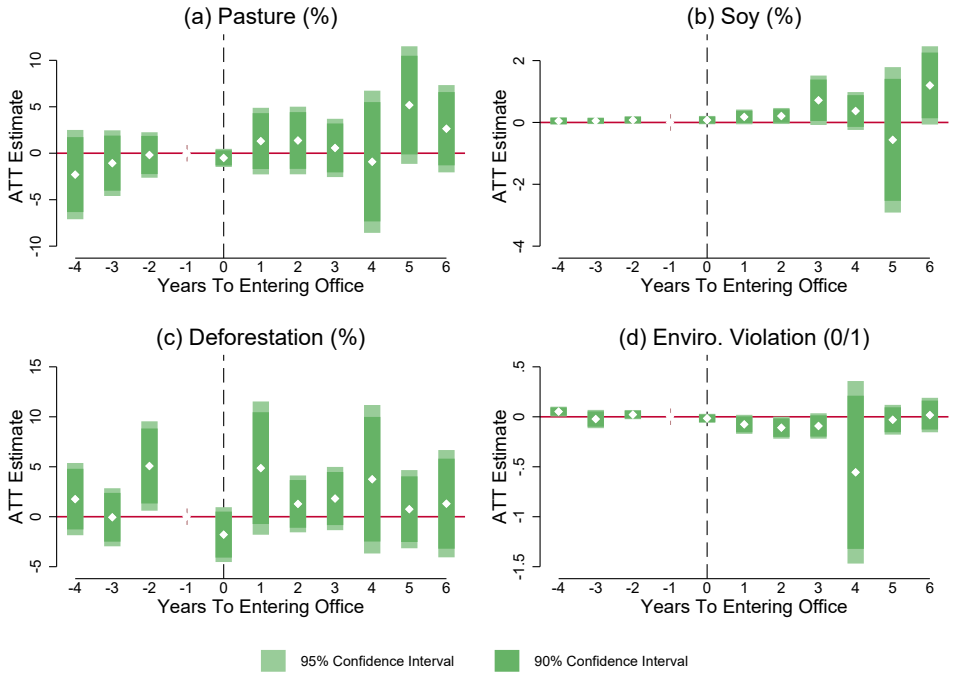


Figure C16: Donors: 10% Election Cutoff in Mato Gross, Pará, and Rondônia

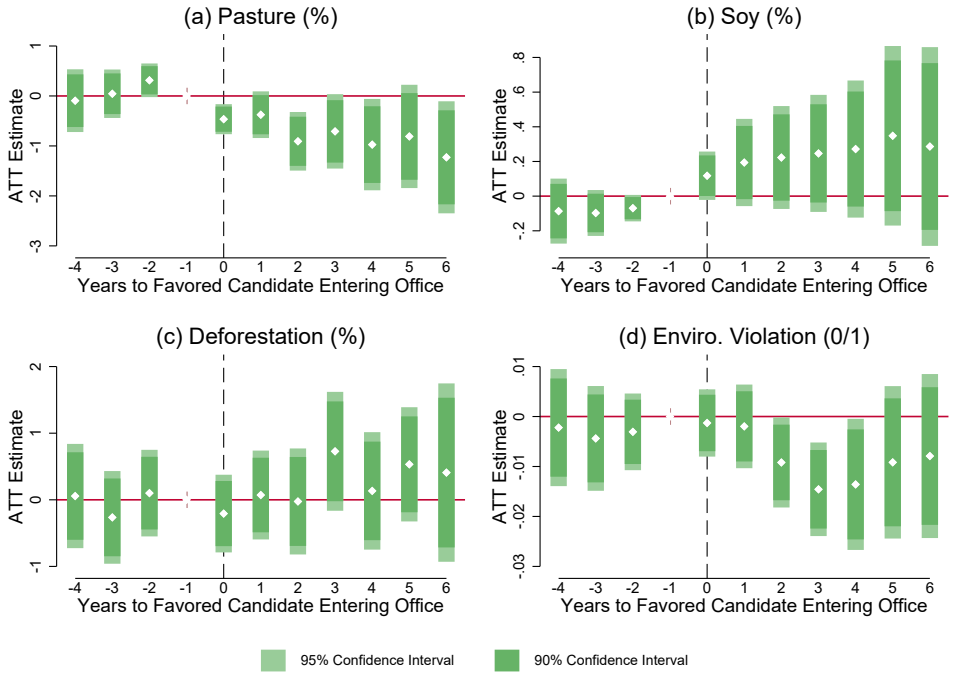


Figure C17: Candidates: 10% Election Cutoff in Mato Gross, Pará, and Rondônia

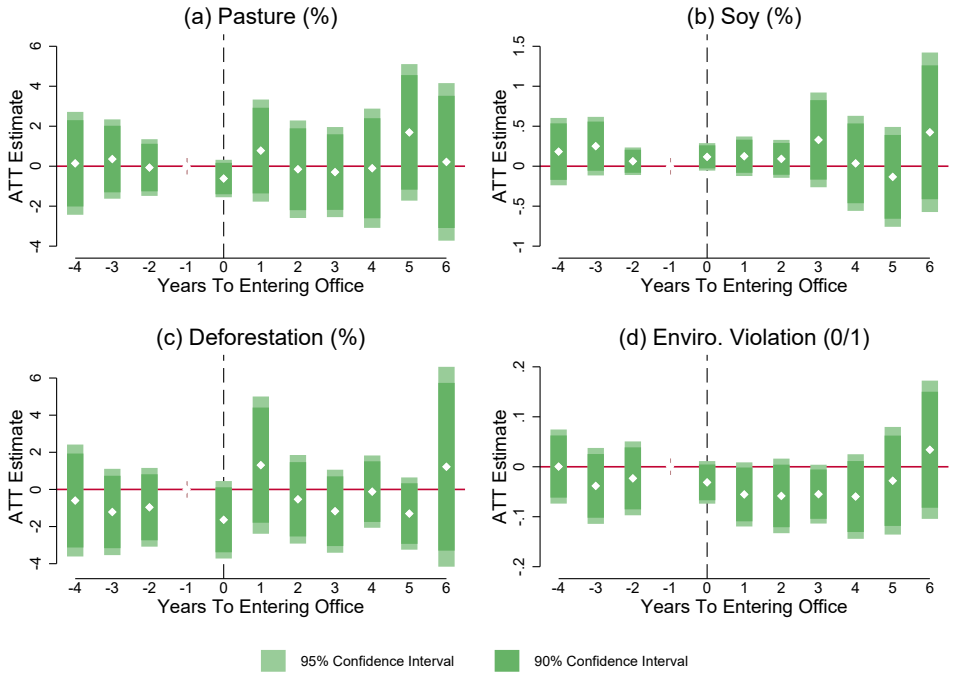


Figure C18: Donors: No Election Cutoff in Mato Gross, Pará, and Rondônia

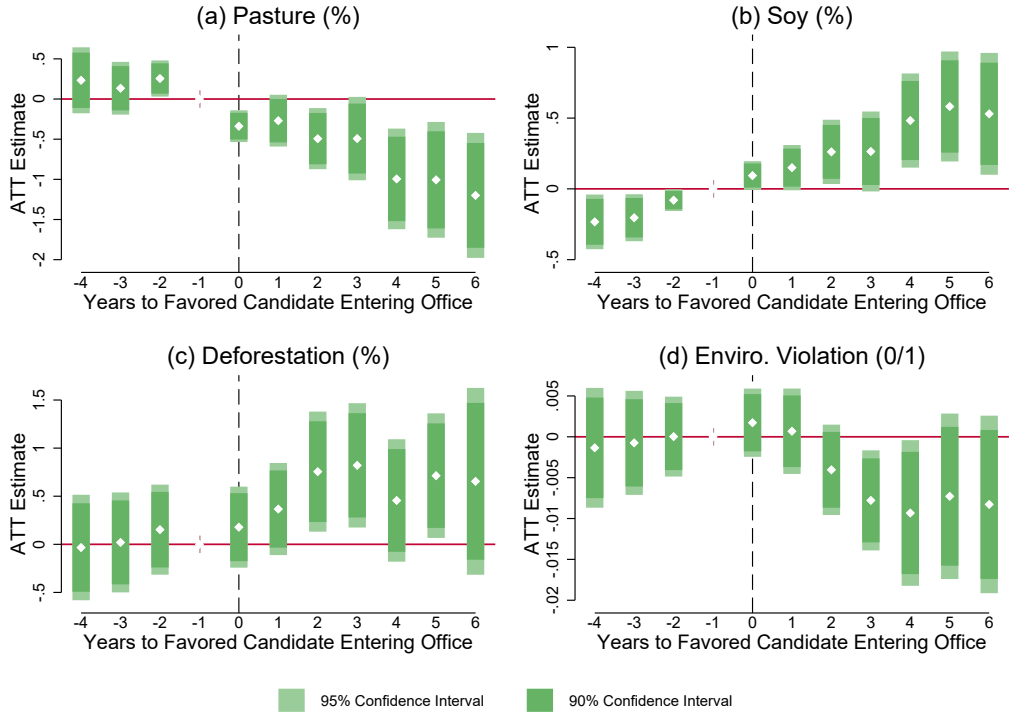


Figure C19: Candidates: No Election Cutoff in Mato Gross, Pará, and Rondônia

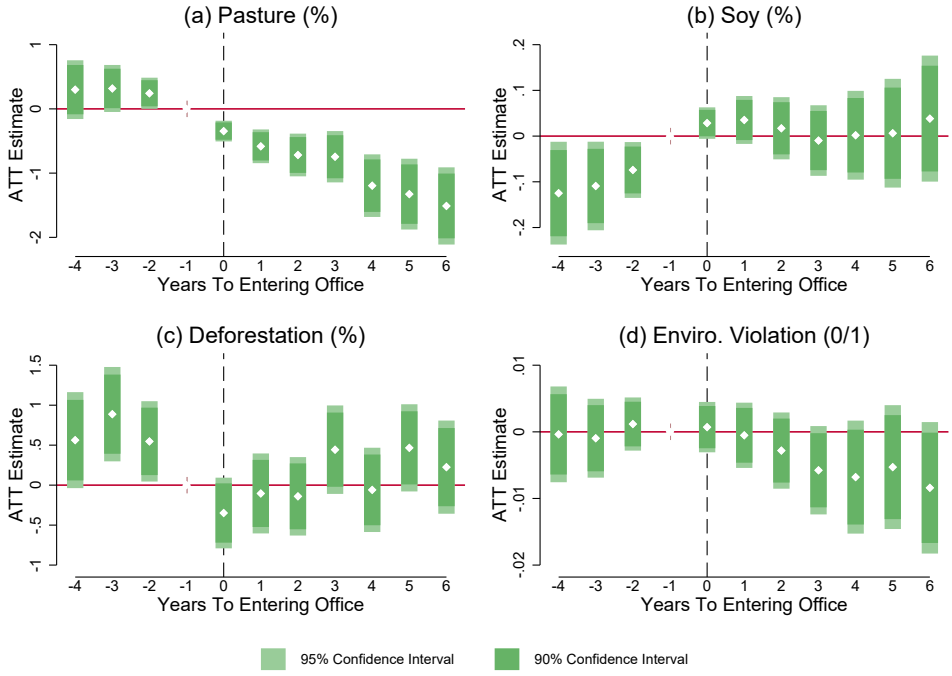


Figure C20: Donors: 10% Election Cutoff in Legal Amazon

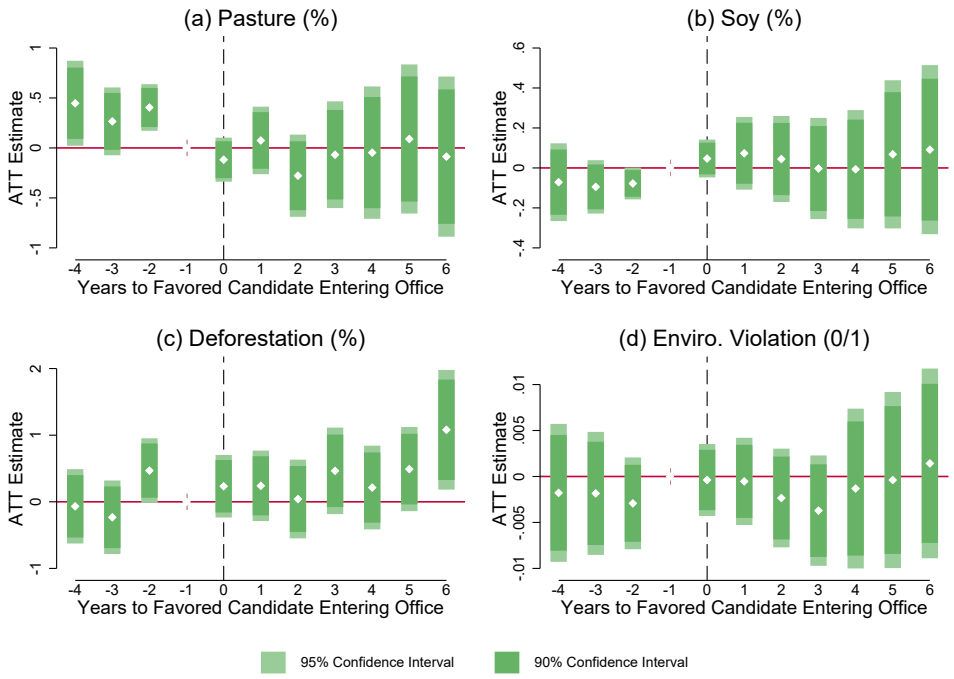


Figure C21: Donors: No Election Cutoff in Legal Amazon

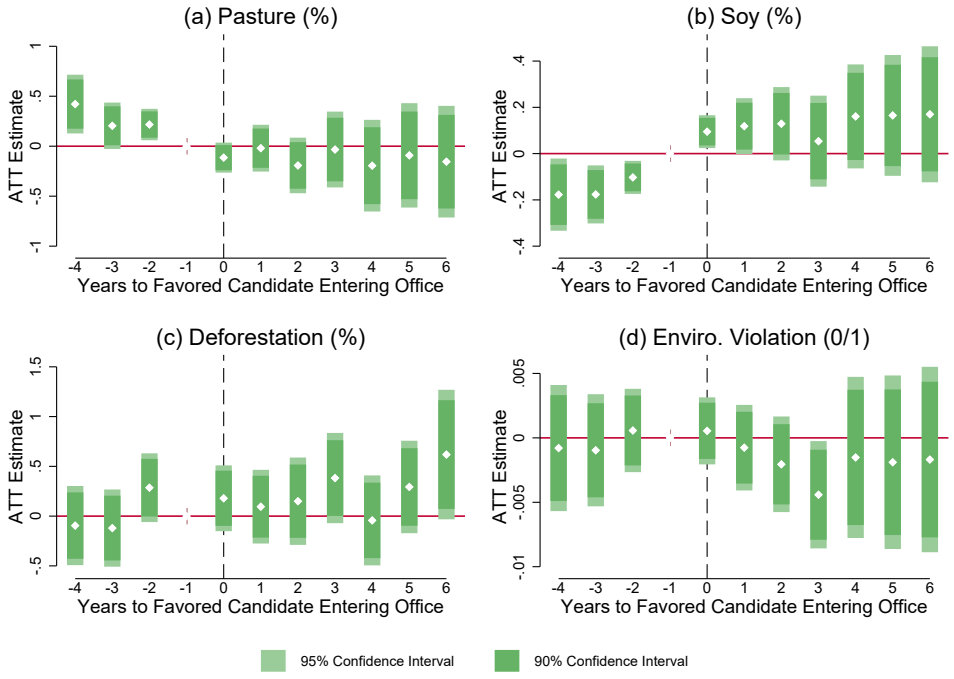


Figure C22: Donors: Mato Gross, Pará and Rondônia with asinh Transformation

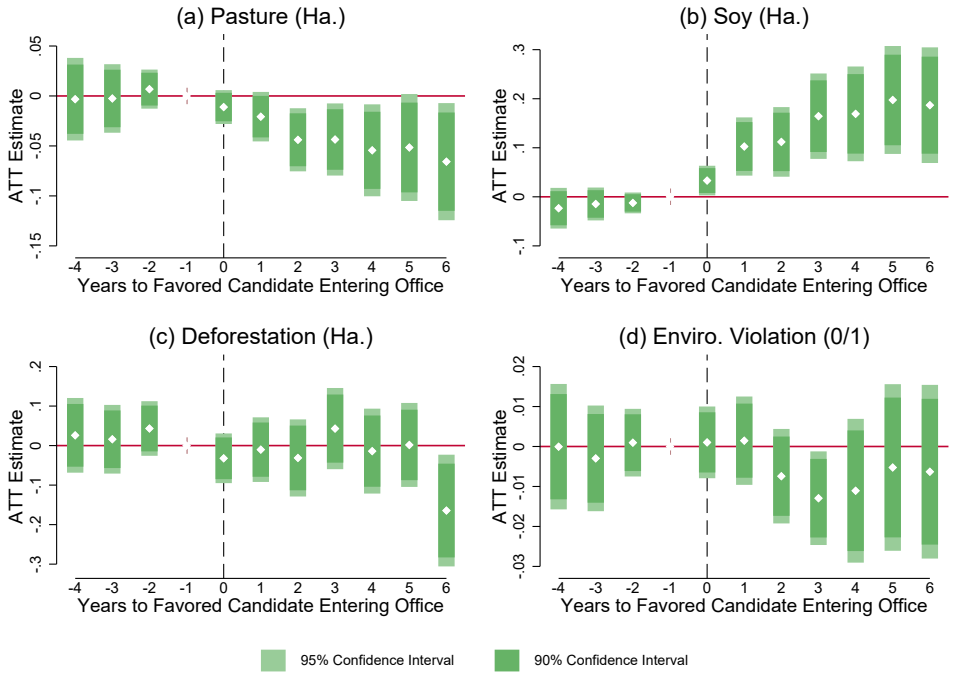


Figure C23: Candidates: Mato Gross, Pará and Rondônia with asinh Transformation

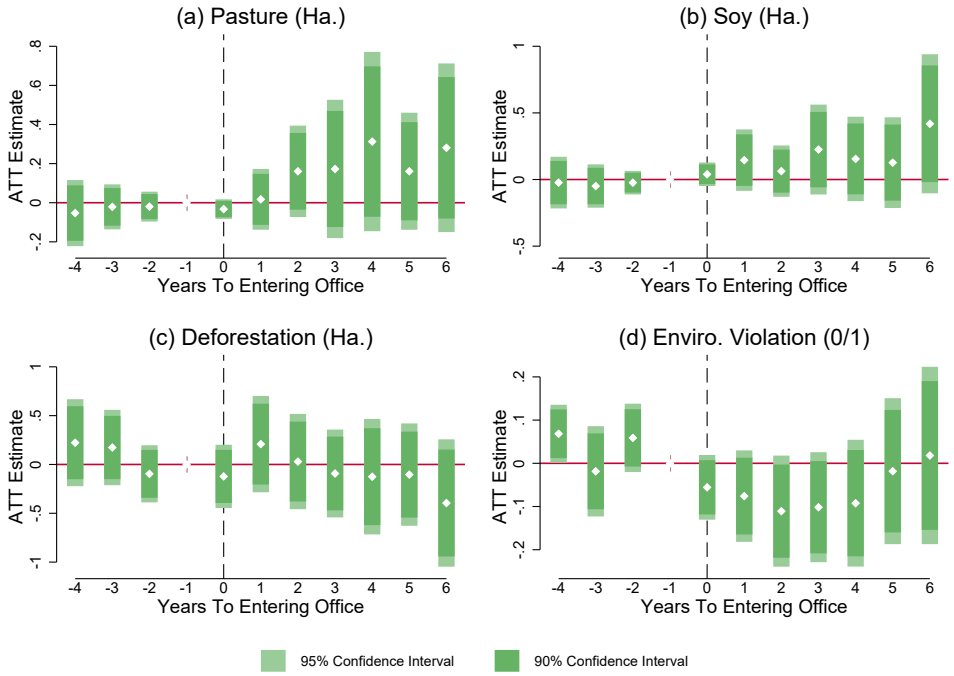


Figure C24: Donors: Alternative 10% Close Election Cutoff with asinh Transformation

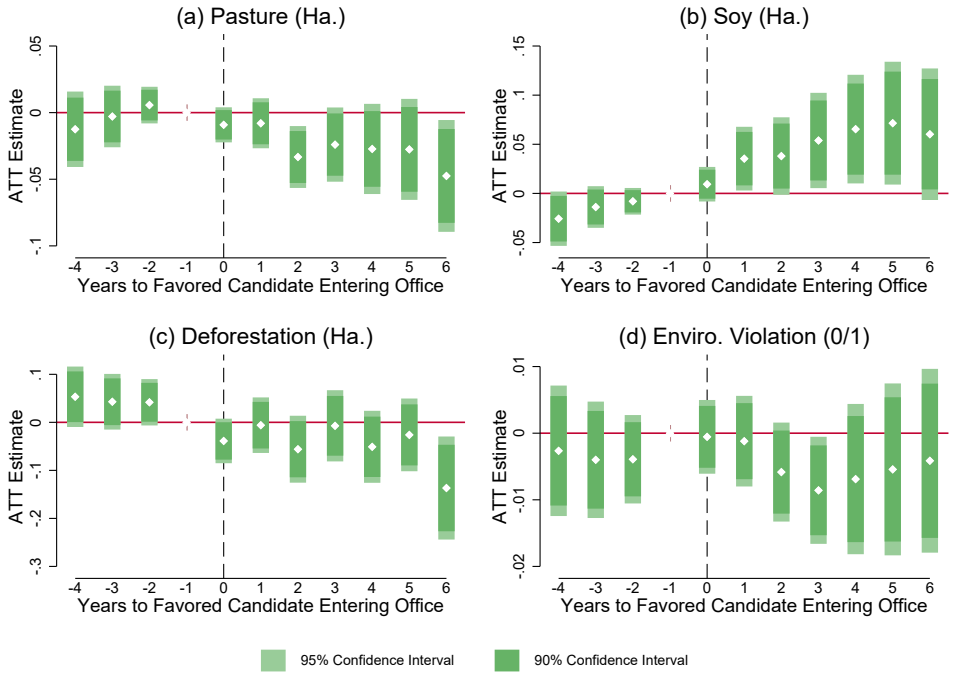


Figure C25: Candidates: Alternative 10% Close Election Cutoff with asinh Transformation

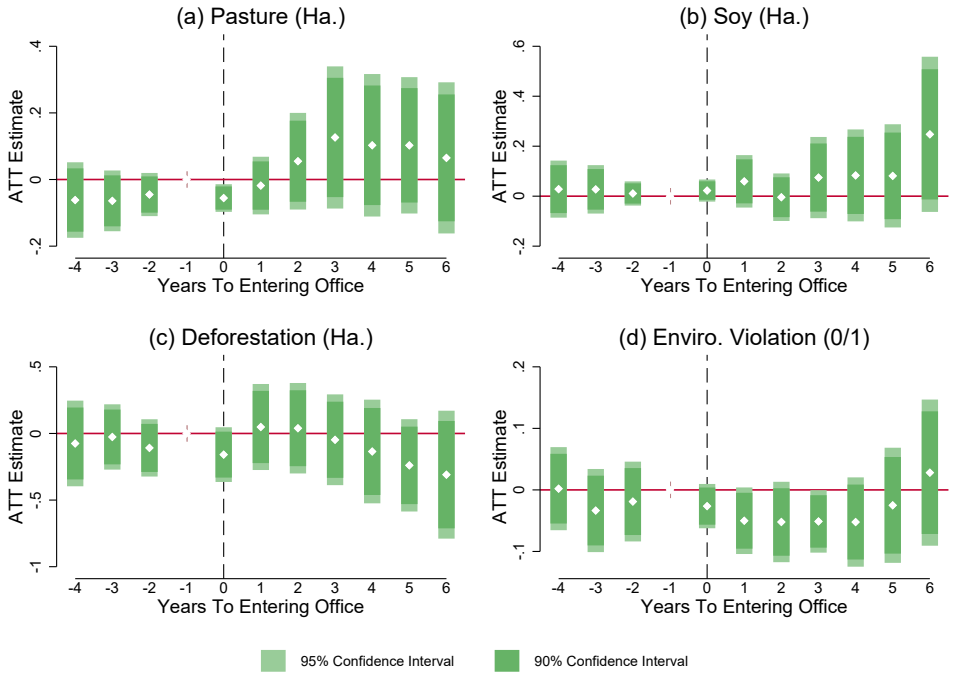


Figure C26: Donors: No Close Election Cutoff with asinh Transformation

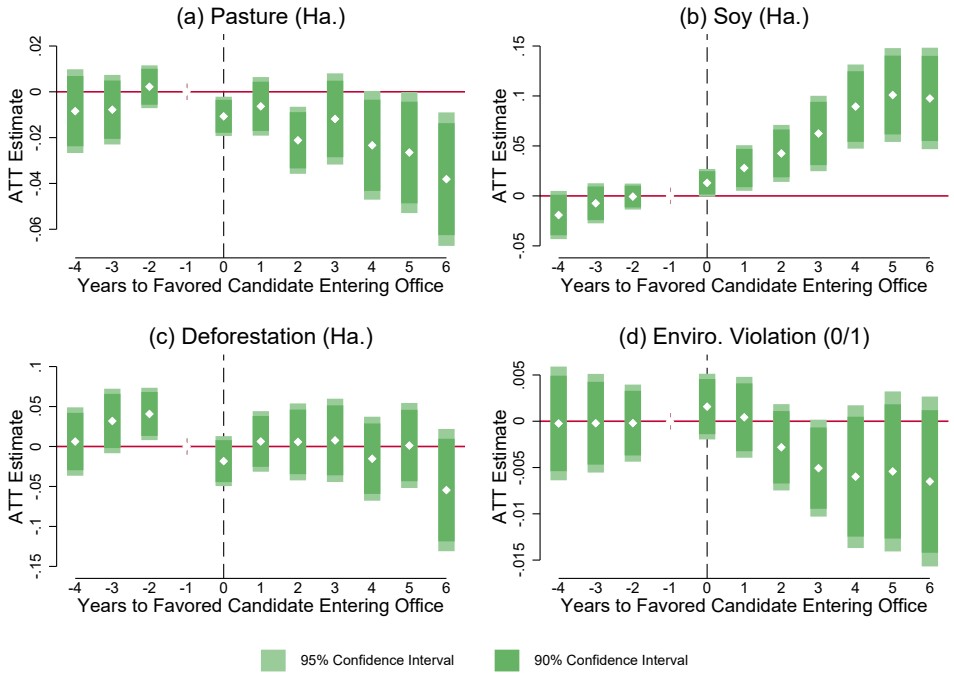


Figure C27: Candidates: No Close Election Cutoff with asinh Transformation

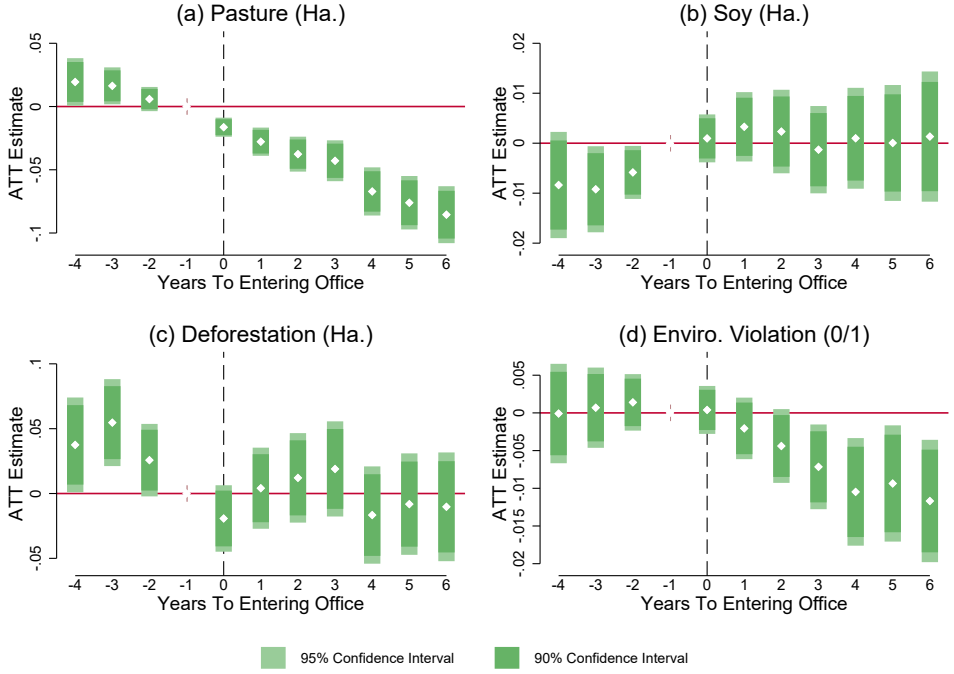


Figure C28: Donors: Mato Grosso, Pará and Rondônia with 10% Close Election Cutoff and asinh Transformation

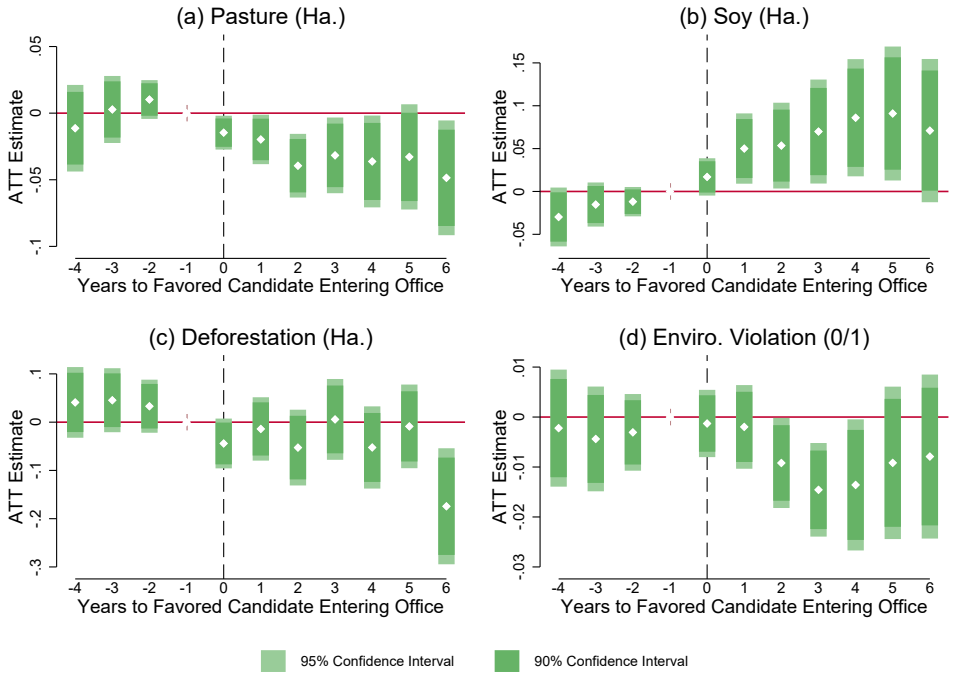


Figure C29: Candidates: Mato Grosso, Pará and Rondônia with 10% Close Election Cutoff and asinh Transformation

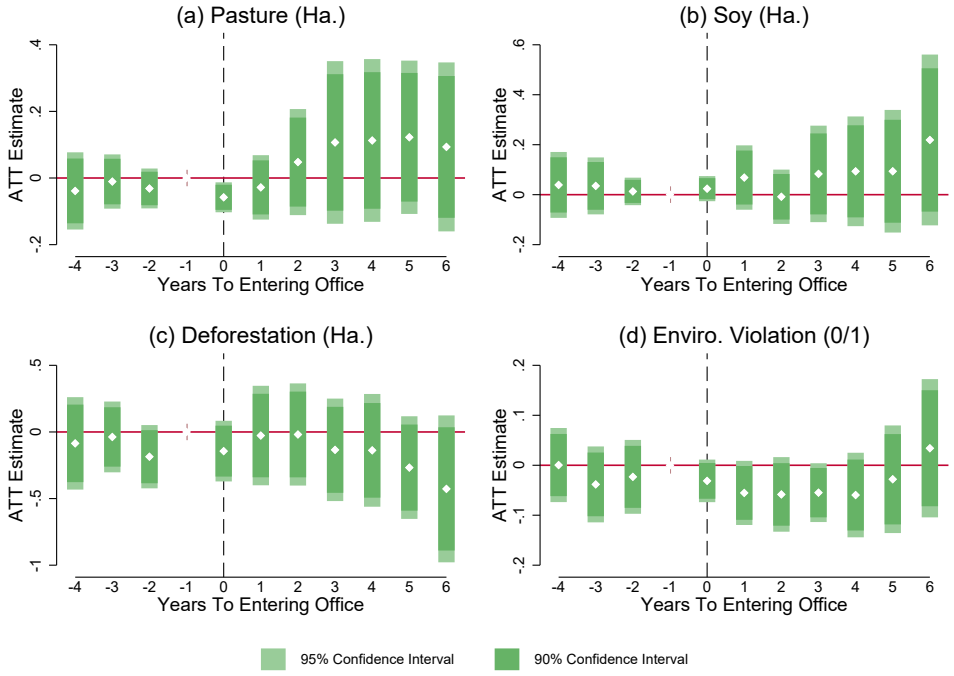


Figure C30: Donors: Mato Grosso, Pará and Rondônia with No Election Cutoff and asinh Transformation

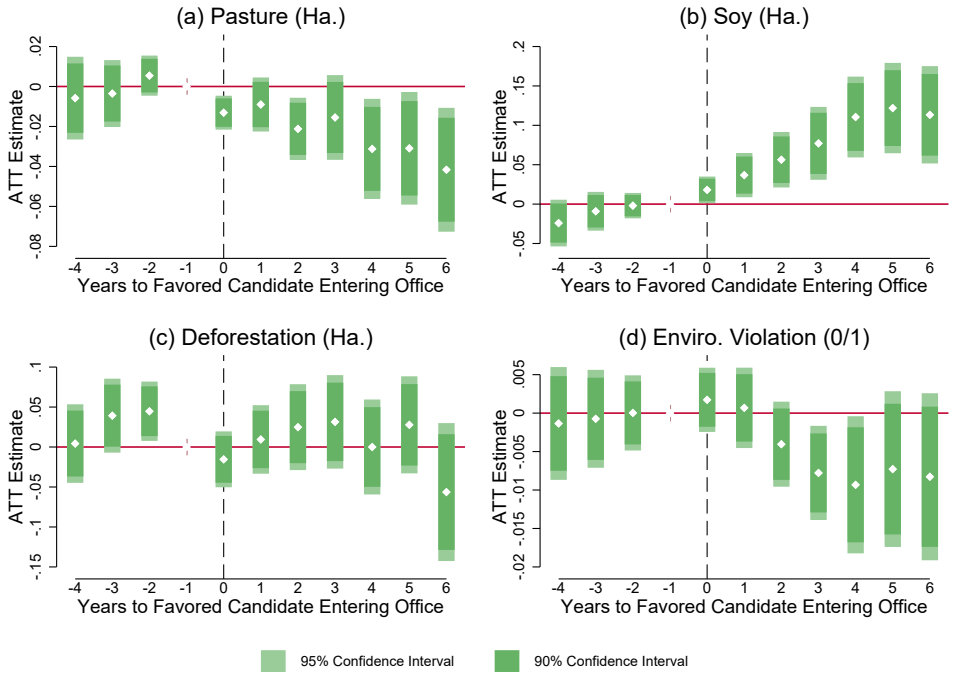


Figure C31: Candidates: Mato Grosso, Pará and Rondônia with No Election Cutoff and asinh Transformation

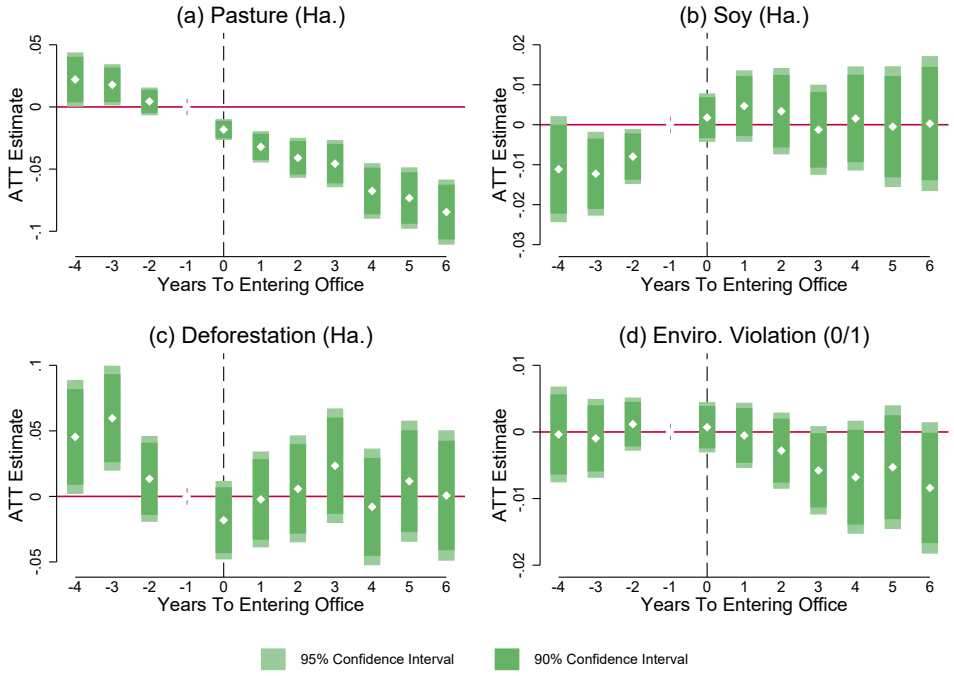


Figure C32: Donors: Legal Amazon with 10% Close Election Cutoff and asinh Transf.

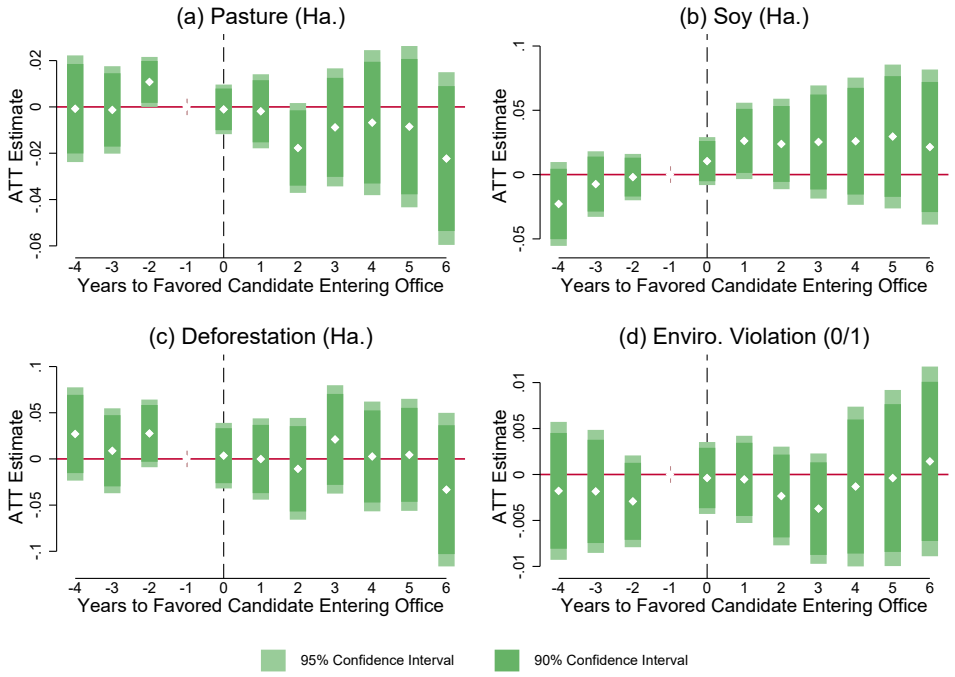


Figure C33: Donors: Inclusion of Win-Margin Running Variable (asinh)

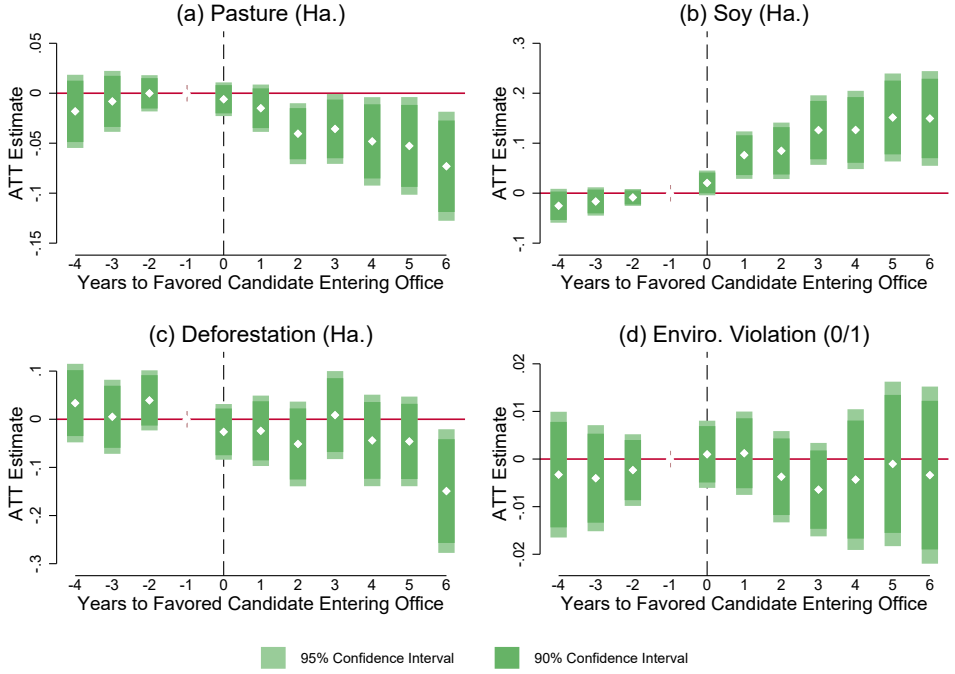


Figure C34: Donors: Mato Grosso, Pará, and Rondônia with Municipality-Election Fixed Effects

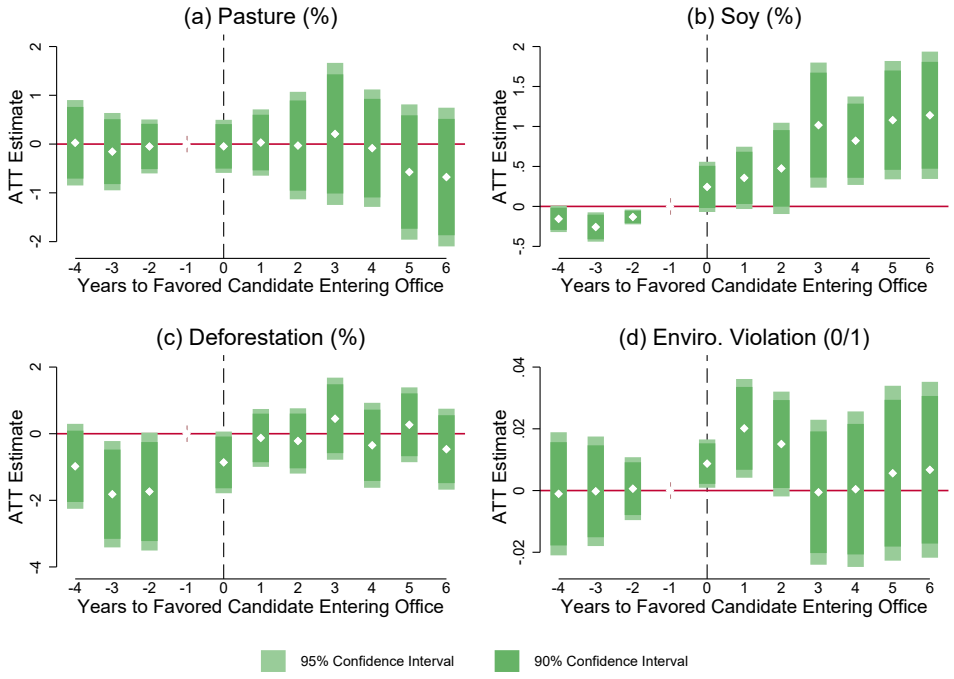


Figure C35: Donors: Alternative 10% Close Election Cutoff and Municipality-Election Fixed Effects

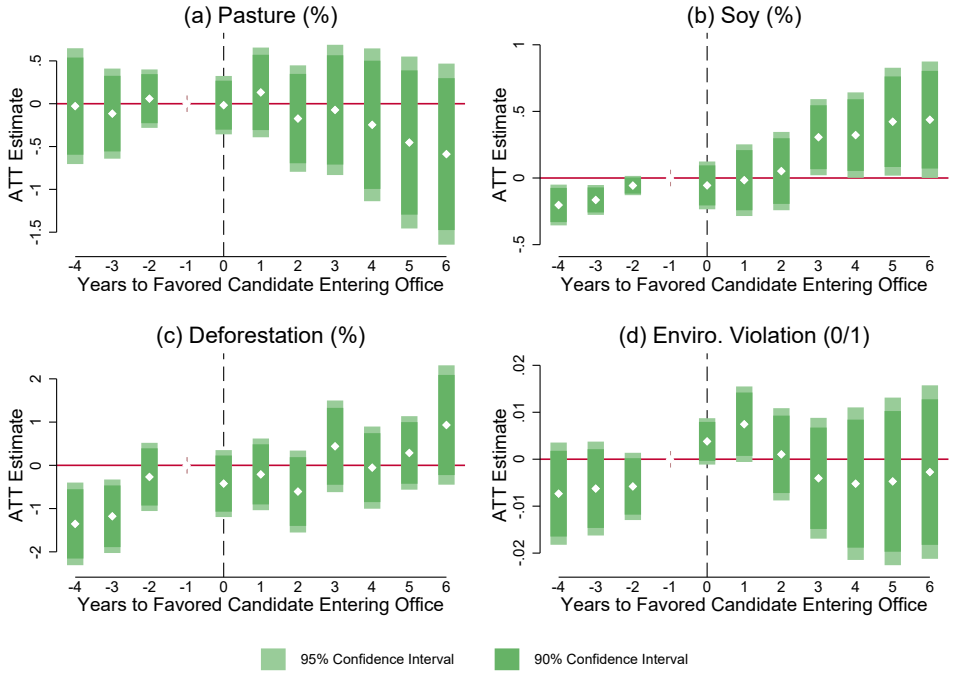


Figure C36: Donors: Mato Grosso, Pará, and Rondônia with 10% Close Election Cutoff and Municipality-Election Fixed Effects

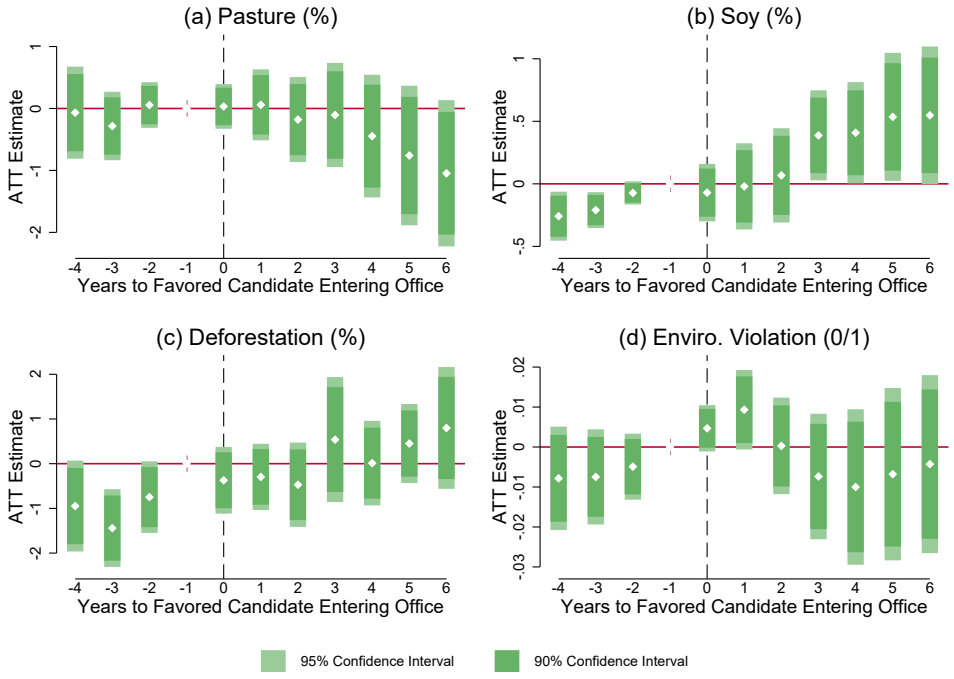


Figure C37: Donors: No Close Election Cutoff and Municipality-Election Fixed Effects

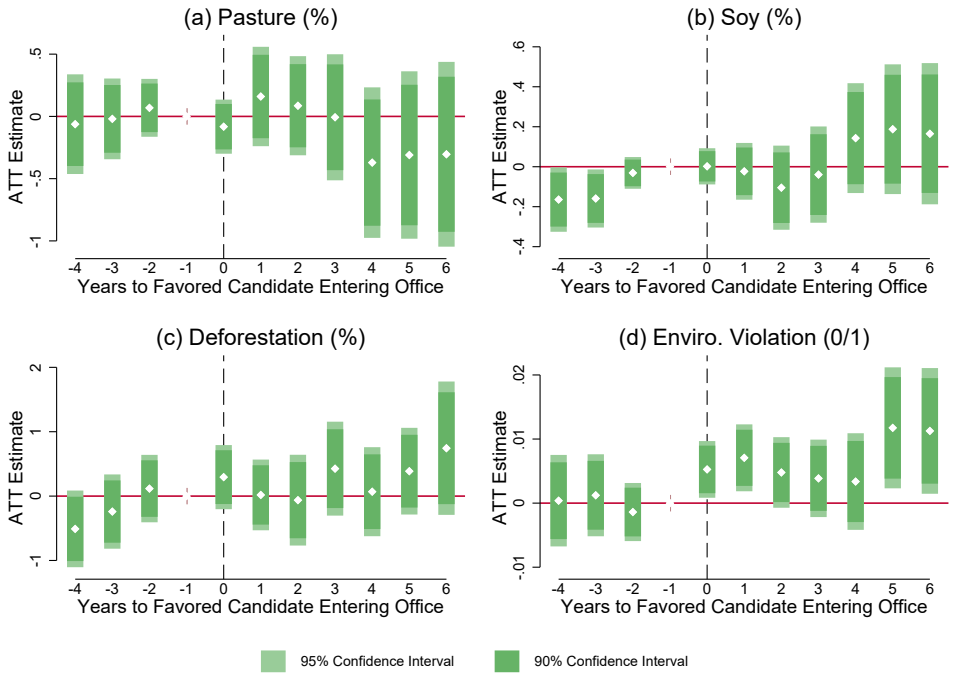


Figure C38: Donors: Mato Grosso, Pará, and Rondônia with No Close Election Cutoff and Municipality-Election Fixed Effects

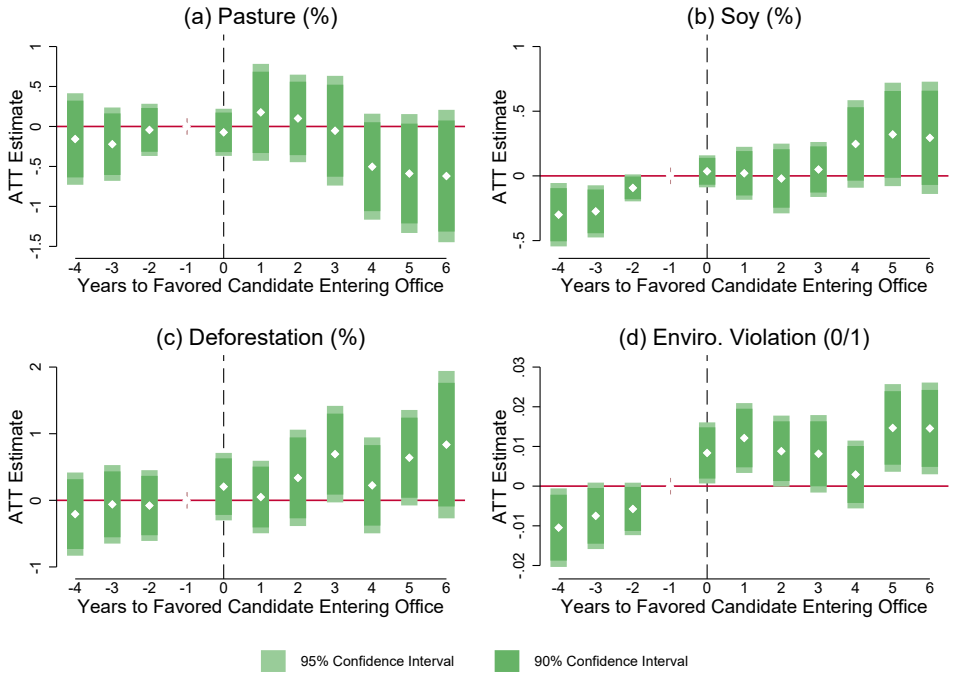


Figure C39: Donors: Legal Amazon with Municipality-Election Fixed Effects

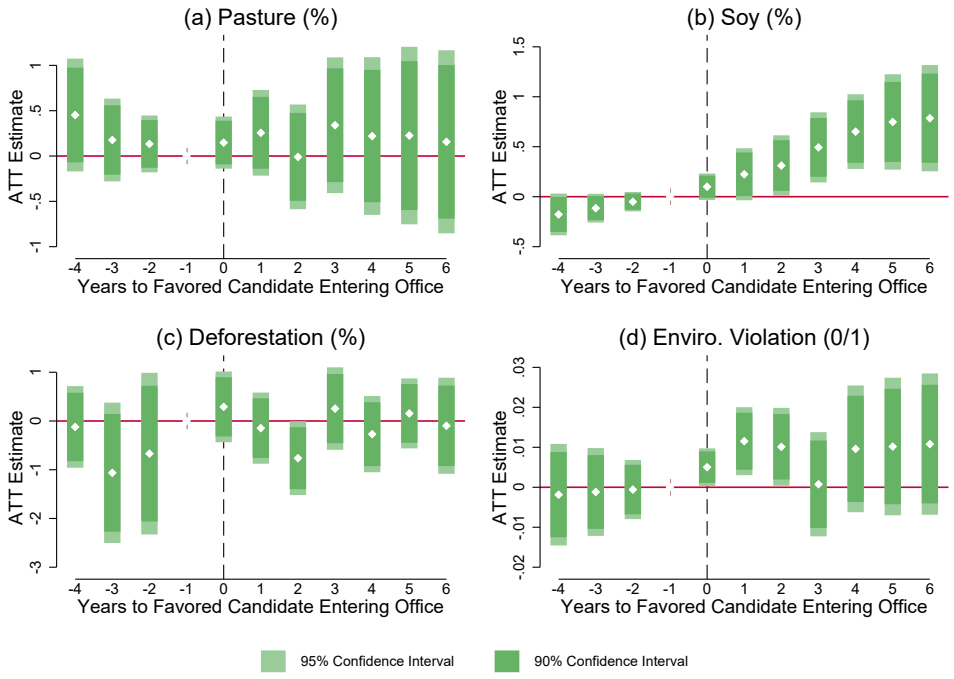
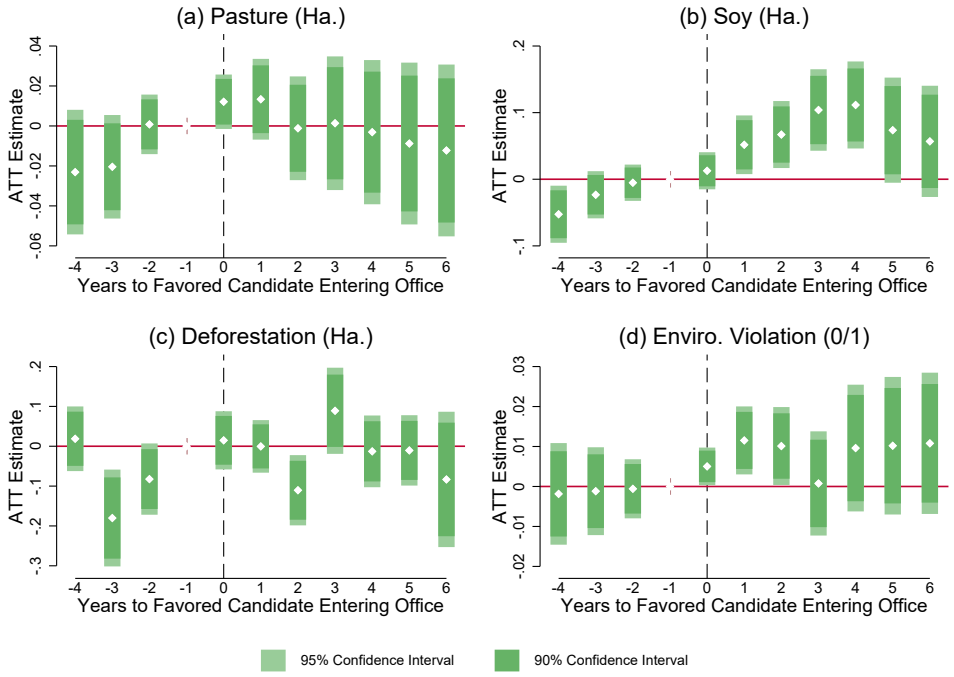
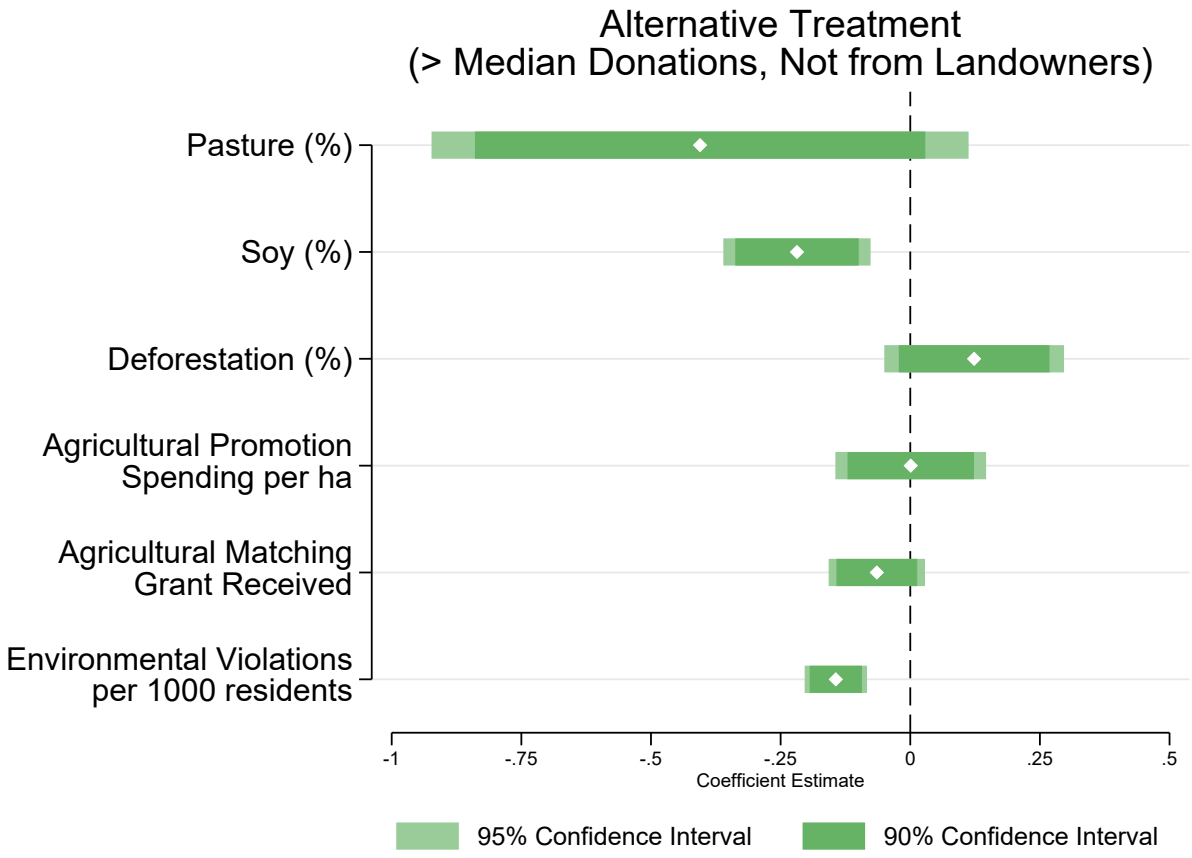


Figure C40: Donors: Legal Amazon with Municipality-Election Fixed Effects (asinh)



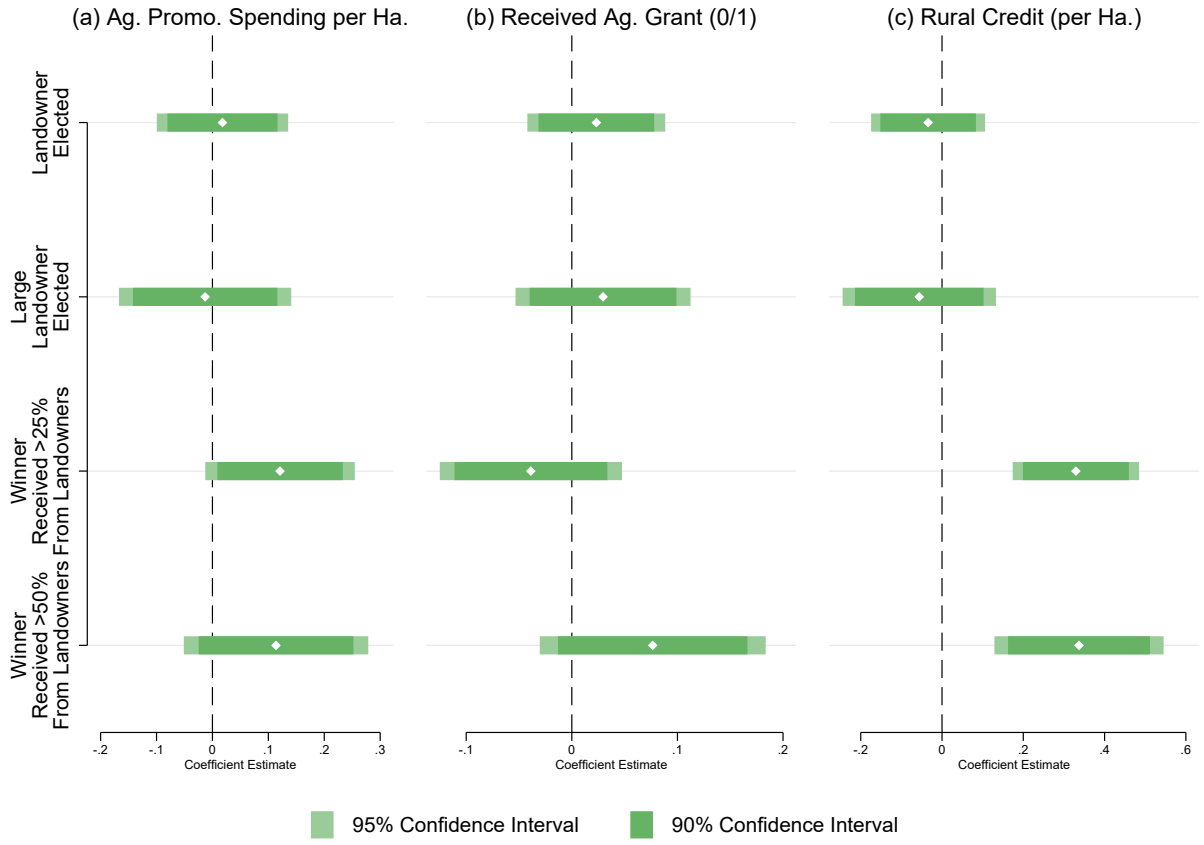
C.2 Robustness Checks: Municipal-Level

Figure C41: Effects of Election of Mayor with Above Median Donations but No Donations from Landowners on Selected Outcomes (Sample = Elections with $\leq 5\%$ Win Margin)



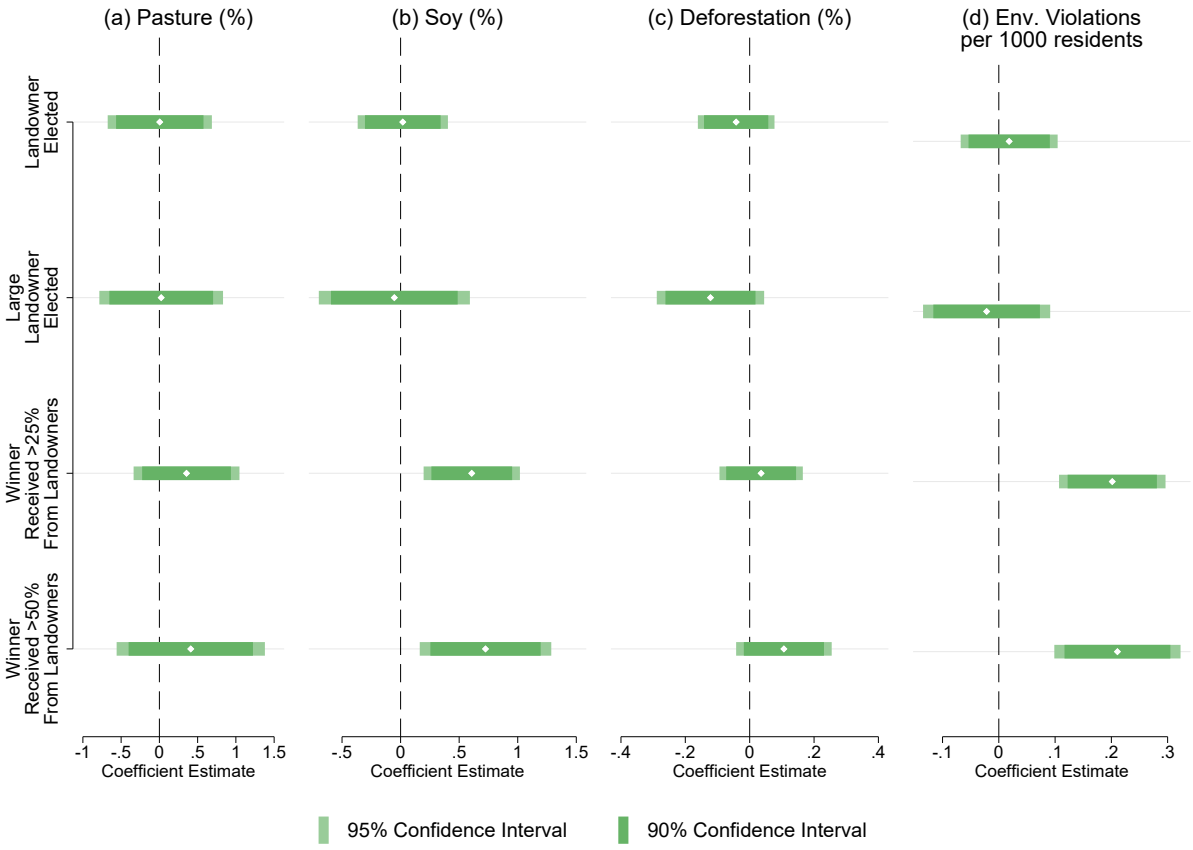
Note: Figure reports coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummy (mayor who received $\geq$ median value of total campaign donations but no donations from landowners in office). Specifications include municipality 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 deforestation as percentages of municipal area, agricultural promotion spending per capita (transformed by inverse hyperbolic sine and deflated to constant 2010 BRL), an indicator of whether the municipality received a federal matching grant from the Ministry of Agriculture, and the number of environmental violations per 1000 residents, transformed by inverse hyperbolic sine)

Figure C42: Municipalities: 10% Close Election Cutoff (Governance)



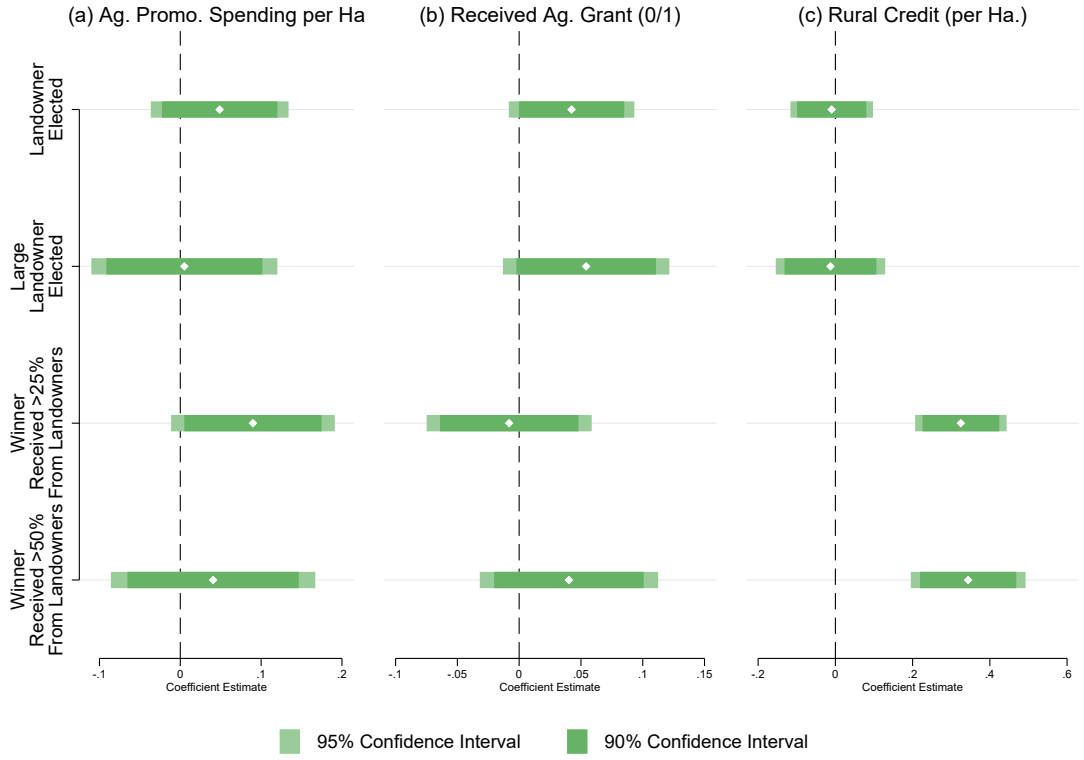
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies: (i) landholder in office, (ii) large landholder ($\geq$ 500 ha.) in office, (iii) mayor who received $\geq$ 25% of their donations from landholders in office, and (iv) 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 the municipality level. Sample is panel of all municipality-election periods (2001-2005 through 2016-2019) in the Amazon biome where win-margin between winner and runner-up mayor was $\geq$ 10%. Left figure reports estimated effects on municipal spending on Agricultural Promotion per hectare; central figure reports estimated effects on an indicator for receiving 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 (asinh). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

Figure C43: Municipalities: 10% Close Election Cutoff (Land-Use)



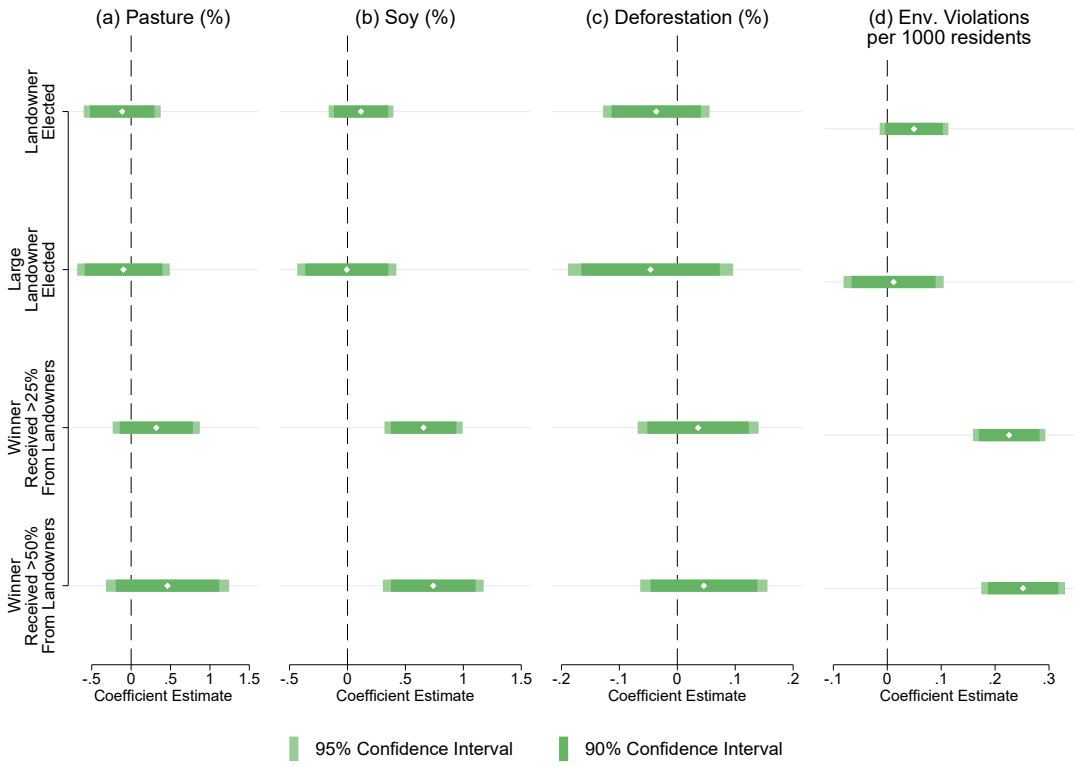
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% 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) in the Amazon biome where win-margin between winner and runner-up mayor was $\geq$ 10%. Figures report, from left to right, estimated effects on pasture, soy, and deforestation as percentages of municipal area, and environmental violations (asinh) per 1,000 municipal residents.

Figure C44: Municipalities: No Close Election Cutoff (Governance)



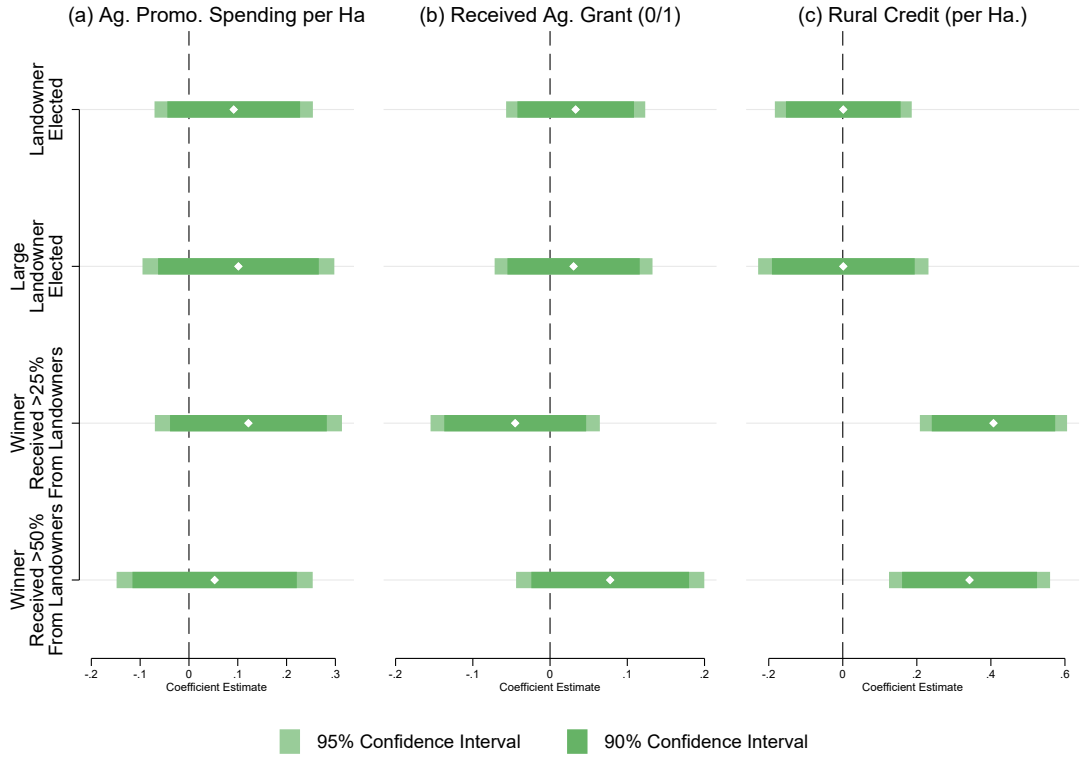
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies: (i) landholder in office, (ii) large landholder ($\geq$ 500 ha.) in office, (iii) mayor who received $\geq$ 25% of their donations from landholders in office, and (iv) 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 the municipality level. Sample is panel of all municipality-election periods (2001-2005 through 2016-2019) in the Amazon biome. Left figure reports estimated effects on municipal spending on Agricultural Promotion per hectare; central figure reports estimated effects on an indicator for receiving 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 (asinh). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

Figure C45: Municipalities: No Close Election Cutoff (Land-Use)



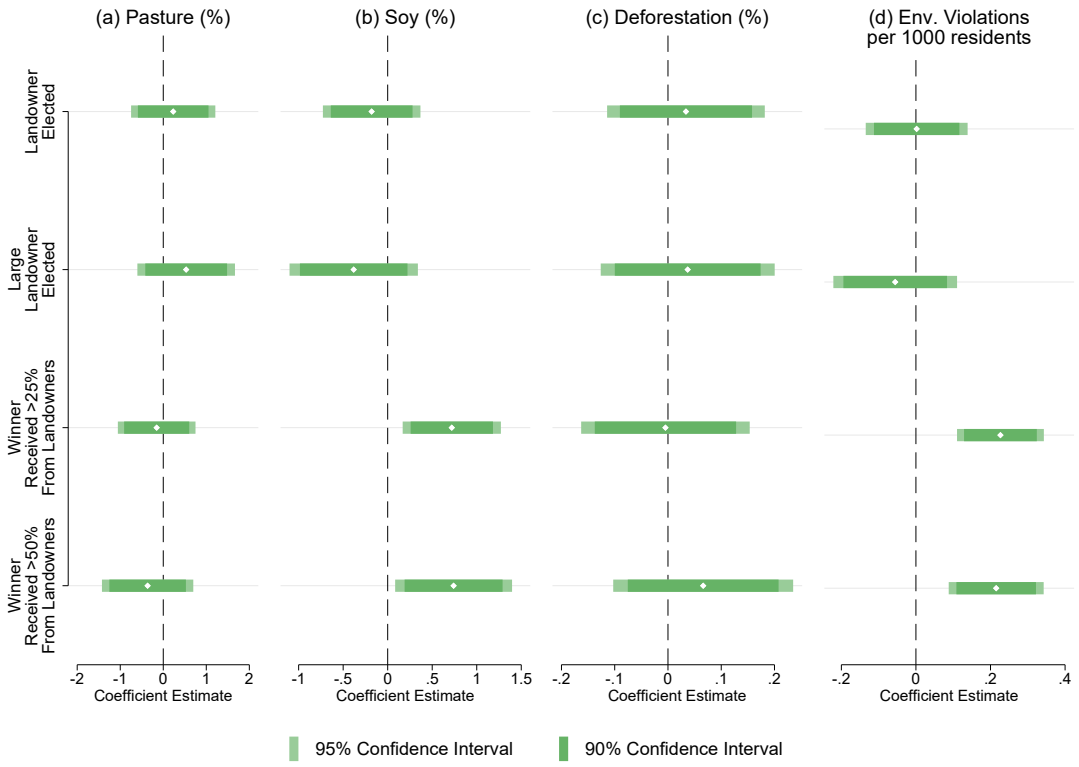
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% 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 all municipality-election periods (2001-2005 through 2016-2019) in the Amazon biome. Figures report, from left to right, estimated effects on pasture, soy, and deforestation as percentages of municipal area, and environmental violations (asinh) per 1,000 municipal residents.

Figure C46: Municipalities: Mato Grosso, Pará, and Rondônia (Governance)



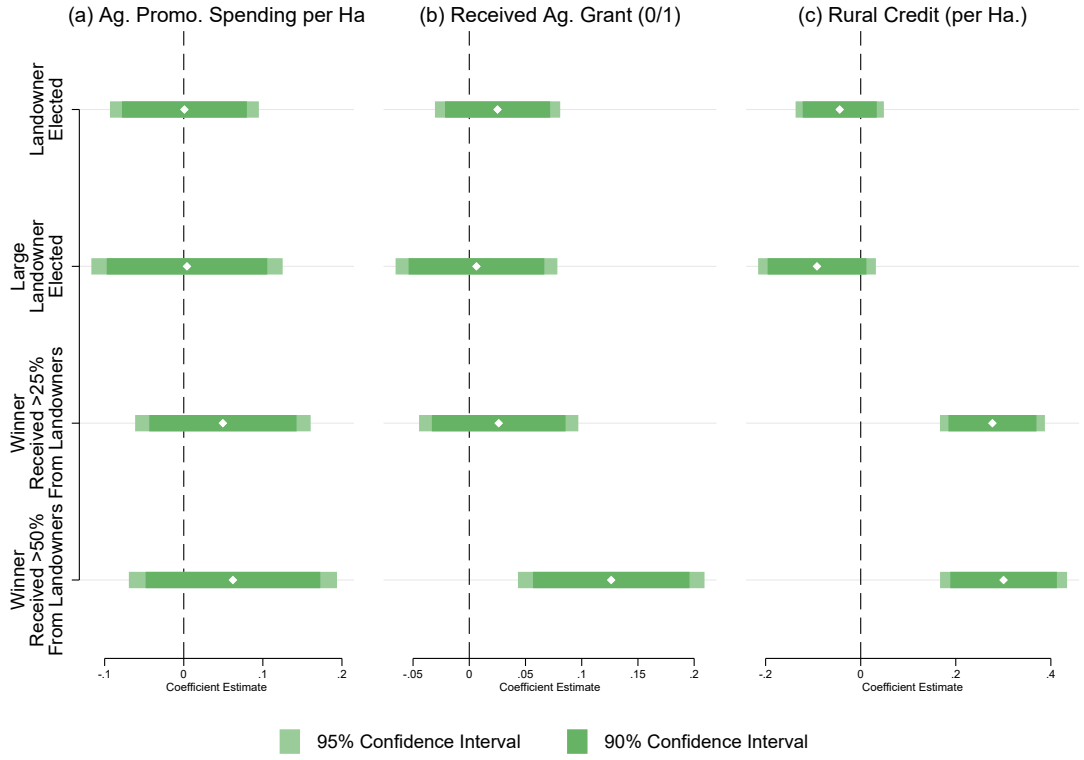
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies: (i) landholder in office, (ii) large landholder ($\geq$ 500 ha.) in office, (iii) mayor who received $\geq$ 25% of their donations from landholders in office, and (iv) 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 the municipality level. Sample is panel of all municipality-election periods (2001-2005 through 2016-2019) in Mato Grosso, Pará, and Rondônia where win-margin between winner and runner-up mayor was $\geq$ 5%. Left figure reports estimated effects on municipal spending on Agricultural Promotion per hectare; central figure reports estimated effects on an indicator for receiving 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 (asinh). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

Figure C47: Municipalities: Mato Grosso, Pará, and Rondônia (Land-Use)



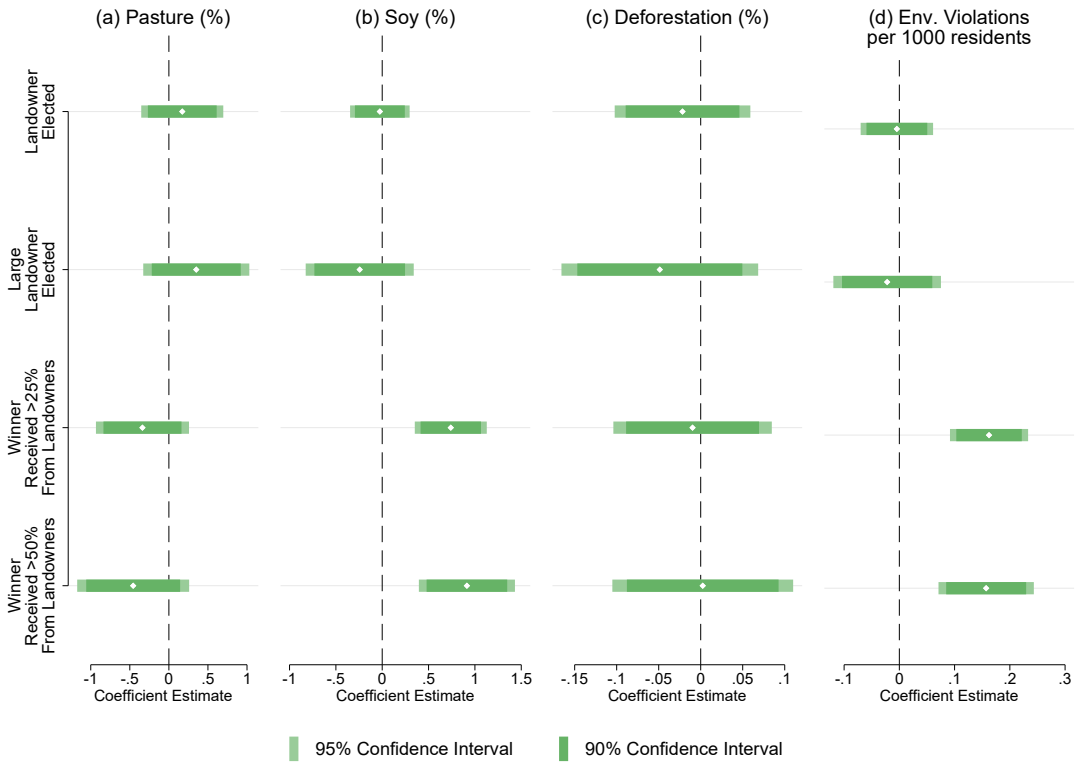
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% 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) in Mato Grosso, Pará, and Rondônia where win-margin between winner and runner-up mayor was $\geq$ 5%. Figures report, from left to right, estimated effects on pasture, soy, and deforestation as percentages of municipal area, and environmental violations (asinh) per 1,000 municipal residents.

Figure C48: Municipalities: Legal Amazon (Governance)



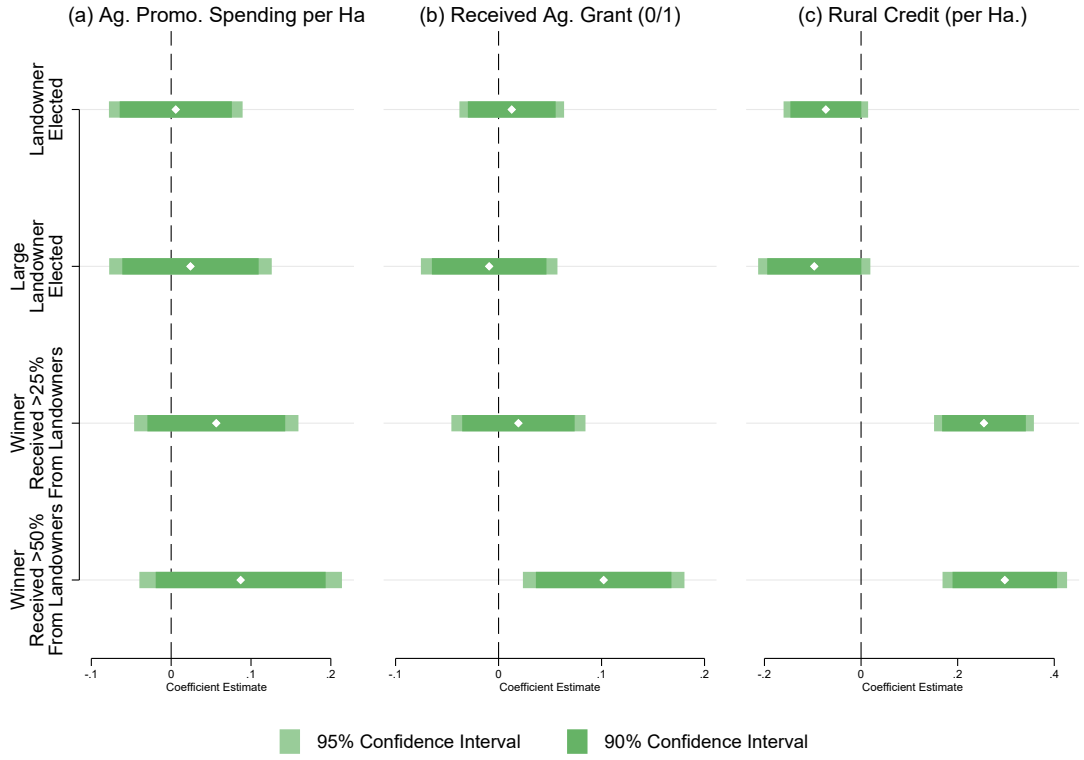
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies: (i) landholder in office, (ii) large landholder ($\geq$ 500 ha.) in office, (iii) mayor who received $\geq$ 25% of their donations from landholders in office, and (iv) 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 the municipality level. Sample is panel of all municipality-election periods (2001-2005 through 2016-2019) in the Legal Amazon where win-margin between winner and runner-up mayor was $\geq$ 5%. Left figure reports estimated effects on municipal spending on Agricultural Promotion per hectare; central figure reports estimated effects on an indicator for receiving 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 (asinh). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

Figure C49: Municipalities: Legal Amazon (Land-Use)



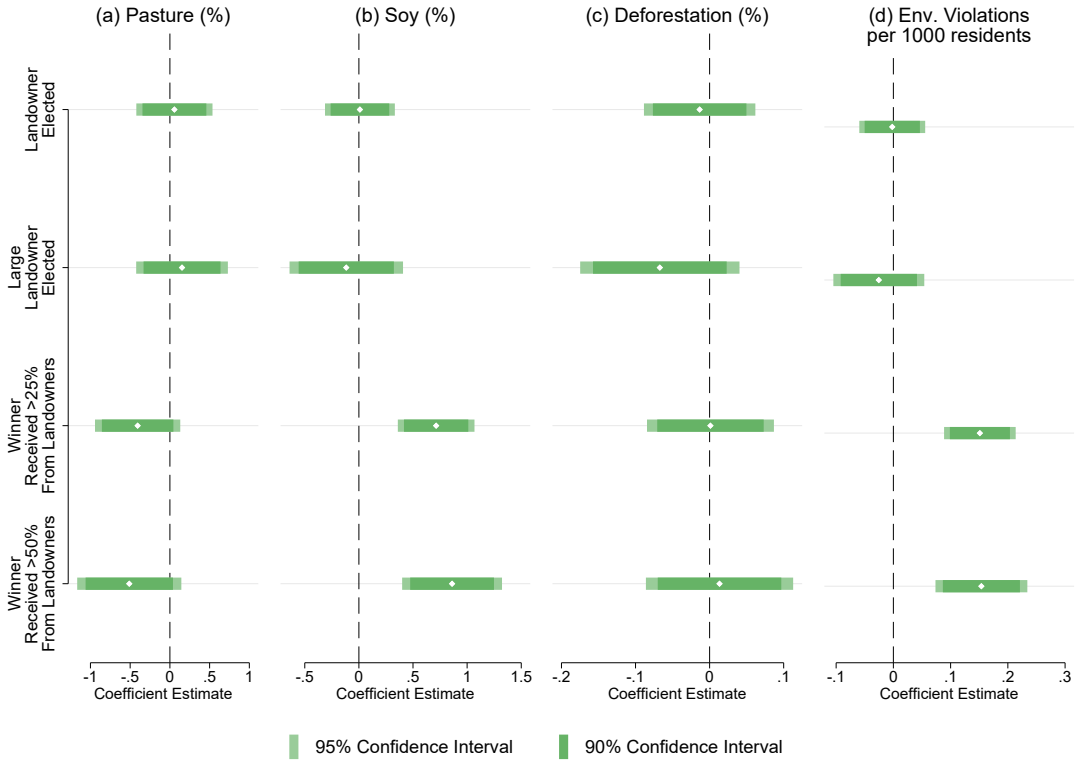
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% 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) in the Legal Amazon where win-margin between winner and runner-up mayor was $\geq$ 5%. Figures report, from left to right, estimated effects on pasture, soy, and deforestation as percentages of municipal area, and environmental violations (asinh) per 1,000 municipal residents.

Figure C50: Municipalities: Legal Amazon (Governance) (10% Close Election Cutoff)



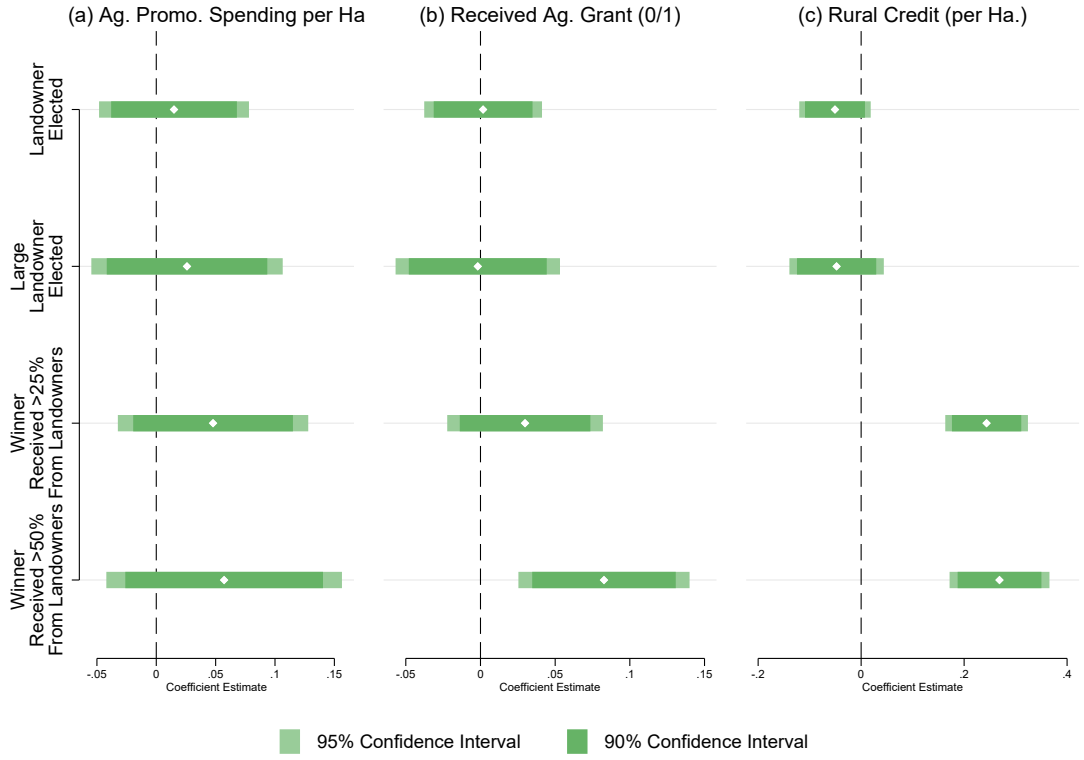
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies: (i) landholder in office, (ii) large landholder ($\geq$ 500 ha.) in office, (iii) mayor who received $\geq$ 25% of their donations from landholders in office, and (iv) 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 the municipality level. Sample is panel of all municipality-election periods (2001-2005 through 2016-2019) in the Legal Amazon where win-margin between winner and runner-up mayor was $\geq$ 10%. Left figure reports estimated effects on municipal spending on Agricultural Promotion per hectare; central figure reports estimated effects on an indicator for receiving 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 (asinh). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

Figure C51: Municipalities: Legal Amazon (Land-Use) (10% Close Election Cutoff)



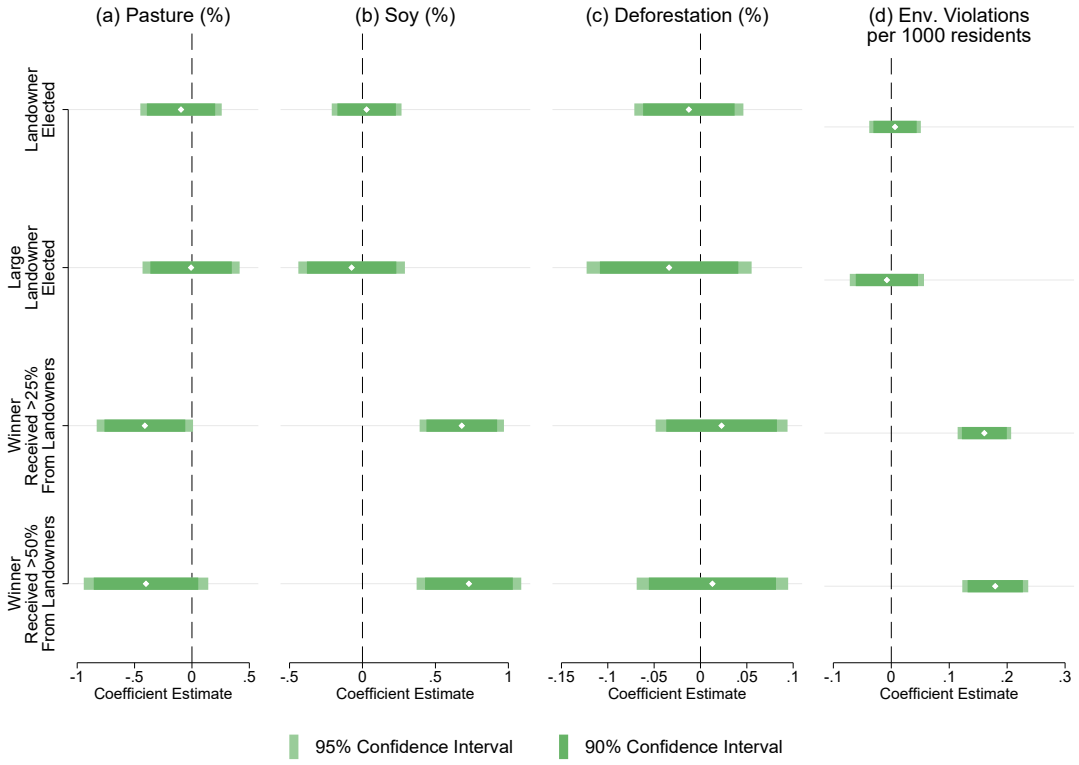
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% 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 the panel of municipality-election periods (2001-2005 through 2016-2019) in the Legal Amazon where win-margin between winner and runner-up mayor was $\geq$ 10%. Figures report, from left to right, estimated effects on pasture, soy, and deforestation as percentages of municipal area, and environmental violations (asinh) per 1,000 municipal residents.

Figure C52: Municipalities: Legal Amazon (Governance) (No Close Election Cutoff)



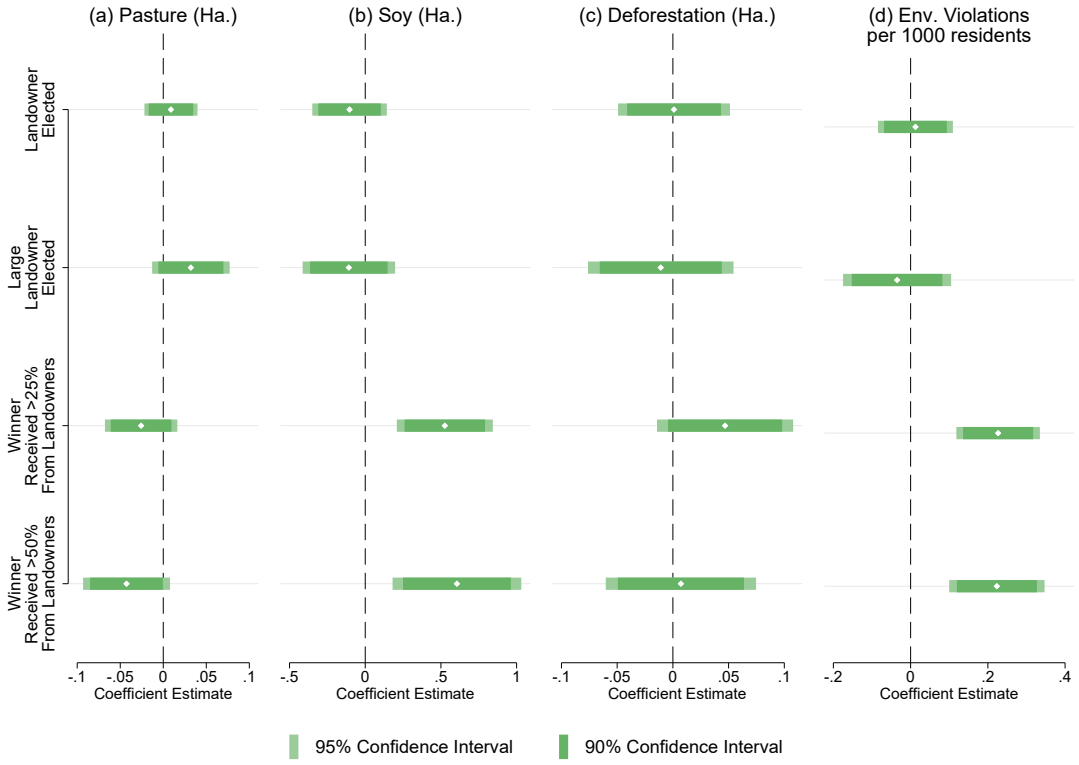
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality-election level treatment dummies: (i) landholder in office, (ii) large landholder ($\geq$ 500 ha.) in office, (iii) mayor who received $\geq$ 25% of their donations from landholders in office, and (iv) 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 the municipality level. Sample is panel of all municipality-election periods (2001-2005 through 2016-2019) in the Legal Amazon. Left figure reports estimated effects on municipal spending on Agricultural Promotion per hectare; central figure reports estimated effects on an indicator for receiving 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 (asinh). Monetary values are deflated to constant 2010 $BRL and transformed using inverse hyperbolic sine function.

Figure C53: Municipalities: Legal Amazon (Land-Use) (No Close Election Cutoff)



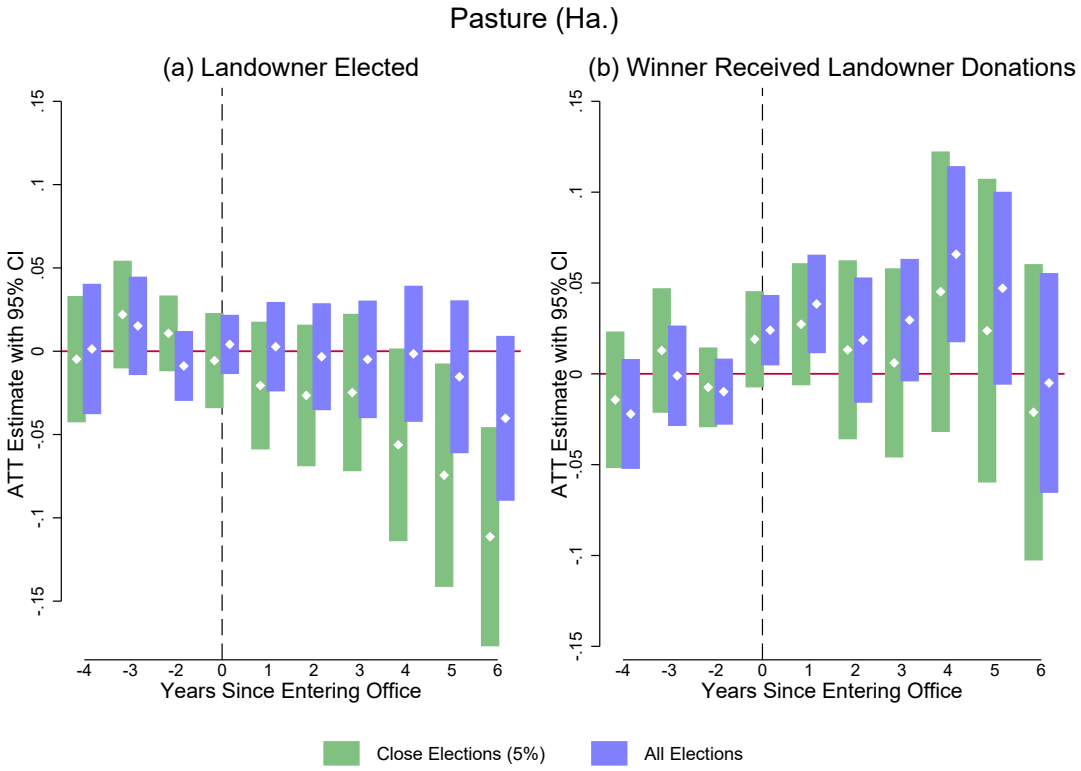
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% 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 the complete panel of municipality-election periods (2001-2005 through 2016-2019) in the Legal Amazon. Figures report, from left to right, estimated effects on pasture, soy, and deforestation as percentages of municipal area, and environmental violations (asinh) per 1,000 municipal residents.

Figure C54: Municipalities: Land-Use with asinh Transformation



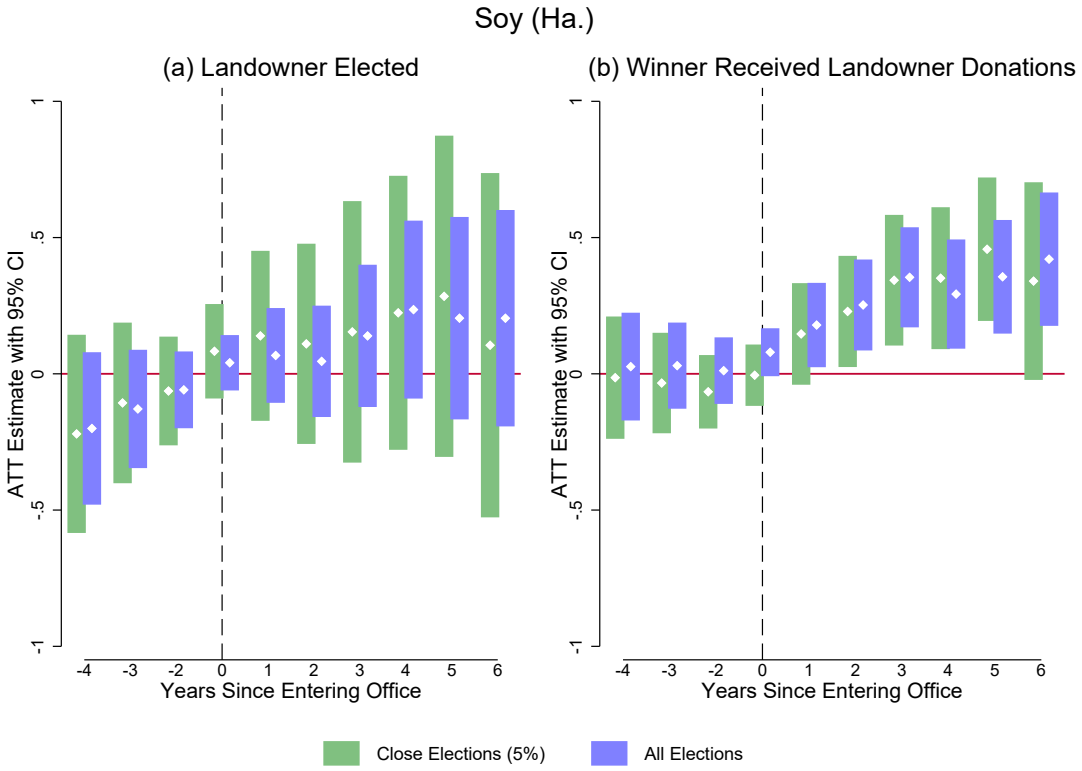
Note: Figures report coefficient estimates and 90 and 95% confidence intervals from regression of outcome on municipality election level treatment dummies (landholder in office, large landholder ($\geq$ 500 ha.) in office, mayor who received landholder donations in office, mayor who received $\geq$ 25% 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 $\geq$ 5%. Figures report, from left to right, estimated effects on pasture, soy, and deforestation with asinh transformation, and environmental violations (asinh) per 1,000 municipal residents.

Figure C55: Municipalities: Dynamic Effects of Landholder or Landholder-Financed (≥25%) Mayor on Pasture



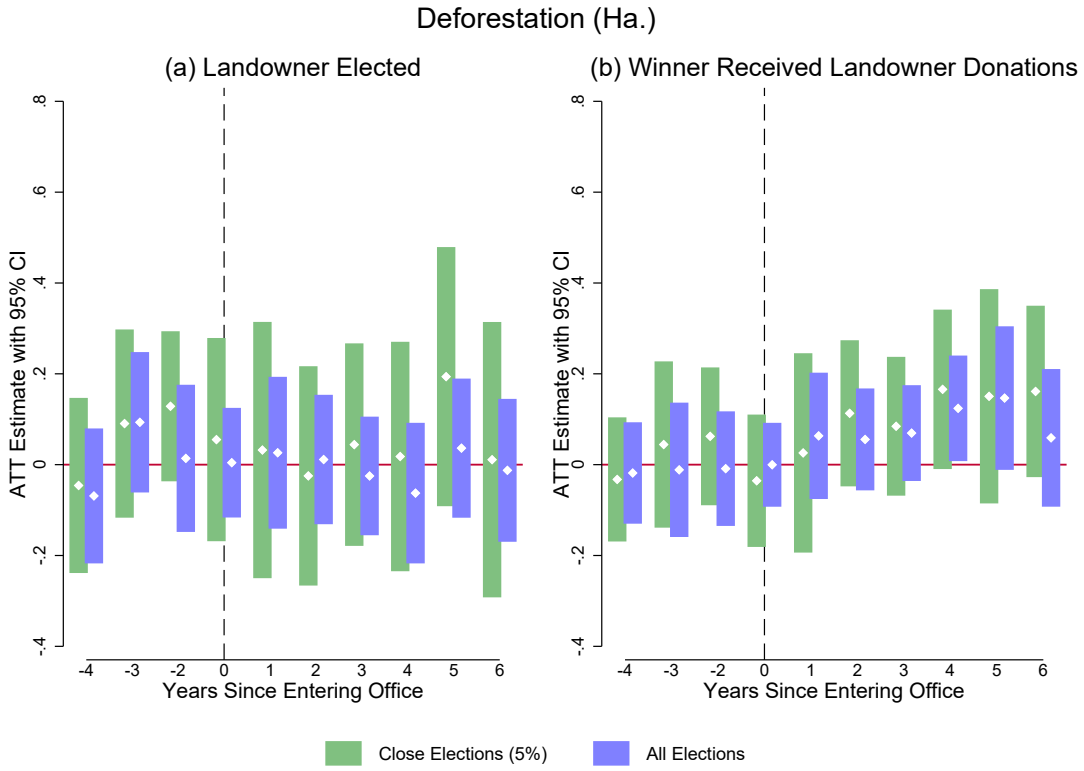
Note: Municipal-level event studies using annual panel data and the Callaway and Sant'Anna (2021) estimator. Sample is restricted to successful and runner-up mayoral candidates in close mayoral elections (≥5% win-margin) in green and to all elections in purple for municipalities located in the Brazilian Amazon biome. Municipality fixed effects, election fixed effects and candidate controls (sex and education level) are included and standard errors are clustered at the municipal level. Left sub-figure presents estimated dynamic effects of a landholder elected and right sub-figure presents the effect of a landholder-financed mayor elected (≥25% of their total donations). This approach faces the limitation of only estimating pre-trends and treatment effects the first time a municipality is treated, while in practice treatment turns on and off frequently within municipalities. The $t-1$ period is set as the base period.

Figure C56: Municipalities: Dynamic Effects of Landholder or Landholder-Financed (≥25%) Mayor on Soy



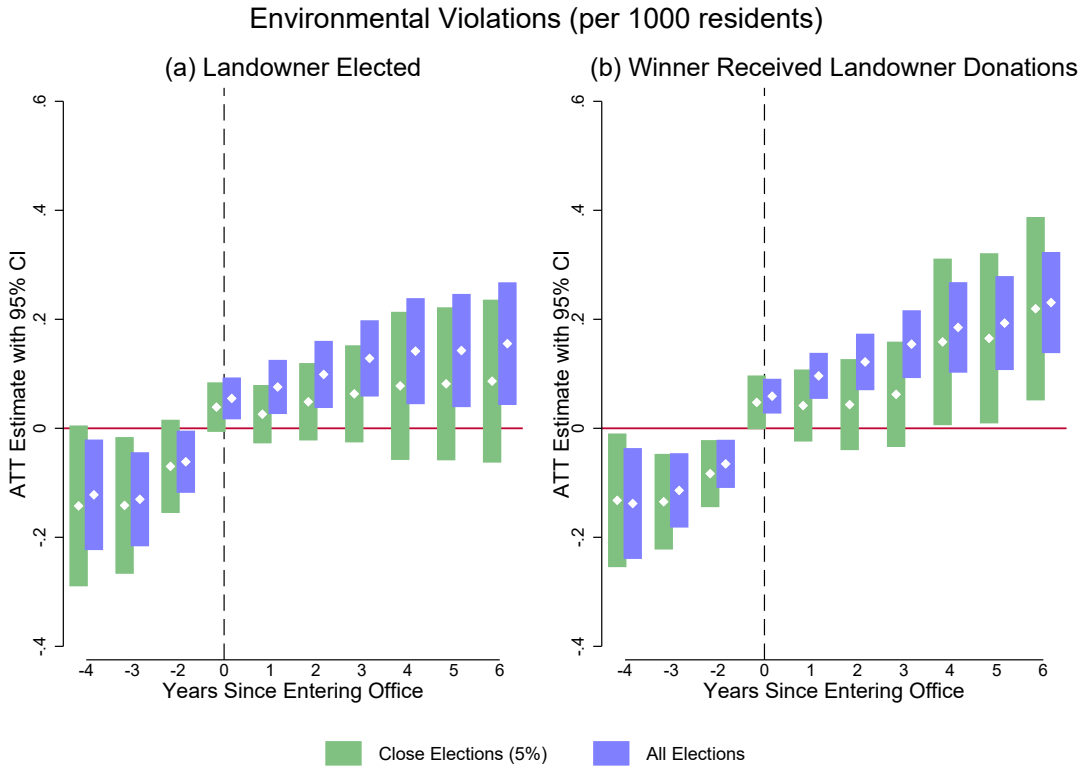
Note: Municipal-level event studies using annual panel data and the Callaway and Sant'Anna (2021) estimator. Sample is restricted to successful and runner-up mayoral candidates in close mayoral elections (≥5% win-margin) in green and to all elections in purple for municipalities located in the Brazilian Amazon biome. Municipality fixed effects, election fixed effects and candidate controls (sex and education level) are included and standard errors are clustered at the municipal level. Left sub-figure presents estimated dynamic effects of a landholder elected and right sub-figure presents the effect of a landholder-financed mayor elected (≥25% of their total donations). This approach faces the limitation of only estimating pre-trends and treatment effects the first time a municipality is treated, while in practice treatment turns on and off frequently within municipalities. The $t-1$ period is set as the base period.

Figure C57: Municipalities: Dynamic Effects of Landholder or Landholder-Financed (≥25%) Mayor on Deforestation



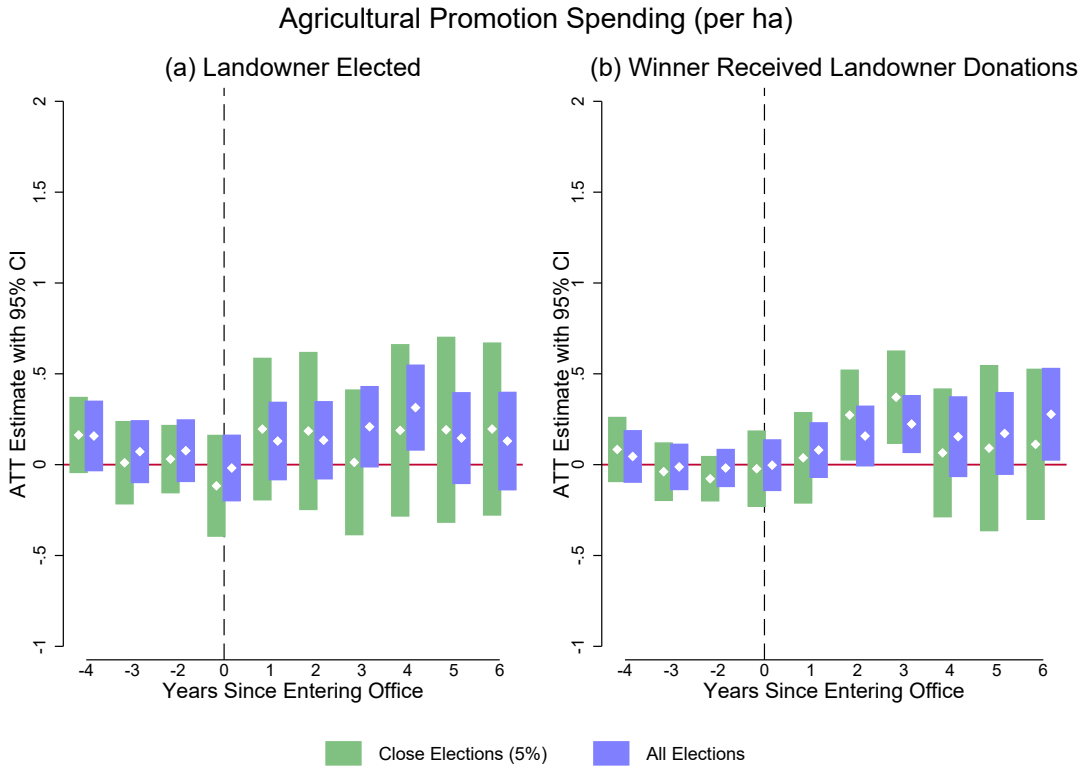
Note: Municipal-level event studies using annual panel data and the Callaway and Sant'Anna (2021) estimator. Sample is restricted to successful and runner-up mayoral candidates in close mayoral elections (≥5% win-margin) in green and to all elections in purple for municipalities located in the Brazilian Amazon biome. Municipality fixed effects, election fixed effects and candidate controls (sex and education level) are included and standard errors are clustered at the municipal level. Left sub-figure presents estimated dynamic effects of a landholder elected and right sub-figure presents the effect of a landholder-financed mayor elected (≥25% of their total donations). This approach faces the limitation of only estimating pre-trends and treatment effects the first time a municipality is treated, while in practice treatment turns on and off frequently within municipalities. The $t-1$ period is set as the base period.

Figure C58: Municipalities: Dynamic Effects of Landholder or Landholder-Financed (≥25%) Mayor on Environmental Violations



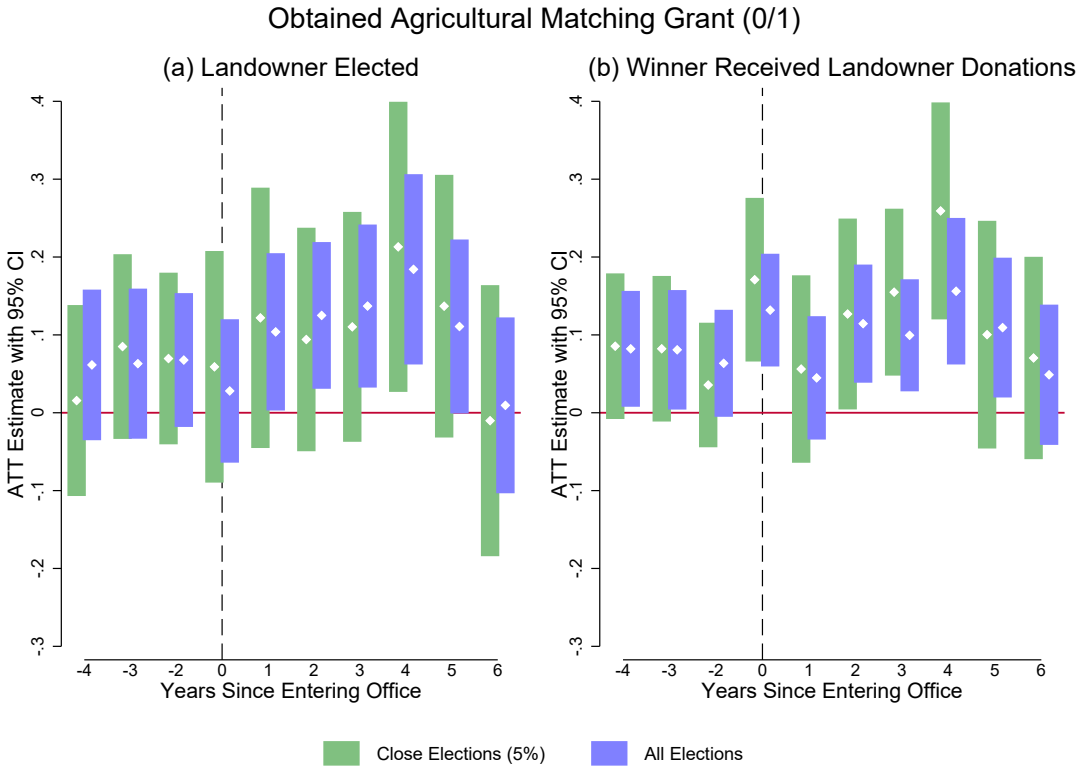
Note: Municipal-level event studies using annual panel data and the Callaway and Sant'Anna (2021) estimator. Sample is restricted to successful and runner-up mayoral candidates in close mayoral elections (≥5% win-margin) in green and to all elections in purple for municipalities located in the Brazilian Amazon biome. Municipality fixed effects, election fixed effects and candidate controls (sex and education level) are included and standard errors are clustered at the municipal level. Left sub-figure presents estimated dynamic effects of a landholder elected and right sub-figure presents the effect of a landholder-financed mayor elected (≥25% of their total donations). This approach faces the limitation of only estimating pre-trends and treatment effects the first time a municipality is treated, while in practice treatment turns on and off frequently within municipalities. The $t-1$ period is set as the base period.

Figure C59: Municipalities: Dynamic Effects of Landholder or Landholder-Financed (≥25%) Mayor on Agricultural Promotion Spending



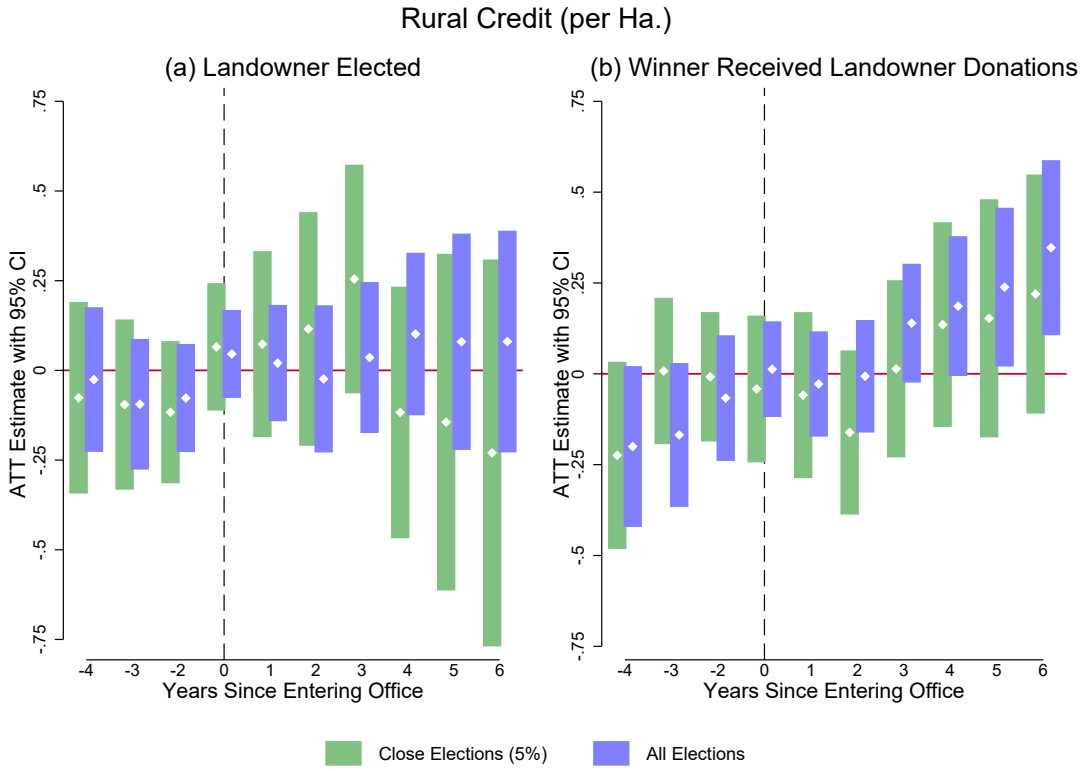
Note: Municipal-level event studies using annual panel data and the Callaway and Sant'Anna (2021) estimator. Sample is restricted to successful and runner-up mayoral candidates in close mayoral elections (≥5% win-margin) in green and to all elections in purple for municipalities located in the Brazilian Amazon biome. Municipality fixed effects, election fixed effects and candidate controls (sex and education level) are included and standard errors are clustered at the municipal level. Left sub-figure presents estimated dynamic effects of a landholder elected and right sub-figure presents the effect of a landholder-financed mayor elected (≥25% of their total donations). This approach faces the limitation of only estimating pre-trends and treatment effects the first time a municipality is treated, while in practice treatment turns on and off frequently within municipalities. The $t-1$ period is set as the base period.

Figure C60: Municipalities: Dynamic Effects of Landholder or Landholder-Financed (≥25%) Mayor on Agricultural Grants



Note: Municipal-level event studies using annual panel data and the Callaway and Sant'Anna (2021) estimator. Sample is restricted to successful and runner-up mayoral candidates in close mayoral elections (≥5% win-margin) in green and to all elections in purple for municipalities located in the Brazilian Amazon biome. Municipality fixed effects, election fixed effects and candidate controls (sex and education level) are included and standard errors are clustered at the municipal level. Left sub-figure presents estimated dynamic effects of a landholder elected and right sub-figure presents the effect of a landholder-financed mayor elected (≥25% of their total donations). This approach faces the limitation of only estimating pre-trends and treatment effects the first time a municipality is treated, while in practice treatment turns on and off frequently within municipalities. The $t-1$ period is set as the base period.

Figure C61: Municipalities: Dynamic Effects of Landholder or Landholder-Financed (≥25%) Mayor on Rural Credit



Note: Municipal-level event studies using annual panel data and the Callaway and Sant'Anna (2021) estimator. Sample is restricted to successful and runner-up mayoral candidates in close mayoral elections (≥5% win-margin) in green and to all elections in purple for municipalities located in the Brazilian Amazon biome. Municipality fixed effects, election fixed effects and candidate controls (sex and education level) are included and standard errors are clustered at the municipal level. Left sub-figure presents estimated dynamic effects of a landholder elected and right sub-figure presents the effect of a landholder-financed mayor elected (≥25% of their total donations). This approach faces the limitation of only estimating pre-trends and treatment effects the first time a municipality is treated, while in practice treatment turns on and off frequently within municipalities. The $t-1$ period is set as the base period.