Bureaucratic Packing in the Brazilian Amazon: How Political Competition Drives Deforestation

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What accounts for subnational variation in deforestation in the Brazilian Amazon? Using satellite imagery data and a novel shift-share instrumental variable design, I explore how local political competition explains this variation. I show that electoral competition causally increases deforestation, especially in the presence of more private commercial interests that deforest. I argue that competition encourages mayors to pursue the strategic non-enforcement of environmental standards to cater to such interests. Drawing on qualitative interviews and administrative data on bureaucratic appointments, I show that to achieve this end, mayors use a strategy I term bureaucratic packing, a surge in appointments of new personnel to bypass existing personnel who may not aid the mayor's agenda. In contrast to existing theories on the use of appointments for rewarding patrons, the analysis spotlights bureaucratic packing as an understudied strategy used to weaken regulatory capacity. Political competition generates incentives for undermining bureaucratic capacity to allow deforestation.

Global deforestation, a threat to biodiversity and a driver of climate change, results from the overextraction of timber and the excessive conversion of forest to agricultural land. Much of the literature on the causes of deforestation places a heavy emphasis on market-based mechanisms with little regard for the role of politics in curbing deforestation. Although the tragedy of commons and the role of communal institutions in preventing it has been a key concept in Political Science (see Ostrom 1990), the political incentives behind such environmental degradation have received limited attention. Despite the large literature on the impact of specific environmental policies, there is a much more limited literature on the political institutions that shape environmental protection. Can institutions explain patterns in managing the environment? Why do some local jurisdictions see rapid deforestation, while others nearby effectively avoid such environmental degradation?

In this article, I examine the ways in which the institution of local political competition, in particular, affects deforestation in Brazil, which houses the largest remaining tract of tropical rainforest in the world. I argue that high levels of political competition pressure local politicians to forsake forest cover in the Amazon to cater to private commercial interests that profit from deforestation. Beyond this claim, which is consistent with existing theory, the focus of the article is on delineating the consequences of these political incentives. Specifically, I argue that competitive elections encourage mayors to pursue the strategic nonenforcement of environmental standards. Drawing on qualitative evidence from semistructured interviews, I illustrate the ways in which in their efforts to weaken enforcement, mayors engage in bureaucratic packing, a surge in appointments of new municipal personnel who are partial to the mayor's agenda. As a strategy, bureaucratic packing allows the mayor's cabinet to bypass working with long-serving bureaucrats or to relax enforcement directly through the appointment of new leadership. Such bouts of bureaucratic expansion, therefore, undermine the role of existing personnel in municipal and state secretariats. Using the example of deforestation in the Brazilian Amazon, the argument illustrates the ways in which local political competition, in encouraging forbearance in the enforcement of regulatory standards, in turn, generates incentives to weaken bureaucratic capacity.

Using satellite-based spatial deforestation data for the 783 municipalities in the Brazilian Amazon between the

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years 2000 and 2012, I test the theory by systematically examining the effects of local political competition on subnational patterns of deforestation. I estimate panel regressions with municipal- and state-year fixed effects, conducting a placebo test that confirms the causality of the effects: Competitive elections predict more deforestation, and not vice versa. To further confirm the causality of the effect, I adapt a novel strategy proposed by Shaukat (2019) for causally estimating the effects of municipal political competition to a setting of coalitional party structures that characterizes subnational politics in Brazil. Specifically, I construct a shift-share instrumental variable (SSIV) for political competition in municipal elections, using the competitiveness of elections at higher levels of government as the "shifts."

Contrary to accountability models of competitive elections, I first find that political competition causally increases the rate of deforestation in Brazilian municipalities. I then show that this positive effect of political competition on deforestation is magnified in municipalities with more private agricultural organizations. Next, I show that prominent alternative explanations for deforestation, such as municipal economic development, the expansion of road infrastructure, and the level of land inequality cannot explain the results. Moreover, the results hold even in models accounting for the mayor's or state governor's partisanship, suggesting that political alignment across levels of government are not driving the results. Lastly, I demonstrate that federal monitoring of local governments and policies, such as the environmental embargo (Institute of Environment and Renewable Natural Resources [IBAMA]) program, the Protected Areas program, and the Priority Municipalities monitoring program, cannot explain the results. A core implication of this study is that democratic institutions can be double-edged in their effects. Political competition is often valued for how the institution improves economic growth (Acemoglu et al. 2019; Gerring et al. 2005; Pinto and Timmons 2005) and public goods provision (Hecock 2006; Stasavage 2005). Yet, this study demonstrates that political competition can also weaken incentives for pursuing longer term policy goals, such as environmental preservation.

The idea that competitive elections may cultivate perverse political incentives is not a new one. A growing literature argues that political competition in developing democracies can induce pork barrel politics, clientelism, and corruption (Calvo and Murillo 2012; Grzymala-Busse 2007; Herrera 2017; Kitschelt and Wilkinson 2007; Min 2015; Post 2014; Weitz-Shapiro 2014); reduce the efficiency of legislative bargaining (Gottlieb and Kosec 2019); or induce patronage politics (Pierskalla and Sacks 2020). I build on this literature and, instead, illustrate a different consequence: bureaucratic packing. While rent-seeking and patronage may be simultaneously at play, I argue that competitive elections incentivize politicians to also make mass bureaucratic appointments for the purpose of undermining enforcement capacity and bypassing existing bureaucratic procedures. Bureaucratic appointments are, therefore, often not used as an end in itself to reward one's patrons but rather as a means to an end. Politicians engage in packing especially when removing existing personnel proves difficult.[1] I illustrate this mechanism using qualitative evidence from semistructured interviews. To test the mechanism systematically, I calculate measures of the timing of municipal bureaucratic appointments using a comprehensive data set of public employment labor contracts available from Brazil's Ministry of Labor and Employment. The analysis confirms that political competition results in a surge in the appointment of new municipal personnel within 12 months after a competitive election, and such packing is, in turn, associated with an increase in deforestation.

This article contributes to the growing literature on the politics of deforestation and its emphasis on the role of the subnational political context (Alcañiz and Gutierrez 2020; Baragwanath and Bayi 2020; Bates 1979; Boone 2014; Buntaine, Hamilton, and Millones 2015; Burgess et al. 2012; Cooperman 2022, 2024; Gulzar, Lal, and Pasquale 2024; Herrera 2017; Mangonnet, Kopas, and Urpelainen 2022; Martínez-Álvarez 2022; Milmanda and Garay 2019; Morjaria 2012; Pailler 2018; Slough, Kopas, and Urpelainen 2021; Slough et al. 2021) as well as that on the relationship between regime type and environmental protection (Aklin and Urpelainen 2013; Bayer, Urpelainen, and Xu 2014, 2016; Bernauer and Koubi 2009; Li and Reuveny 2006; Midlarsky 1998; Klopp 2012; Sanford 2021). It also builds on the growing literature on the contradictory effects of political competition (Arce and Mangonnet 2012; Brierley 2021; Gottlieb and Kosec 2019; Huber and Ting 2021; Pierskalla and Sacks 2020) and the political incentives behind bureaucratic appointments (see, for example, Brierley 2021; Dahlström and Lapuente 2017; Gulzar and Pasquale 2017; Hassan 2020; Huber and Ting 2021; Oliveros 2021; Oliveros and Schuster 2018).

The article makes several contributions to these existing literatures. First, whereas existing work presents contradictory evidence on whether democracy at the country-level is positively or negatively correlated with the environment, this study makes an empirical contribution in causally estimating

1. Thus, bureaucratic packing is distinct from turnover within the bureaucracy. I find that competitive elections are not associated with bureaucratic dismissals. A key theoretical insight is that when a politician cannot dismiss existing personnel, they grow the bureaucracy to secure more control over it.

the effects of a democratic institution. In doing so, it addresses some of the methodological challenges that plague the literature, foregrounding an estimation strategy for confirming the causality of the effect of democratic elections. Second, this article spotlights a previously overlooked strategy of bureaucratic appointments. Research on patronage politics highlights how bureaucratic weakness is an unintended consequence of when politicians use new appointments to reward individuals for their electoral support. In contrast, this article illustrates the concept of bureaucratic packing, the use of new appointments with the intention to undermine bureaucratic capacity, as an understudied strategy in the literature. Existing theories also point to the ways in which bureaucratic capture by vested private interests directly compromises bureaucratic capacity. I illustrate that even without bureaucratic capture, subnational executives can circumvent existing bureaucrats through a process of bureaucratic expansion. Finally, this study also makes a theoretical contribution: It demonstrates that political competition can generate incentives to weaken bureaucratic capacity. The findings reveal how the same political institution that democratic theorists view as being critical for public goods and service delivery also induces environmental degradation through the weakening of regulatory capacity.

DEFORESTATION IN THE BRAZILIAN AMAZON

Between 1970 and 2010, approximately 18% of the Brazilian Amazon was deforested. After the administration of Luiz Inácio Lula da Silva (2003–2011) implemented a series of federal policies for protecting the Amazon, the country experienced a dramatic decline in deforestation since 2004. However, federal policy cannot explain the extensive variation in deforestation within the country during this period. As shown in figure 1, there is considerable variation in the pace and extent of deforestation across municipalities within even the same regions in the Amazon. In the state of Pará, the municipality of Paragominas fared much better in conservation (i.e., 54.7 percentage points in cumulative deforestation by 2012) in a sea of municipalities with extensive forest degradation (i.e., 72.4 percentage points per municipality on average for the region). In a similar vein, within the state of Maranhão, the municipalities of Centro Novo do Maranhão and of Amarante do Maranhão both have venerable track records of conservation. Total cumulative deforestation by the year 2012 for Centro Novo do Maranhão and Amarante do Maranhão was 35.4 and 37.8 percentage points, respectively, in comparison to an average of 67 percentage points across other municipalities in the state.

Deforestation in the Amazon is largely driven by two different dimensions of the region's industrial agricultural economy: the development of large-scale soya monocultures and of pastures for cattle ranching. In addition, in recent

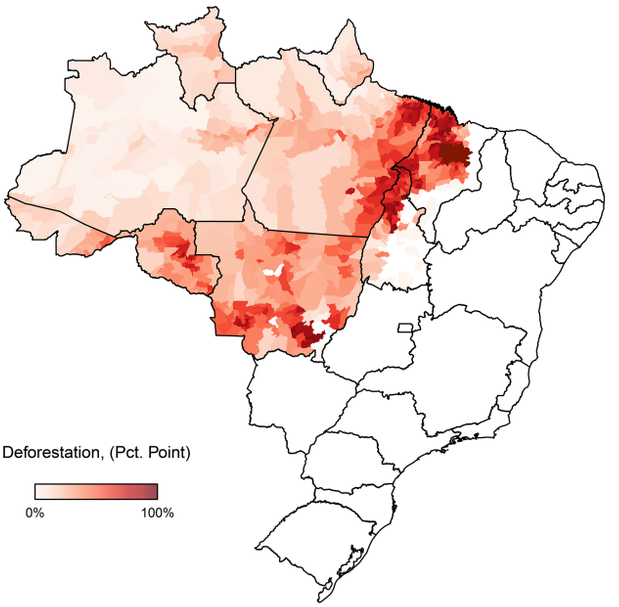

Figure 1. This map shows the spatial distribution of cumulative percent deforested area by 2012.

years, the exploitation of timber has also contributed substantially to deforestation in certain states, such as Mato Grosso. Since 2006, however, various federal initiatives, such as the creation of Protected Areas and of federal credit barriers, have worked to curb deforestation. However, even when controlling for these initiatives, we still see considerable variation in local deforestation.

As one of the most decentralized countries in the world, Brazil provides an ideal setting for examining the role of local institutions. The 1988 Brazilian Constitution granted municipalities permission to act in relation to the environment. The mayor and the leadership within municipal secretariats, in particular, have considerable discretion in the extent to which regulation on the limits to timber extraction and forest-clearing get enforced.

THEORY: LOCAL POLITICAL COMPETITION AND DEFORESTATION

There is a growing literature in political economy that examines the politics behind environmental management. A major focus of this literature is on how regime type, especially democratic rule, affects environmental protection. On the one hand, a set of studies demonstrates that democratic regimes are positively associated with environmental protection (see, for example, Bernauer and Koubi 2009; Li and Reuveny 2006). On the other hand, there is also ample evidence that democratic institutions have largely a negative correlation with various environmental indicators, including deforestation (Midlarsky 1998; Sanford 2021). Case study analyses of Kenya find

that the introduction of multiparty elections in the country corresponded to annual loss of closed-canopy forest cover, and this trend was most pronounced in swing districts (Klopp 2012; Morjaria 2012). Similarly, in their study of Indonesia, Burgess et al. (2012) find evidence of electoral logging cycles, in which deforestation rates are higher in election years. This second set of studies aligns with authors who have made the observation that politicians facing competitive elections forsake protected forests in exchange for votes (Bates 1979; Boone 2014; Sanford 2021).

Drawing on existing theories of electoral competition and qualitative evidence from semistructured interviews, I build on this literature by exploring the exact ways in which local competitive elections affect deforestation in the Brazilian Amazon. Political competition increases the mayor's perceived risk of being voted out of office in the next election. Competitive elections, therefore, often create shortsighted politicians who strive to maximize their immediate chances for reelection, competing with political opponents to exploit opportunities that provide short-term returns. As a result, mayors with such shortened time horizons are more prone to succumb to the demands of powerful vested interests (Avelino, Brown, and Hunter 2005; Grossman and Helpman 1994; Huber 1996; Meso-Lago 1978; Stokes 2015; Weyland 1996). Across municipalities in the Brazilian Amazon, commercial agricultural interests often provide political candidates with various short-term returns using their financial leverage. They invest in political advertisements in favor of specific candidates or use their financial resources to control the local media directly. Consistent with existing theory, I argue that local political competition pressures mayors of the Amazon to cater to such private commercial interests that profit from deforestation at the expense of long-term conservation goals.

Specifically, I argue that to achieve this end, mayors respond to competitive electoral environments by engaging in the strategic nonenforcement of environmental standards. As Brazil's former Minister of the Environment Carlos Minc noted in 2008, the mayoral post is the source of "ignoring illegal loggers."[2] To give an example, local politicians may have incentives to forbear on the issuance of authorizations for the use of equipment and personnel essential for the environmental monitoring process. In his interview, the Head (*Chefe*) of Environmental Control at the Municipal Secretariat for the Environment (SEMMA) in the Amazonian municipality of Santarém relays his experience with such behavior: "My work is more vulnerable to political interests. With environmental monitoring, I need structured logistics: authorization for use of vehicles, boats, tools, and manpower to conduct this monitoring, because Santarém is a big municipality with very mixed terrain. There are many steps and many authorizations needed, but people in this very office can deny these authorizations. It is a political problem that affects my work."[3]

Holland (2017) illustrates her concept of forbearance, the intentional nonenforcement of laws, as a strategy for politicians to informally redistribute to the poor to win their votes. However, as she observes, politicians can also engage in a form of regressive forbearance that benefits those at the upper tranches of the income distribution. Holland (2017) finds that especially in poorer districts, mayors actively choose not to sanction illegal street vending and squatting to benefit the poor. In a similar vein, I expect that in municipalities with a greater presence of private commercial interests that defoest, mayors reduce the enforcement of environmental standards.[4] In this first step of the theoretical exposition, I argue that political competition encourages such forms of regressive forbearance (i.e., increases the rate of deforestation), and the presence of private commercial interests magnifies this effect.

H1. Local political competition increases the rate of deforestation.

H2. The effect of political competition on deforestation is larger in municipalities with more private commercial establishments that deforest.

I clarify that a key scope condition of the argument is that environmental monitoring is a low visibility issue area. I assume that political competition encourages politicians to focus on vested economic interests, especially under conditions of low political visibility. The median voter in the Amazon, even those employed in agriculture, is attuned to the need for sustainable rates of forest clearing.[5] However, the protection of forest resources is a form of public welfare

2. See "Brazilian Government Faces Criminal Charges Over Amazon Deforestation," *The Guardian*, September 30, 2008.

3. Author interview with Mr. Heiby da Costa Sarrazin, *Chefe do Controle Ambiental*, *Secretaria Municipal de Meio Ambiente de Santarém*, Santarém, Brazil on July 19, 2023.

4. This behavior takes two forms: choosing not to enforce the law (i.e., forbearance) and issuing more environmental licenses that allow pollution, contamination, and deforestation. Therefore, besides engaging in forbearance, local politicians can also "legalize illegal behavior" (see Milmanda and Garay 2019) through the issuance of licenses.

5. See appendix A4 for analysis of median voter preferences.

that exhibits low political visibility. I define political visibility as both the degree to which a policy is tangibly (e.g., physically) observable by voters and the extent to which provision can signal a political commitment by a specific political party or candidate. As an interviewed Coordinator of Environmental Planning in the State Department explained, "The problem with environmental preservation is that it's not a visible issue compared to other forms of welfare, such as education or health. People can't see and monitor it. We are invisible, in a castle . . . and because of this, the Environmental Secretariat is seen as a coin for exchanging political favors."[6] The act of providing public goods, especially of infrastructural public goods, is one that is highly visible to the recipient constituency (Mani and Mukand 2007).[7] In contrast, localities are naturally endowed with the commons. Relative to the political returns of provision, the protection of the commons exhibits a much lower level of political visibility.

Because managing the commons is not a politically visible issue area, the median resident is rarely in a position to hold politicians accountable. Instead, the onus for monitoring deforestation rests on municipal and state secretariats that issue environmental licenses and closely assess adherence to these standards. I highlight that these local regulatory agencies play a critical role, in that they are the main accountability mechanism that monitors deforestation. How can politicians pursue strategic nonenforcement in the presence of these monitoring agencies? Politicians cannot easily circumvent these institutions and procedures that have been in place since before their mandate. In addition, for such an ideological issue area, politicians also struggle to convince the long-standing "activist" bureaucrat to relax enforcement standards.[8]

To overcome these barriers, Brazilian mayors engage in a strategy I term bureaucratic packing, the mass appointment of new personnel to bureaucratic agencies for the purpose of weakening enforcement.[9] Such occasions of bureaucratic expansion weaken regulatory capacity through two channels: (1) It dilutes the authority of each preexisting personnel, and (2) it provides a supply of new public servants who are amenable to regulatory forbearance. Newly appointed personnel can directly delay enforcement or force nonenforcement, even when long-serving public servants prove unwilling to aid these efforts. Mayors recognize that there are legal and procedural difficulties with dismissing existing bureaucrats.[10] As a strategy, bureaucratic packing therefore enables politicians to circumvent existing personnel who may not be as acquiescent to their agenda. As the Head of Strategic Planning at SEMMA of the municipality of Belém explains, "These appointments are usually associated with licensing and contract renewal [with private firms]. They were appointed to get the approval of some specific contracts or licenses. In some cases, they work in a way that make the 'old managers' renew the contracts even if it was against their will."[11] A different interviewee from a neighboring municipality in the Amazon details a similar experience: "Those newly appointed to the supervising roles, they wanted to issue some of the licenses immediately. They wanted to take care of it in the moment of instead of going through the right procedures. Some of the 'old' supervisors felt really uncomfortable, but they were powerless in this situation . . ."[12]

In fact, politicians engage in bureaucratic packing especially when removing existing personnel proves difficult. A key theoretical insight from the qualitative evidence is that when politicians cannot dismiss or "capture" the bureaucracy, they instead weaken the agency by expanding it. Such shifts in bureaucratic structure disrupt the institutionalization of the formal and informal procedures behind municipal regulatory politics. Through bureaucratic expansion, the mayor is in a better position to forestall authorizations for environmental monitoring. She is also better equipped with personnel to push through environmental licenses and contracts on commercial projects that would not have been approved as quickly or approved at all. "We cannot deny the upsurge in environmental licensing around an election year," observes one interviewed public servant. "When the mayor faces a tough opposition, licenses get approved."[13] In the context of municipalities in the Amazon, a consequence of this pattern is increased deforestation.

6. Author interview with Teresa Castilho Mansor, *Coordenadoria de Planejamento Ambiental, Secretária de Estado do Meio Ambiente*, on June 29, 2016.

7. The visibility of public goods and services also depends on whether its provision reduces spatial externalities (Xu 2024).

8. The majority of interviewed local personnel have a strong personal stance toward environmental preservation and are often activists themselves. See also Abers (2019) on the concept of "bureaucratic activism" in Brazil.

9. Insights from author interviews conducted with local personnel working at SEMMA in Santarém, Belém, Manaus, and other municipalities in the Brazilian Amazon.

10. Empirically, I also confirm that political competition does not affect bureaucratic dismissals.

11. Author interview with Sr. Pedro Neves de Castro, *Chefe do Núcleo Setorial de Planejamento Estratégico*, SEMMA, Belém, Brasil on July 28, 2023.

12. Author interview with Anonymous, *Chefe do Controle Ambiental* (Head of Environmental Control), SEMMA in a Brazilian municipality, in July 2023.

13. Author interview with Ana Cristina Pasini da Costa at *Companhia Ambiental do Estado de São Paulo* (CETESB) on June 27, 2016.

Critically, patterns in the competitiveness of elections determine when local politicians engage in such behavior. The "insurance" view in the bureaucratic politics literature claims that politicians will undertake civil service reform when they face electoral uncertainty (Besley and Persson 2011; De Figueiredo 2002; Huber and Ting 2021; Ting et al. 2013). In this framework, uncertainty in elections encourages incumbents to build "good" bureaucracies as a way to "insure" programmatic policy choices in the event they are voted out of office. In contrast, this study illustrates how electoral uncertainty, instead, generates incentives to weaken the civil service system.[14] Electoral uncertainty from competitive elections shortens the mayor's time horizon, encouraging reduced valuation of forest conservation and other long-term benefits of environmental monitoring. Politicians facing high levels of competition are also more vulnerable to the demands of influential vested interests (Avelino et al. 2005; Grossman and Helpman 1994; Huber 1996; Meso-Lago 1978; Stokes 2015; Weyland 1996), as discussed previously. This combination—that is, shortened time horizons and the political clout of special interests—provides the incentives for deforestation.

Bureaucratic packing is therefore not an end in itself but rather a means to achieving this end of allowing deforestation. The need for bureaucratic weakness then becomes an ancillary consequence. The central argument I advance is that political competition, in particular, generates incentives to undermine bureaucratic capacity. In the Amazonian municipality of Santarém, highly contested elections in 2012 and in 2016 were followed by a surge in bureaucratic appointments within the municipal environmental secretariat (i.e., SEMMA). As Head of the Division of Environmental Control of SEMMA of the municipality explains, "60% of the bureaucracy changed" because of the new hires. "The number of new hires in our agency has increased three-fold. We used to have 7 supervisors, and now we have 21." In contrast, there has been minimal new appointments within the bureaucracy during the current administration after an "easy" electoral win for the mayor in the last election.[15] Thus, while electorally safe subnational executives tend to refrain from exercising this discretionary power, mayors facing electoral uncertainty have incentives to pack municipal secretariats in their efforts to weaken them.

I highlight that the appointment of top-level personnel in particular is a common form of bureaucratic packing. "All the higher up positions are appointed by the mayor," explains Mr. Brito, the Head of the Registration and Licensing Division of SEMMA in Belém. "In addition, the *Vereadores* (city councilors) usually indicate to the mayor some preferred appointments too. The Secretary [of SEMMA], who is usually appointed by the mayor, also appoints a number of positions. So the elections can influence the appointment of people at all levels . . ." These top-level appointments can even change the agencies' overall stance toward environmental conservation. An interviewee gave a particular example. "When we were working on a ruling for regulating land waste policy, our office received a call from the new secretary to drop the project . . . It was an article of the law that we had been working on for years, but we just crossed it off. His first day in office . . . one phone call, and we dropped the project. It was delayed for five years."[16] My interviewee went on to explain that the new secretary, overall, pursued a stance of regulatory forbearance. Her team increasingly struggled to withstand his efforts as the agency expanded in size.

Existing studies on patronage politics illustrate that politicians make civil service appointments for two purposes: either to reward political patrons or to exchange these positions for political services (e.g., campaigning, mobilizing voters) down the road (see, for example, Brierley 2021; Oliveros 2021; Pierskalla and Sacks 2020). I argue that politicians also make mass appointments of new personnel with the purpose of weakening the capacity of these bureaucratic structures to function as a regulatory institution. In addition, the literature on bureaucratic capture emphasizes the ways in which private vested interests can corrupt existing bureaucrats to achieve economic ends. Alternatively, I argue that even when existing personnel cannot be corrupted, they can be circumvented through a process of bureaucratic expansion. In municipalities across the Brazilian Amazon, mayors concerned with winning the margins are pressured to pursue regulatory forbearance of the enforcement of environmental standards as a means to cater to vested interests. Competitive elections, in turn, encourage bureaucratic packing as a strategy to undermine regulatory capacity. The hypotheses are therefore as follows.

H3. Local political competition increases the appointment of new personnel in municipal secretariats.

14. The argument, therefore, aligns with the "investment" model of bureaucratic politics, which finds that electoral uncertainty reduces civil service reform. Politicians invest in reform only when they are electorally secure (Acemoglu, Ticchi, and Vindigni, 2011; Besley and Persson, 2010). However, this study goes beyond observing that electoral uncertainty discourages such investment. It demonstrates such uncertainty actively encourages perverse behavior that weakens these regulatory agencies.

15. Author interview with Mr. Heiby da Costa Sarrazin, *Chefe do Controle Ambiental*, *Secretaria Municipal de Meio Ambiente de Santarém*, Santarém, Brazil on July 19, 2023.

16. Author interview with Anonymous in the Secretaria de Estado do Meio Ambiente.

H4. Such surges in new personnel are negatively associated with deforestation.

DATA AND RESEARCH DESIGN

The main explanatory variable is political competition in municipal elections for mayor, a concept I measure in three different ways (see appendix). The main measure I use is that of the mayoral margin of victory (i.e., difference in vote shares between the winning and runner-up candidate) in the previous election.[17] When margin of victory in the previous election is a strong predictor of the incumbent's performance in the current election, it can be used as a measure of the expected electoral competitiveness of the election in the current period. To test this assumption, I use a logit estimation framework with simulated effects to determine whether the previous electoral cycle's margin of victory for the winning candidate predicts an incumbent win in the current electoral cycle. The estimation shows that the odds of winning the current election increase by 9% for every 10 percentage point boost in the margin of victory in the previous election. The distribution of the measure for the 2000, 2004, and 2008 elections is shown in figures A1 to A3 in the appendix. As the figures show, the level of political competition exhibits considerable variation across Amazonian municipalities and also over time.

The primary dependent variable is the logarithmized value of the deforested area in square kilometers in municipality i at time t. The data is available from the PRODES satellite system of the Brazilian Space Agency.[18] Given that the variable is logarithmized, changes in the forest cover are estimated as a percentage of the total, allowing an analysis that accounts for variation in both municipality size and initial forest cover.[19] To assess bias in the estimates from nonrandom assignment of margins of victory, I regress rainfall and cloud coverage on the margin of victory. The results, shown in table A15 in appendix A11, make clear that there is no statistically significant partial correlation between the margin of victory and rainfall or cloud coverage. This observation suggests that the margin of victory is not spatially correlated with the conditions for rainforest growth or depletion. To further address concern for spatial correlation between the units of analysis (i.e., municipalities), I also estimate the main results using the spatial correction in standard errors proposed by Conley (1999), with a distance threshold of 100 kilometers. This robustness test is presented in table A16 in appendix A11.

I test the main hypotheses using a panel regression design to estimate the association between the mayor's margin of victory in the previous election and subsequent deforestation during the mayor's four years of rule for electoral mandates throughout the 2000 to 2012 period.[20] The analysis includes both elections with and without an incumbent candidate. The list of 783 municipalities in the Legal Amazon is based on the 2000 census of Brazil, giving a total of 10,179 municipality-year observations of deforestation.[21]

The main model is specified as follows:

$$Y_{m,t} = \alpha_m + \beta_1 \mathrm{MoV}_{m,t} + \sum_k \gamma_k x^k_{m,t} + \mu + \epsilon_m, \qquad (1)$$

where m denotes municipalities and t years. The variable MoV is the ruling mayor's margin of victory in the previous election. x^k are control variables, and μ is a vector of state-year fixed effects. I cluster robust standard errors by municipality. The main assumption of this research design is that through the inclusion of various fixed effects and control variables, I can deal with omitted variable bias. Below, I provide evidence for this identification assumption by running various placebo tests. I include municipality fixed effects throughout to ensure that the estimation is only based on within-municipality variation. The fixed effects control factors that are time invariant (e.g., land area) or slow moving (e.g., institutional capacity to deal with illegal deforestation). All models also include state-year fixed effects to account for secular trends in the nine states that constitute the Legal Amazon, such as state policies and variation in commodity prices.

To adjust for Brazil's federal deforestation program, I also include indicators for the assignment of Priority Municipality status—in other words, blacklisting—to municipalities during the enhanced efforts to control deforestation that the federal government initiated in 2008. The Priority Municipality status is coded "1" beginning in the year of enactment until the municipality is no longer considered a priority, if ever. Another adjustment for national forest conservation programs is a control variable for the share of municipal area designated as Protected Areas (0–1), under Brazilian Law 9,985 in July 2000. See appendix A2 for more information. I also test the robustness of the results to the inclusion of a wide array of control variables, such as incumbent electoral victory, number of cattle, soybean

17. The data are from Brazil's Electoral Court (see http://www.tse.jus.br/).

18. Raw data are available at http://www.dpi.inpe.br/prodesdigital/prodesmunicipal.php.

19. I do not, however, include a time-varying control for forest cover because such a control would induce Nickell (1981) bias in the presence of fixed effects.

20. Deforestation is measured for each of the four years including and after each election year. The main estimation, therefore, compares deforestation for all election and postelection years across municipalities with varying levels of electoral competition.

21. The number of observations in the estimations, at times, varies as a result of missing data for certain control variables.

cultivation (hectares), rainfall (annual, in decimeters), and cloud coverage. In appendix A2, I discuss in greater detail why these variables are relevant and the exact data sources used to measure them. The summary statistics for all variables are shown in tables A1 and A2 and the histograms in appendix A3.

AN SSIV FOR ESTIMATING POLITICAL COMPETITION

A possible concern with the empirical strategy is the endogeneity of local electoral competition to deforestation. The theory maintains that competitive elections increase deforestation, but deforestation could also shape the extent of local electoral competition by changing vote choices. To check this possibility, in table A3 in appendix A4, I estimate the association between the mayor's margin victory and the four-year lag of deforestation. Given municipal elections in Brazil occur every four years, the placebo test checks for the possibility that historical trends in deforestation are what is driving the results on current period deforestation. As table A3 in appendix A4 shows, the mayor's margin of victory does not predict past deforestation, supporting the identification assumption behind the panel fixed-effects estimation. Political competition could induce deforestation, but not vice versa.

To further ascertain the causality of the effect, I follow Shaukat (2019) in constructing an SSIV that exploits changes in the popularity of each political party in elections for state-level office to predict political competition in municipal elections. Although critics of instrumental variable designs have cast doubt on the validity of the estimation strategy in general, recent developments in SSIVs prove to be an exception. In her doctoral dissertation, Shaukat (2019) develops an SSIV to examine subnational political competition in India. I adapt Shaukat's (2019) strategy to the Brazilian context. The instrument takes advantage of the fact that a party's performance at higher levels of government can also have an impact on how it fares in local elections. To give a concrete example, the 2014 federal-level corruption scandal, known as *Lava Jato* ("Operation Car Wash"), that implicated Brazil's popular Worker's Party (*Partido dos Trabalhadores* [PT]) also had consequences for local candidates affiliated with the PT. Municipal elections in Brazil are staggered from state-level elections by two years. Therefore, I use, for example, the change in party support between the 1998 and 2002 state-level elections for governor and for state deputies affiliated with the party to predict the change in vote share for the party between the 2000 and 2004 municipal elections. Because I examine changes in municipal political competition that are driven exclusively by actions at the state or federal levels, they are not endogenous to other municipal-level characteristics.

Although municipal partisan affiliation is weak in Brazil, empirically, this concern is moot as long as the first-stage test of the instrumental variable indicates a strong first-stage effect. The construction of the instrument leverages changes in party support among only the largest (i.e., strongest) parties that have a consistent subnational presence over time in Brazil. The instrument's design, therefore, filters out short-lived parties and, in some cases when relevant, also accounts for municipal coalition (*coligações*) structures in its construction. Despite how municipal partisan identities can be weak in Brazil, several major parties, such as the Partido dos Trabalhadores (PT), Partido da Social Democracia Brasileira (PSDB), Partido do Movimento Democrático Brasileiro (PMDB), and Partido da Frente Liberal (PSL), among others, exhibit strong partisan identities at both the state and municipal level. Thus, empirically, state-level partisanship still strongly predicts the success of municipal copartisans, as indicated by the strong first-stage effect of the instrumental variable (see table A10 in app. A8.3).

In contrast to a standard shift-share instrument, the "shifts" (i.e., changes in aggregate party popularity) in this case affect political competition across each municipality nonmonotonically (Shaukat 2019). In other words, a positive shift in a specific party's performance at higher levels of government decreases political competition in municipalities where the party holds a majority, yet it increases competition in municipalities where the opposition has a stronghold. Nonmonotonicity is therefore a key identification assumption. In appendix A8, I thoroughly discuss the identification assumptions behind this shift-share approach in greater detail. Following Shaukat (2019), I construct the following measure of predicted vote shares, $\hat{s}_{p,m,s}$, for each party p in municipality m and state s at time t (i.e., the 2004, 2008, and 2012 municipal elections):

$$\hat{s}_{p,m,s,t} = z_{p,m,s} + g^{-m}_{p,s,t}. \quad (2)$$

$z_{p,m,s}$ represents the party vote share in the baseline election year—in this case, the 1998 state elections. $g^{-m}_{p,m,t}$ is a measure of the aggregate change in party vote share at the state level that leaves out only the change in support for that party in municipality m. This leave-out feature in the calculation of the shifts ensures that they are not driven by location-specific factors, such as the behavior of the incumbent in municipality m (Shaukat 2019). Next, I plug the predicted vote shares calculated for each municipality-year's winning mayoral party w, $\hat{s}_{w,m,s,t}$, as well as that for the runner-up opposition party, o, $\hat{s}_{o,m,s,t}$, into the calculation of political competition as follows:

$$\text{Pred. Competition}_{m,s,t} = 1 - |\hat{s}_{w,m,s,t} - \hat{s}_{o,m,s,t}|. \quad (3)$$

I use this measure of predicted competition to instrument for the actual competition between the incumbent and opposition parties in each municipal election. In other words, I use the following empirical framework.

First stage:

$$\text{Competition}_{m,s,t} = \mu + \delta \text{Pred. Competition}_{m,s,t} + \gamma_m + \omega_{s,t} + \epsilon_{m,s,t} \quad (4)$$

Second stage:

$$\bar{y}_{m,s,t} = \alpha + \beta \text{Competition}_{m,s,t} + \gamma_m + \omega_{s,t} + \varepsilon_{m,s,t} \quad (5)$$

where Pred. Competition$_{m,s,t}$ is the predicted competition instrument calculated in equation 3, γ_m indicates municipality fixed effects, and $\omega_{s,t}$ is state-year fixed effects. I estimate two-staged least squares both with and without municipal-level controls to observe the robustness of the results to potential bias from conditioning on concomitant variables. In appendix A8, I show balance on these municipal-level variables for the instrument.

EMPIRICAL FINDINGS

Main results

The main results using panel fixed-effects estimation (equation 1) are shown in table 1. In table A16 in appendix A11, I also report these results using standard errors that correct for arbitrary cluster correlation across space (see Conley 1999).

The association between a high margin of victory—a measure of low political competition—and low deforestation is robust. Across the models, the coefficient for margin

Table 1. Main Results Using Panel Fixed Effects

	Dependent Variable				
	Deforestation (log)				
	(1)	(2)	(3)	(4)	(5)
Mayor margin of victory (0–1)	−.067**	−.067**	−.063**	−.069**	−.090**
	(.027)	(.027)	(.027)	(.027)	(.042)
Incumbent win		.007	.006	.002	.010
		(.004)	(.004)	(.005)	(.006)
Cloud coverage (log)			.016***	.014***	.016***
			(.002)	(.002)	(.003)
Mean rainfall (dms per pentad)			−.010***	−.011***	−.012***
			(.002)	(.002)	(.003)
Number of mayoral candidates				−.004	−.003
				(.005)	(.007)
PT				−.016	−.017
				(.010)	(.012)
Existence of environmental councils				.004	.014
				(.008)	(.011)
Priority municipality				.128***	.116***
				(.016)	(.019)
PAs (0–1)				.188***	.159**
				(.069)	(.074)
Cattle (log)				.024*	.023
				(.013)	(.016)
Soybeans (log)					−.005
					(.006)
Municipality fixed effects	✓	✓	✓	✓	✓
State-year fixed effects	✓	✓	✓	✓	✓
Observations	9,799	9,788	9,788	9,706	6,698

Note. The dependent variable is the logarithmized value of the deforested area within a municipality. The model is linear, and standard errors are clustered by municipality across all models. PAs, Protected Areas.

* $p < .1$.

** $p < .05$.

*** $p < .01$

of victory is negative, statistically significant, and shows little sensitivity to specification. In other words, political competition (low margin of victory) increases deforestation. In the most comprehensive model (5), increasing the margin of victory by 10 percentage points decreases deforested area by 1 percentage point. A standard deviation's increase in the margin of victory, on the other hand, decreases deforested area by 1.3%. With a mean deforested area across municipalities of about 20 percentage points in 2012, this is a relatively large decrease. These results are consistent with the hypothesis that political competition directly affects the depletion of natural resources.

Specifically, the theory (i.e., hypothesis 2) maintains that the presence of private commercial interests that deforest accounts for this effect. Political competition encourages mayors concerned with winning the margins to cater to private interests in agriculture. To test hypothesis 2, I use data from the Brazilian Agricultural Census available for the year 2006 that measures the number of commercial agricultural establishments by municipality. The measure excludes establishments owned by small-holder farmers to capture exclusively large-scale commercial agricultural establishments. In municipalities in the Amazon, the measure is therefore a good proxy for the presence of commercial agricultural interests that deforest. I once again estimate the association between political competition and deforestation using fixed-effects estimation, though I include the interaction of political competition and this measure of private interests in the estimation. In table 2, model 1 presents the regression of deforestation on the number of commercial agricultural establishments, and models 2 through 4 demonstrate the robustness of this result to the inclusion of the control variables. In addition, model 5 presents the results from the estimation with the interaction term, and model 6 shows the results from the same estimation but with the control variables.

The results show that, as expected, the number of commercial agricultural units corresponds negatively with deforestation. Consistent with the main results, an increase in margin of victory (i.e., a decrease in political competition) has a strong negative association with deforestation. Last and critically, this effect of margin of victory is reduced as the number of commercial agricultural establishments increases. As predicted, the effect of political competition on deforestation is conditional on the presence of private commercial interests, providing direct evidence in support of hypothesis 2.

Bureaucratic packing

In this section, I further examine how political competition alters the political behavior of Brazilian mayors. The qualitative evidence presented points to the ways in which political competition incentivizes mayors of Brazil to engage in bureaucratic packing, a surge in new appointments in municipal secretariats that undermines regulatory capacity. To test hypothesis 3 further on a larger scale, I use data from the *Relação Anual de Informações Sociais* (RAIS) available from Brazil's Ministry of Labor and Employment. The RAIS data is an annual survey that documents the complete universe of all labor contracts for public employees. The database notes the start and end dates of all contracts, the legal nature or category of profession of the contract, and various other characteristics. Using the RAIS database, I calculate measures of bureaucratic packing to use as an independent variable. Specifically, the main measure I use is the count of municipal personnel (logarithmized) who were newly appointed within 12 months after each municipal election between 2000 and 2012 to capture the immediate reactionary effects to each election.

As with the main results presented in table 1, I estimate panel fixed-effects models of new municipal personnel on mayoral margin of victory. The models include municipality and state-year fixed effects and robust standard errors clustered by municipality. The results, presented in table 3, confirm a strong and robust negative association between mayoral margin of victory—that is, low political competition—and new personnel within municipal bureaucracies.

Specifically, in the most comprehensive model (model 5), a 10 percentage point increase in margin of victory corresponds to a decrease in new municipal personnel by around 7 percentage points. The reverse is also true: A decrease in margin of victory (i.e., an increase in political competition) increases the appointment of municipal personnel. In addition, in appendix A6, I run panel fixed-effects estimation of deforestation on the appointment of new municipal personnel, and the results confirm, instead, a strong positive association. Bureaucratic packing, in turn, corresponds to an increase in deforestation. This set of results provides direct support for the theory that competitive elections encourage the mayor to pursue a strategy of bureaucratic expansion to enable deforestation (hypotheses 3 and 4). Consistent with the claim that politicians engage in packing especially when removing existing personnel proves difficult, I find that competitive elections are not associated with an increase in bureaucratic dismissals.

Checks for robustness

In appendix A10, I also explore a series of tests of the robustness of the results. First, in table A11, I find that even when margin of victory is allowed to have nonlinear effects, low margin of victory consistently has positive coefficient estimates, suggesting that political competition indeed contributes

Table 2. The Effect of Commercial Agricultural Interests

	Deforestation (log)					
	(1)	(2)	(3)	(4)	(5)	(6)
Agricultural establishments (hundreds)	.250***	.247***	.260***	.225***	.327***	.292***
	(.080)	(.080)	(.085)	(.078)	(.068)	(.068)
Mayor margin of victory (0–1)					.484	.253
					(.460)	(.466)
Margin of victory × agricultural establishments					−.542***	−.446**
					(.185)	(.180)
Incumbent win		.068	.067	.033		.032
		(.076)	(.074)	(.074)		(.076)
Cloud coverage (log)			.101***	.117***		.115***
			(.025)	(.027)		(.027)
Mean rainfall			.091***	.093***		.095***
			(.019)	(.018)		(.018)
Number of mayoral candidates				.006		−.012
				(.046)		(.047)
PT				−.042		−.081
				(.183)		(.185)
Existence of environmental councils				.348***		.325***
				(.117)		(.115)
Priority municipality				1.594***		1.504***
				(.181)		(.175)
PAs (0–1)				−.449*		−.441*
				(.231)		(.232)
Observations	10,117	10,004	10,004	9,872	9,773	9,691

Note. Standard errors in parentheses. PAs, Protected Areas.
* $p < .1$.
** $p < .05$.
*** $p < .01$

to deforestation. Next, in table A11 in the appendix, I examine how the results change if I exclude geographic areas (observations) that have very little remaining forested area. The table shows that the results are robust when incrementally excluding municipalities with minimal forest cover. The results are not sensitive to using differential cutoffs for low-forest-coverage municipalities. This robustness test shows that the logarithmized approach is valid and does not bias the results.

In table A12 in the appendix, I next show the results when states in the Amazonia Legal are dropped one by one. This jackknife estimation is used to check that the results are not driven by any particular state. I also test for the robustness of the results when I exclude margins of victory in excess of 70 percentage points. The results are shown in table A13 in the appendix. This cutoff was chosen because investigation of the data shows that some municipalities in the 70 to 80 percentage point range for margin of victory may be outliers in their conservation efforts. The results remain robust for both of these tests.

Testing alternative explanations

I first consider the role of market forces as an alternative channel. As I have noted earlier, deforestation largely stems from the agro-industrial economy. Therefore, local political competition could have an unintended effect on deforestation through increased or decreased economic activity. To be clear, this alternative channel of local economic activity (e.g., cattle ranchers, farmers, etc.) is different from vested private sector interests who extract profits from the region and lack a stake in generating growth in the local economy. In a similar vein, the political incentives to focus on economic growth differ from those that encourage a focus on vested private interests. To account for these agro-economic drivers of

Table 3. Political Competition and Municipal Bureaucratic Appointments

	Dependent Variable				
	New Municipal Personnel (log)				
	(1)	(2)	(3)	(4)	(5)
Mayor margin of victory (0–1)	−.379*	−.400**	−.383*	−.339*	−.710**
	(.196)	(.198)	(.196)	(.199)	(.327)
Incumbent win		.038	.031	.023	.128
		(.054)	(.054)	(.055)	(.093)
Cloud coverage (log)			.068**	.063**	.065
			(.027)	(.027)	(.044)
Mean rainfall			.015	.020	.003
			(.018)	(.018)	(.032)
Number of mayoral candidates				−.011	−.025
				(.033)	(.049)
PT				.157	.109
				(.108)	(.195)
Existence of environmental councils				−.031	−.055
				(.068)	(.110)
Priority municipality				−.060	.000
				(.143)	(.)
PAs (0–1)				.975*	1.477**
				(.534)	(.632)
Cattle (log)				−.049	−.043
				(.105)	(.154)
Soybeans (log)					.019
					(.056)
Municipality fixed effects	✓	✓	✓	✓	✓
State-year fixed effects	✓	✓	✓	✓	✓
Observations	2,577	2,573	2,573	2,549	1,358

Note. Margin of victory and municipal bureaucratic appointments: panel fixed-effects models with standard errors clustered by municipality. Standard errors in parentheses.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

deforestation, I conduct placebo tests to discern the plausibility of this alternative channel in table A16 in the appendix. See appendix A12 for a discussion.

Another alternative explanation that could confound the observed effects of municipal activity on deforestation is the implementation of federal policy. Specifically, I examine whether the effects are driven by the IBAMA federal program of embargoes. One of the main federal initiatives to counteract deforestation, the program allows the federal government to impose an embargo on municipalities that exceed threshold deforestation rates. I also conduct a related test in which I regress the share of municipal area designated by the federal government as Protected Areas on the mayor's margin of victory. As models 3 and 4 in table A16 in the appendix show, Brazil's main federal policy initiatives for conservation, such as the IBAMA embargo program or the designation of PAs, do not drive the results.

Next, I also consider the role of poverty and land inequality. Given that municipalities in the Amazon depend on resource extraction, it could be that we only see the largest effects of political competition in poor areas. I include municipality fixed effects to control for income effects, but I also estimate an interaction model that tests poverty (i.e., municipal income) as a modifying factor. In addition, I investigate

whether land inequality conditions the effects of political competition to see if the incentives outlined above depend on the concentration of natural resources in the hands of a small number of large landowners. The results, provided in tables A17 and A18 in the appendix, indicate that poverty (or lack thereof) and land inequality are not alternative mechanisms that explain the results.

I also estimate models that allow the effect of margin of victory to depend on the mayor's partisanship (partisan politics hypothesis) and the state governor's partisanship (state-level intervention). The income and land inequality measures are cross-sectional, so I do not include the constituent term in the regressions, as it would be subsumed by the municipal fixed effects.[22] As table A19 in the appendix shows, there is very little evidence for interactive effects. Once I control for whether the mayor is a first- or second-term officeholder, the interaction coefficient becomes small and statistically insignificant. Taken together, these findings lend little evidence for arguments that emphasize the special role of partisanship and of Lula's PT, in particular, in the municipal politics of deforestation. Likewise, table A20 in the appendix provides limited evidence for an alternative theory that emphasizes the role of intergovernmental partisan alignment and state-level intervention on the part of the governor.

CONCLUSION

Deforestation is a major contributor to climate change, a threat to indigenous rights and livelihoods, and a source of considerable biodiversity loss. Much of the literature on the causes of deforestation focuses on the market mechanisms that drive such environmental degradation. However, the underlying political institutions that shape the destruction of the commons have received much more limited attention. I use a combination of panel fixed-effects estimation and a novel shift-share instrumental variable approach proposed by Shaukat (2019) to systematically explore the effects of political competition in particular. Using detailed satellite imagery data on forest coverage over time, the analysis finds that local political competition has a robust causal and positive effect on deforestation. Drawing on qualitative evidence from interviews with public servants, I argue that competitive elections encourage a focus on private vested interests that deforest.

Standard models of political accountability showcase the benefits of democracy. Democracy is equated with better governance and accountability and has been shown to have tangible effects on development outcomes, such as improved economic growth and public goods provision. On the contrary, this study demonstrates that competitive elections also have negative normative implications: It induces environmental degradation. While touted for their various benefits, local democratic institutions also encourage politicians to value immediate gains at the expense of long-term environmental conservation goals. Critically, in doing so, competitive elections, in turn, produce incentives for subnational politicians to weaken local regulatory agencies that monitor deforestation and enforce environmental standards. In particular, the analysis spotlights bureaucratic packing, the mass appointment of new personnel within these agencies, as an understudied strategy used to weaken them. Leveraging a detailed database of public employment contracts, I find that local political competition indeed corresponds to an increase in the appointment of new municipal personnel within the first 12 months after each competitive election. I find that these bureaucratic appointments, in turn, correspond to an increase in deforestation.

The analysis spotlights how Holland's (2017) concept of forbearance, the strategic nonenforcement of the law, is also a common strategy used to benefit wealthy private interests. It demonstrates that in the process of engaging in forbearance, politicians often may need to "break" the bureaucracy. Thus, the study builds on Holland's (2017) pioneering work by illustrating both a cause of forbearance (i.e., political competition) and a consequence of it (i.e., weakened bureaucratic capacity). The results also provide a piece of robust evidence for the political origins of deforestation, addressing the methodological and measurement difficulties that come with studying political competition. Beyond illustrating the role of private commercial interests and the strategy of bureaucratic packing, the analysis carefully considers a set of prominent alternative mechanisms, such as partisan alignment across levels of government, federal policy mechanisms that seek to curb illegal deforestation, and land inequality and local development, among others, showing these alternatives cannot explain the observed effect of political competition. The results spotlight the need for developing new theory and systematic evidence for understanding the effects of democratic institutions on the environment and on bureaucratic capacity.

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22. For data on land inequality, see Albertus, Brambor, and Ceneviva (2016).

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