Playing Politics with Environmental Protection: The Political Economy of Designating Protected Areas*

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Abstract

Protected areas play an important role in biodiversity conservation, but they also carry local costs in the form of constraints on natural resource extraction. Here we investigate how policymakers make trade-offs between national environmental benefits and local economic costs. Examining the designation of protected areas in the Brazilian Amazon, we conduct a geographic regression discontinuity analysis. We find that the Brazilian government systematically over-designates protected areas in municipalities controlled by opposition mayors relative to municipalities controlled by co-partisan mayors. This causal effect of political alignment is limited to federally designated areas and does not apply to state-level designations or indigenous lands. The results show that political considerations bias the geographic distribution of protected areas in the world's largest rainforest.

Keywords: Latin America; Brazil; deforestation; political alignment; protected areas

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1 Introduction

The afternoon of February 12, 2006, was an auspicious moment in the history of the Brazilian Amazon rainforest. President Luiz Inácio Lula Da Silva, from the Workers' Party (PT), signed eight executive orders demarcating the largest protected environmental area ever created in this region. They amplified existing reserves and introduced a Flora Sustainable District in the state of Pará, considered to be the first one in the country. The total covered area was twice the size of Belgium. Paulo Adário, a Greenpeace official, applauded the decision by stating that "the Lula administration has made today a great contribution to the protection and sustainable use of the Amazon's environmental assets, seriously threatened by road paving projects and the expansion of soybean agribusiness."[1] But Joselito Soares, mayor of Itaituba from the Brazilian Social Democratic Party (PSDB), was indignant. He lamented that "nearly 300 companies have been already shut down in the municipality, laying off more than 27,000 workers" and breeding discontent among timber businessmen.[2]

This episode raises an important question: How do governments decide which areas to protect and why? These decisions have major impacts on nature and society (e.g., Naughton-Treves, Holland, and Brandon, 2005; Wilkie et al., 2006). Protected areas such as national parks or indigenous reservations can curtail deforestation, help to conserve the natural habitat, and enhance the welfare of local populations whose livelihoods depend on forest resources. But they can also shape local economic activity to a great extent, limiting land use or incurring costs such as foregone opportunities for investment or lost property.

Building on contributions on fiscal federalism (Oates, 1972, 2005; Besley and Coate, 2003; Adler, 2005; Urpelainen, 2009), we argue that the declaration of protected areas entails not only benefits but also costs to elected politicians. We propose the hypothesis that national-

[1]"Lula cria mosaico de áreas protegidas na fronteira de expansão do agronegócio." *Greenpeace*, February 12, 2006 (accessed June 30, 2017).

[2]"Prefeitos criticam reservas florestais." *O Liberal*, February 15, 2006 (accessed June 30, 2017).

local *political alignment* plays a crucial role in the creation of these areas. At the national level, protected areas provide public goods as well as increasing international recognition for pursuing efforts in environmental conservation. However, a protected area also engenders costs at the local level because it restricts the extraction of natural resources by local firms. We argue that these "costs" of conservation are most strongly concentrated in industries that involve the clearing of forest and/or the large-scale extraction of natural resources, such as agro-industrial soybean production, cattle ranching, timber, and mining, all of which are significantly constrained in protected areas. While limiting extractive industries in an area could also decrease the availability of local employment more generally, these costs will be primarily concentrated among the local elites who have ties to extractive industries. Therefore, we consider that maintaining the support of these elites will be the primary consideration for local politicians when lobbying the federal government.

The main strategy of the federal government when allocating protected areas will be to maximize the diffuse benefits from conservation efforts while limiting costs to local economic elites in areas governed by political allies. A central government can theoretically claim credit for the designation of a protected area in any ecologically significant region and therefore the exact location of a new protected area is somewhat fungible. However, national officials must cope with the localized political cost of curbing the local primary sector. If a protected area is allocated in a jurisdiction controlled by a political party belonging to the national cabinet, a co-partisan pays the political cost of not being able to capture local resources. By contrast, if the area is placed where an opposition party is in office, then the local challenger absorbs such cost. Hence, we expect areas under environmental protection to be comparatively smaller when the central and local governments are aligned.

We put this hypothesis under empirical scrutiny in the Brazilian Legal Amazon, the country's greatest geographic division. The Amazon is a suitable domain to test our theory for two main reasons. First, it provides an interesting test case that occupies a large extension of the country as is important both for its potential as an area of environmental conservation but also agricultural and mineral production. Higher global demand for timber and agricultural commodities in the last two decades has increased primary industries' investments in the region, raising concerns about environmental risks (Gibbs et al., 2010). As a result, protected areas have flourished in the Amazon since the creation of the Ministry of Environment in the 1990s (Rylands and Brandon, 2005). This provides us with a vast territory that exhibits considerable variation in both protected areas and political variables of interests to our study. Second, Brazil's federalism grants the President a great share of power for designing and implementing public policy (Mainwaring, 1997), including environmental policy (Chiavari et al., 2016). Although federal legislation stipulates a number of prerequisites to be met before they are sanctioned, the Brazilian President enjoys substantial discretion when allocating and defining the boundaries of protected areas. That leaves plenty of room for protecting the environment based on the political characteristics of local governments.

We construct a novel dataset composed of grid cell-year observations of areas that are close to the borders of Amazonian municipalities for the 1997-2012 period. We restrict our sample to those grid cells that (i) fall within $25km$ of a municipal border and (ii) form a pair of treatment and control units—i.e., grid-cells whose mayor is aligned to the federal government on one side of the municipal border and not aligned on the other. To estimate the causal impact of federal-municipal political alignment on the decision of the President to protect an area, we use a geographic regression discontinuity design. Such approach enables us to exploit an administrative boundary that divides units into treated and control areas, making the case that such division occurs in an as-if random manner.

The results are straightforward. We find that the probability of the federal government declaring a grid-cell as a federally protected area decreases when the mayor's political party is aligned with the President's coalition. Specifically, we find that a coalitional alignment between the President and the mayor reduces the incidence of protected areas by 0.9 to

1.4 percentage points. Substantively, these effects are large relative to the sample mean for protected area coverage. In the supplementary appendix, we also show that our main results are robust to cutoffs at different distances from the municipal border. We further strengthen the credibility of our empirical findings by running similar analyses with alternative forms of protected areas.

Our work makes a number of substantive and empirical contributions. First, it joins a generation of studies on federalism that investigates the political, rather than policy-oriented or market-related, incentives facing central governments when choosing programs that have an impact on local jurisdictions (e.g., Wibbels, 2005; Bakke and Wibbels, 2006; Wilkinson, 2006; Magaloni, Diaz-Cayeros, and Estévez, 2007). That is, this literature assumes that public officials in higher levels of government have objectives shaped by political institutions that oftentimes diverge from maximizing the welfare of local populations. Whereas federal protected areas supply public goods to municipalities, our work shows that these are delivered in ways that do not hinder the local extraction of natural resources by partisan fellows. In this regard, our results offer empirical support for the claim that "[w]holly apart from administrative efficiencies and fiscal equalization, centralization affords regimes with political leverage over lower governments and citizens ... the incumbent regime compromises citizens' ability to throw the rascals out, to exercise fiscal autonomy, and to influence public policies" (Weingast, 2009: 289).

Second, we make an important contribution in understanding how political motivations can drive governments' decisions to protect the environment. Particularly, in federal or multi-level regimes. Most of this literature has focused on bureaucratic competition between national and local agencies (Scheberle, 2004), the effect of environmental governance institutions (Rodríguez-Franco, 2014), or downgrades in local environmental regulations—i.e., "race to the bottom"—to attract investors (Konisky, 2007). However, they offer little insights as to why a central government decides to protect a local jurisdiction but not other within the same national regime, overlooking the benefits as well as the costs of environmental policies affecting both central and local-level authorities. To the best of our knowledge, our work could be one of the first ones to propose a top-down political explanation to the question of uneven environmental protection in the context of a federalized polity.[3]

Finally, our identification strategy is another notable contribution. We combine a geographic regression discontinuity design with variation in electoral outcomes at the municipal level over time. This cross-over design allows us to benefit from the relatively weak identifying assumptions of a discontinuity design while reaping substantial efficiency gains from estimations based on within-unit variation.

2 Protected Areas in the Brazilian Amazon

Although the first forest reserve was created in the federal territory of Acre in 1911, protected areas in Brazil's Amazon basin have been on the rise over the past twenty years. Between 1995 and 2014, both the Ministry of Environment and subnational governments sanctioned 190 new areas across the nine states of the Legal Amazon.[4] As to 2014, there were 327 Amazonian areas, amounting to more than 204 million hectares under protection—that is, 40.37 percent of the entire region, turning the Amazon into the largest protected biome of the country.[5]

A body of empirical evidence shows that Brazilian protected areas have aided in preserving the Amazon rainforest and achieving social goals. Soares-Filho et al. (2010) presents evidence indicating that protected areas accounted for a 37-percent decline in deforestation between 2004-2006. Similarly, Nepstad et al. (2009) also find that indigenous lands have an inhibitory effect on deforestation and fire occurrences and can provide secure tenure to

[3] An exception is Ferraz (2007).

[4] Authors' elaboration based on data from ISA Conservation Areas: `https://uc.socioambiental.org/en/uc/pesquisa` (accessed June 30, 2017)

[5] ISA Conservation Areas, Federal State: `https://uc.socioambiental.org/en/ucs-federais-e-estaduais-na-amazônia-legal/federal-state` (accessed June 30, 2017)

native populations.

Areas protecting the environment are known as conservation units in Brazil. Prior to the new federal constitution enacted in 1988, the country's conservation system suffered from duplicated functions between government agencies. After the introduction of the Forest Code in 1965, conservation units such as national parks and biological reserves were administered by the Brazilian Forest Development Institute (IBDF). Another public office, the Special Secretariat for the Environment (SEMA), was in charge of ecological stations and other categories. The IBDF promoted a plan for instituting an integrated protected areas scheme by the late 1970s, attempting to rationalize sixteen categories of conservation as well as their management objectives. Because the IBDF's proposal never came into effect, conservation categories were poorly defined and their goals remained highly confusing. These two agencies finally joined by 1989 to constitute the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) within the recently founded Ministry of Environment.[6]

The National Protected Areas System (SNUC) was introduced on September 1989, adjusting all conservation categories.[7] The SNUC ended up becoming Brazil's single framework administering protected areas at the federal but also state levels (Rylands and Brandon, 2005). It defined twelve categories divided into two subtypes. First, strictly protected such as parks, biological reserves, or ecological stations. The principal goal of strict protection is preserving biodiversity. It forbids exploitation of natural resources and promotes non-extractive activities like environmental education, scientific research, and recreation. The second subtype is sustainable use in which biodiversity conservation is not a top priority and various, regulated forms of extraction are allowed; for example, responsible logging, hunting, or farming to support the economic sustenance of local communities in the countryside. Sus-

[6]In August 2007, President Lula reestructured IBAMA and further created the Chico Mendes Institute for Biodiversity Conservation, which became the federal autarchic office responsible for implementing and monitoring federal protected areas.

[7]Although it was introduced in 1989, the National Congress officially sanctioned in July of 2000 (Law 9985).

tainable areas are numerous, but the most relevant ones are forests, environmental protection areas, and areas of relevant ecological interest.

The Brazilian legislation stipulates that protected areas are created via presidential executive orders. The SNUC dictates prerequisites such as biogeographic standards, assessments of potential contributions to vegetation and wildlife, and public consultations,[8] yet the President enjoys highly discretionary power when physically delimiting and introducing a protected area in a particular location. In consequence, it is believed that "approval or disapproval merely follows political criteria" (Chiavari et al., 2016: 50). Local politicians across the Amazon have criticized the arbitrariness of the federal government in designating protected areas. For instance, the mayors of Porto de Moz and São Félix do Xingu (PMDB) attacked the decision to create the *Verde para Sempre* reserve because " [...] prior consultation doesn't take place. They [federal authorities] come here with their cadastral maps ready, invite some religious people, two or three fishermen and small farmers, PT supporters, NGOs representatives and hold a meeting [...] We don't know how it was created and what's going to happen in there."[9]

In addition to his prerogatives for sanctioning new protected areas, the President has many ways to manipulate existing ones. The Ministry of Environment or civil society organizations can sponsor proposals for new areas, but it is the President who has the final word about its implementation. According to an important director at the Ministry of Environment, presidential approval is imperative. Without it, proposals could be held up for years: " [...] the President can delay a project for conservation, if he doesn't homologate it, then it'll never be implemented [...] We have a number of those ready to go, we've been working on them for years but we just don't get the President's signature."[10] Even though the National

[8]For a full, detailed description of the administrative process featuring the creation of a federal protected area, refer to the interactive infographic "How is a Conservation Area designated?" at

[9]"Prefeitos contrarios a criação das reservas," *Diario do Pará*, February 18, 2005 (accessed September 29, 2017).

[10]Authors' interview at the Ministry of Environment, Brasília DF, October 5, 2017.

Congress is the only body legally allowed to reduce protected areas, recent anecdotal evidence indicates that the President has unilaterally remapped some of them.[11]. Whereas congressmen can propose bills to create, reduce, or make regulatory changes, Brazil's presidential institutions include veto powers to override such intiviatives[12]

Like presidents, governors can also use executive orders and similar powers to assign or modify state protected areas within state boundaries. Officials at the Ministry of Environment, nevertheless, pointed out that the President has a number advantages vis-à-vis governors.[13] Given that the supply of land in which they can effectively operate is significantly lower, governors tend to face fewer incentives to renounce to potentially productive tracts of land for environmental purposes. This is more pronounced in Acre, Amapá, or Roraima, as they are the smallest states in the Amazon. More relevantly, the Brazilian Constitution empowers the President to establish federal protected areas on any kind of land, including state vacant lands—public lands belonging to state governments, dubbed *terras devolutas*—on the basis of a necessity to "protect the natural ecosystem."[14] Conversely, states cannot create units on federal public lands. Governors are more interested in demarcating new conservation units when they can anticipate national authorities' intentions to conceive protected areas in their jurisdiction, thereby obstructing the President from claiming credit at their expense.[15] They are also more likely to create or expand existing units if the Presi-

[11]President Dilma Roussef (PT), for example, issued an executive order in January 2012 reducing the perimeter of seven units in the states of Amazonas and Pará so as to accommodate new hydroelectric plants. See "Dilma não criou nenhuma nova unidade de conservação na Amazônia," *O Globo*, August 4, 2014. (accessed October 1, 2017)

[12]In March 2007, President Lula overruled a bill permitting the cultivation of genetically modified crops in the sustainable category of environmental protection areas. See "Quase 900 vetos presidenciais esperam por votação no Congresso," *Diário Comércio Indústria & Serviços*, February 7, 2008 (accessed October 1, 2017).

[13]Authors' interview at the Ministry of Environment, Brasília DF, October 5, 2017.

[14]The Constitution (Art. 225, Inc. VII, Par. 5) asseverates that it is the President's exclusive power to create protected areas on state vacant lands: "Vacant state lands or lands seized by the states through discriminatory actions, which are necessary to protect the natural ecosystems, are inalienable."

[15]The governments of Amazonas and Roraima announced *Rio Branco* in 2006, a cross-state environmental protected area that blocked a federal program to create the *Baixo Rio Branco-Jauaperi* extractive reserve. According to technicians from IBAMA, this area "was created with the intention of make the proposal for an

dent donates extensive portions of federal land to the state government since doing so implies no cost to them.[16]

A second type of federal protected area, indigenous areas, follows a different set of norms.[17] Indigenous areas grant full rights over a designated plot to the indigenous peoples living on it, banning any sort of extractive activity unrelated to their economic well-being. Demarcating and monitoring these areas are the responsibilities of the National Indian Foundation (FUNAI), an agency of the Ministry of Justice. Similar to conservation units, indigenous areas are also created at the President's discretion (Britto, 2003; Barros and Barcelos, 2016). He appoints the team of researchers who determines whether an area has been inhabited by indigenous ancestors;[18] can neglect or postpone the approval of ongoing projects for indigenous lands;[19] or narrow down existing ones in order to permit the extraction of natural resources.[20]

However, unlike conservation units, indigenous areas are exposed to judicial obstacles that restrain the scope of executive discretion. Two differences are key in this regard. First, they tend go through bottom-up channels (Schwartzman and Zimmerman, 2005), as formal petitions requesting to create an indigenous area can be submitted to FUNAI. Advocacy groups representing indigenous peoples, such as the Articulation of Brazilian Indigenous Peoples (APIB), have successfully litigated to advance these claims, compelling the Minister

extractive reserve unfeasiable. See "Reserva em compasso de espera," *O Eco,* September 8, 2010 (accessed April 12, 2018).

[16]For example, President da Silva signed an executive order in 2007 transferring 3.8 million hectares of federal land to the state of Amapá, which were used to consolidate a large biodiversity belt under the *Amapá Floresta Estadual* forest reserve. See "Transferência de terras ao Amapa deve beneficiar 11 mil familias," *Agência Brasil,* December 8, 2007 (accessed April 12, 2018).

[17]The Indian Statute, enacted in 1973, and the 1988 Constitution set the legal foundations for indigenous protection. The Legal Amazon, especially the states of Amazonas and Roraima, hosts the largest number of indigenous citizens in the country (IBGE, 2010).

[18]"GT da Funai para demarcar terras indígenas só com autorização da presidenta." *Conselho Indigenista Missionário*, November 1, 2011 (accessed November 27, 2017).

[19]"Justiça dá 30 dias para Funai concluir demarcação de área indígena em MT." *O Globo*, April 4, 2014 (accessed November 27, 2017)

[20]"Governo extingue reserva no Amapá e no Pará para liberar área a mineradoras." *Poder 360*, August 23, 2017 (accessed November 27, 2017)

of Justice to swiftly initiate the creation process. As a chief cartographer responsible for demarcating areas at the FUNAI told us, "The criteria for picking cases could be many ... but there are claims the FUNAI must deal with because there's a judge telling us to do so."[21] Indigenous legal mobilization have also led to the declaration of areas that were brought to a halt due to lack of presidential approval.[22] Second, non-indigenous affected parties are legally allowed to appeal demarcated areas before presidential approval.[23] This legal resource enables local mayors and powerful economic actors to contest indigenous areas in a court of law, retarding the bureaucratic process leading up to its creation and eventually exerting pressure on the President before he makes a final decision.[24]

3 A Political Economy of Protected Areas

Protected areas generate winners and losers. On the one hand, protecting the rainforest improves Brazil's national reputation, contributes to efforts to mitigate climate change, appeases environmental interest groups, and secures forest people's livelihoods (Nepstad et al., 2006; Hochstetler and Keck, 2007). On the other hand, protected areas are costly to the local primary sector because they prevent the profitable extraction of forest resources and land clearing (Chomitz, 2007). The problem is one of public good provision in the spirit of Samuelson (1954) and Olson (1965): locally costly actions generate broader social benefits

[21] Authors' interview at the FUNAI, Brasília DF, October 6, 2017.

[22] The *Manoki* area in the state of Mato Grosso is an example of this: after a six-year wait, a court order forced the Presidency to approve the demarcation plan. Refer to "Justiça dá 30 dias para Funai concluir demarcação de área indígena em MT." *O Globo*, April 4, 2014 (accessed November 27, 2017).

[23] Executive Order 1775 from 1996 establishes that state and municipal governments as well as other interested parties can contest an indigenous area by demanding a proper compensation or invoking irregularities in the demarcation process.

[24] Amilton Gadelha (PT), mayor of São Gabriel de Cachoeira, made an appeal in 1996-2000 to prevent the enlargement of the area *Terra Méia Rio Negro I* that would stop the extraction of granite (Ricardo, 2000). President Lula's decision to regualrize the *Raposa Serra do Sol* area in the state of Roraima also encountered resistance since a group of cattle ranchers challenged the presidential decree for three-year period in a federal court. Refer to "Entenda o conflito na terra indigena Raposa Serra do Sol." *O Globo*, May 11, 2008 (accessed November 28, 2017).

at the national, and even global level.[25]

In political economy, the "fiscal federalism" approach tackles the problem of local provision of public goods. The literature recognizes the key trade-off as one between the internalization of externalities and local information. The advantage of centralized provision is that the central government does not ignore the public good; the advantage of decentralization is that local policymakers have more information about the costs of local provision. This classical approach thus predicts that when local jurisdictions have strong informational advantages but externalities between jurisdictions are weak, decentralized policy produces better outcomes. Conversely, the absence of local informational advantages and strong externalities—whether positive (public goods) or negative (harm caused)—would favor a centralized approach.

An important gap in the literature concerns the consideration of local costs by the centralized authority. In our empirical case, the federal government of Brazil, led by the President, can allocate locally costly protected areas across municipalities. How does the President decide on where to create protected areas, given the characteristics of different municipalities? We approach this problem from the perspective of cross-level political alignments (Asher and Novosad, 2015; Solé-Ollé and Sorribas-Navarro, 2008; Fenwick, 2009; Brollo and Nannicini, 2012; Dynes and Huber, 2015; Niedzwiecki, 2016). Specifically, we examine how the President's incentive to create protected areas depends on the partisanship of the mayors in different municipalities. In this context, the President *is* able to differentiate policies across local areas, exploiting his or her own information to tailor policies by locality.

We approach this problem with a stylized formal model. In our model (See Appendix Section A1), a national government decides on the area of land to be protected in a local jurisdiction, which we call a municipality for concreteness. Adding protected area furnishes national-level benefits in the form of environmental public goods and enhanced international

[25]To be sure, protected areas can also generate local benefits, such as ecotourism and livelihoods. If these benefits are substantial enough, there is no need for the federal government to interfere. In such a case, the local government can protect the natural resources without federal intervention.

reputation for commitment to environmental conservation. Protected areas, however, carry local costs because they constrain the extraction of natural resources by the local population. Ideally, central authorities should efficiently allocate protected areas in municipalities that have a "comparative advantage" in conservation, for example, those that have relatively low potential for extractive activities or strong local support for conservation. However, we argue that political favoritism can distort the efficient allocation of protected areas by reducing incentives for central authorities to internalize these local costs and benefits.

In this model, political alignment plays a crucial role as it determines whether or not the central government internalizes these local costs when deciding how to allocate protected areas. We assume that the national government reaps the identical benefits from protected areas regardless of who is in power in the municipality, but that the costs vary. If the municipal mayor is from a political party that belongs to the national cabinet, then the national government internalizes the local cost of protected areas to a significant extent. If the municipal mayor is from an opposition party, the national government discounts the local cost. The mayor's role in the federal government's calculus depends on the extent to which local voters and interest groups attribute bad economic outcomes to the federal versus the municipal government. Thus, the national government targets locally costly protected areas to areas controlled by a mayor aligned with an opposition party.[26]

Based on this reasoning, we submit the following hypothesis:

Hypothesis 1. *When a mayoral candidate aligned with the President's party or coalition members wins an election in a municipality, the area under federal protection within that municipality decreases.*

Local costs due to the loss of economic opportunities are borne by two main sectors. One the one hand, protected areas can discourage profitable initiatives from domestic and

[26]Empirically, we are unable to distinguish whether the governments rewards loyal allies or punishes opponents using targeted creation of protected areas. Both mechanisms would be consistent with our formal model and empirical results below.

foreign investors, which will primarily affect local economic elites with ties to extractive industries (timber, mining, agro-industrial, etc.). When President Fernando Henrique Carodoso's (PSDB) issued an executive order creating the park *Montanhas do Tumucumaque* in the state of Amapá, the mayor of Laranjal do Jarí (PSC) complained to be "going through a situation of territorial suffocation, fenced by preservation areas and reserves" that limit "the mineral and vegetal potential of the region, which is economically strategical to the development of municipalities." He was specifically worried about timber, which had the potential to generate 50,000 jobs in five years.[27] These restrictions could also reduce revenue flows to the municipality by reducing potential royalties from extractive activities such as mining, which are transferred directly to municipal government (CFEM, 2006).[28] For these costs, the municipal politician will primarily be concerned with maintaining support of local elites or access to rents.

On the other hand, protected areas can also be costly to local communities who depend on small-scale economic activities, such as hunting, fishing, family farming, or tourism. For example, the designation of *Jací-Paraná* in the town of Burutis, Rondônia, outlawed the presence of 350 untenured laborers, leading the mayor (PT) to call the National Institute for Colonization and Agrarian Reform to intervene and title their land.[29] These costs would be borne by the broader electorate in the municipality, and therefore the local politician's concern would be with maintaining votes, and not access to rents of concentrated elite support.

We argue that the first set of considerations (i.e., rents and elite support) will dominate over the later for three reasons. First, the concentrated costs on the elites will provide better

[27] "Prefeitos protestam contra Reserva do Tumucumaque," *O Dia*, July 11, 2002.

[28] If the distribution of royalties were spread more equally among mining and non-mining municipalities, this would likely change the incentive structure for local politicians as they would not directly benefit from these rents .

[29] "Prefeito defende permanencia de posseiros em resverva extrativista," *Diario da Amazonia*, February 12, 2001.

conditions to organize effectively to influence local politicians than broader, more diffuse costs (Olson, 1965). Second, blame for diffuse economic costs can always be shifted to the national government, which is the sole authority charged with designating national protected areas. Third, costs felt by small-scale activities are easily avoided through strategies of forbearance or limiting enforcement of the law (Holland, 2017), or by designations of protected areas such as extractivists reserves which allow for small-scale exploitation of resources. By contrast, sizable forest clearings and large-scale agriculture are harder to conceal and prone to be monitored by federal agencies more closely (Gibbs et al., 2010).[30]

We focus on political alignment between the federal government and municipalities due to the critical role that municipalities play in Brazilian politics. They are among the most autonomous subnational jurisdictions in Latin America (Nickson, 1995) and enjoy considerable policy authority over a pool of local-level resources (Falleti, 2010),[31] which can be used to meet constituencies' demands and pursue reelection (Samuels, 2003). More important is the alignment between municipal mayors and federal parties. The fragmented nature of the federal party system and the lack of regional presence for many national-level parties necessitates the building of cross-party coalitions to mobilize votes for national elections (Brollo and Nannicini, 2012; Titiunik, 2009). In this relationship, national parties provide preferential access to targeted federal programs while local mayors act as brokers mobilizing voters. Thus, a federal protected area could have implications for mayors' ability to extract local rents and further their electoral goals.

The role of cross-level political alignments in Brazilian politics has been empirically

[30]For example, IBAMA relies on satellite data and field visits to impose fines and embargoes on large rural properties that have been deforesting illegally.

[31]The new 1988 Constitution confirmed the legal status of municipalities as federal entities. Article 30 (Ch. IV) in the Constitution formally listed municipal responsibilities such as the protection of historical and cultural patrimony, the parcelling of land, and the provision of public services like public transportation and schooling. Unlike state governors, mayors also enjoy soft budget constraints—according to Rezende (2007), 40 percent of their budget comes from federal transfers—and can define multiple fiscal instruments to collect taxes.

demonstrated in past research. Focusing on federal-state alignments, Niedzwiecki (2016) finds that when opposition parties govern Brazilian states, they hesitate to use conditional cash transfers as a social policy. Fenwick (2009), on the other hand, finds that the federal government of Brazil used Bolsa Família, a flagship cash transfer policy, despite resistance from opposition state governors. By examining federal-municipal alignments, Brollo and Nannicini (2012) use an electoral regression discontinuity to show that politically aligned municipalities benefit from discretionary transfers from the federal government. Similarly, Ferraz (2007) finds that Brazilian governors approve more environmental licenses for industrial plants in municipalities where the incumbent belongs to his party.

4 Research Design

Our main goal is to identify the effect of political alignment between the national government and the mayor on the designation of federal protected areas in the Brazilian Amazon. To achieve this objective, we use data on the creation of new federal protected areas between the years 1997-2012. With municipal elections at the end of 1996, 2000, 2004, and 2008, we have a large number of bordering municipalities which present variation in the political alignment of the ruling coalition at the federal level and the mayor at the municipal level.

4.1 Empirical Strategy

For causal identification, we utilize a Geographic Regression Discontinuity (GRD) design (Keele and Titiunik, 2015). We examine how the area covered by protected areas close to a municipal boundary changes when one side of the boundary is governed by an aligned mayor, but the other side is governed by an opposition mayor. The GRD design is similar to a normal regression discontinuity, which relies upon a sharp discontinuity in a "running" or "forcing" variable near a specific cutoff that determines whether a unit observation is assigned "treatment," or the casual variable of interest (Lee and Lemieux, 2010). Assuming all other unobserved variation is smooth across this discontinuity, the assignment of treatment will be near random for those observations close to the cutoff point. Here, for our GRD design the running variable is the distance the a municipal boundary, across which the treatment assignment (political alignment) will change. The GRD analysis provides the benefit of being able to interpret variation in the treatment assignment close to border regions of a casual effect given a much weaker set of assumptions that required for normal regression analysis.[32]

Analysis and interpretation of the GRD design is straightforward. Let i denote grid cells and j the municipality pair boundaries under which they can be grouped. The index t denotes years (1997-2012). With this notation, we estimate the following model:

$$Y_{ijk} = \alpha_j + \beta \text{Align}_{ijt} + \epsilon_{ijt}, \tag{1}$$

where β is the coefficient for mayor-ruling coalition alignment. All models contain municipality-pair fixed effects α so that only neighboring grid cells on opposite sides of a given boundary are compared; some also include grid cell and state-year fixed effects. Standard errors are conservatively clustered by municipality-pair throughout.[33]

Figure 1 below gives a visual representation of our estimation strategy, as applied to the specific example of the Balata-Tufari National Forest, designated in 2006 in the Amazonas State. In the map, grid cells that form part of the data set for 2006 are identified according to political coalition status with the president's party (blue for non-coalition, red for coalition). The Balata-Tufari National Forest is identified in light green, and grid-cells

[32] A standard application would be a regression discontinuity design in close electoral races (Lee, 2008), allowing us to identify the causal impact of aligned mayors winning the municipal election on the proportion of a municipality's area under environmental protection. However, this would lead to a considerable loss of observations. The total number of Amazonian municipal elections in the period is 3,204. For a bandwidth of 3 percentage points in vote share around the threshold, the number of observations was 132. For a wider bandwidth (5 percentage points), observations were 237. Hence, loss of statistical power and a higher risk of false negatives precludes us from pursuing this strategy.

[33] Methodological research on such dyadic designs highlights the difficulties associated with estimating confidence intervals when covariates are monadic (Erikson, Pinto, and Rader, 2010). In our case, political alignment is co-determined by partisanship on both sides of the border, and thus we expect the problem of deflated standard errors to be less of a concern.

which overlap the forest are coded with a light-green crosshatch pattern. The protected area primarily covers the Canutama municipality (headed by an opposition mayor at the time), while largely avoiding the neighboring Tapau and Humait municipalities (both in the president's coalition).[34]

[Figure 1 about here.]

4.2 Data and Sample Construction

Our dataset comprises grid cell-year observations of areas proximate to municipal borders within the Brazilian Legal Amazon.[35] The use of grid cells as our level of analysis provides two principal advantages for our study design. First, it facilitates the estimation technique we use to identify a causal impact by allowing us to utilize geospatial data that are within a close distance to a municipal border. Second, we can also greatly increase precision of our estimates by incorporating GIS data from environmental and economic factors, such as preexisting vegetation, rainfall, or suitability of soil for cultivation that may also be predictive of our outcome of interest—the establishment of new protected areas. To construct the dataset, we overlay a grid of 25km^2 hexes over the the entire Legal Amazon. Hexes offer an advantage over square grid cells, which are typically used GIS studies, as they provide a more realistic unit of analysis and greater precision when sampling variables that span over two dimensions of space. One complication that this method of constructing our dataset presents is that municipal borders are not stable, but periodically suffer changes as new municipalities are created. To account for changing municipal boundaries, we overlaid three different maps form the Brazilian Institute of Geography and Statistics (IBGE) over municipal boundaries from 1980, 1991, and 2000. We then accounted for boundary shifts using the founding dates of each municipality and coded grid cells accordingly.

[34]While many federal protected areas stop at municipal borders, 34 out of 71 or nearly half of the protected areas in our final sample crosses at least one municipal border.

[35]The Legal Amazon in Brazil includes the following states: Amapá, Amazonas, Arce, Maranhào, Mato Grosso, Pará, Rondônia, Roraima, and Tocantins.

The GRD design requires that we examine only areas neighboring geographic discontinuities, with the assumption that all other variables not related to the geographic discontinuity (e.g. rainfall, vegetation, suitability for conservation, etc.) are equivalent in expectation on either side of the boundary. The discontinuity of interest to our analysis is the municipal boundary, and we therefore include only grid cells that fall within 25km of a municipal border.[36]

Including grid cells far from the border would compromise our identification strategy and result in potentially biased results. If we found a correlation between alignment and protected area creation in the full sample, it would not constitute evidence for the causal effect of alignment on protected area creation; if we found no such correlation, it would not allow us to reject the existence of such a causal effect. Therefore, given that correlation does not equal causation, our preferred strategy for obtaining reliable causal estimates is to focus on grid cells very near to municipal borders.

Next, we further subset our sample to include only grid cells along a border segment that separates two municipalities that form a treatment-control pairing for a given cohort year. Given that we also control for unique border segments, regression estimates also exclude grid cells that do not show variation in treatment assignment over time. The resulting data set is a partial panel data of grid cell-year observations that exclude all years in which a grid cell does not fall along a border segment of a treatment-control pair. While this method drops many observations from our data set, it is necessary to maintain the requirements of the GRD design, which is only valid when for border segments that separate neighboring municipalities that form treatment-control pairs. Otherwise, if the neighboring municipality were of the same treatment condition (aligned/aligned, or un-aligned/un-aligned) then there would be no discontinuity in treatment assignment around the cutoff of the municipal boundary.

To create this sample, we first code each grid-cell according to the municipal-pair bound-

[36]We also test different cutoffs at 20km, 15km, and 10km, which do not substantively change our results.

ary segment to which it is most spatial proximate. For each year in the dataset we code a given municipality with a dichotomous treatment indicator and drop all grid cells that do not abut a border segment which divides two municipalities with opposing treatment conditions for that year. For example, if Municipality A (treated) is bordered by two others in a given year, Municipalities B (treated) and Municipality C (control), then Municipality A will have two border segments for that year each with a unique municipality-pair coding (A-B and A-C). Since we examine only grid cells with opposing treatment conditions, we then would drop all grid cell observations for grids along the A-B border, as these municipalities are both treated for that year. Grid cells along the A-C border, however would enter into the dataset, as they are along an opposing treatment-control border. A diagram of our subsetting method is included in Figure 2 below.[37]

[Figure 2 about here.]

The resulting sample is summarized in Table 1. We have a total of 121,141 grid cells and 870,719 cell-year observations within 666 unique municipalities and 2,075 municipality pairs. Given the changing municipal borders and the shifting treatment conditions of each municipality, not all grid cells are included in each yearly cohort of the final dataset.

[Table 1 about here.]

4.3 Dependent Variable: Protected Areas

To test our primary hypothesis, we estimate the causal impact of political alignment on the area under federal protection. Our main dependent variable is the fraction of a grid cell's area covered by a federal protected area—i.e., a federal conservation unit. Data on

[37] In a traditional fixed effects approach, we would include any grid cells that see a change in alignment status over time. Our identification is based on the geographic regression discontinuity instead, which is why we drop all treatment-treatment and control-control municipal boundary pairs. As we explain below, variation over time enhances the efficiency of our estimator but is not our core identifying assumption.

protected areas were obtained from shapefiles that the World Database on Protected Areas (WDPA) constructs based on national authorities and NGOs expert partners.[38]. The WDPA is the most comprehensive database on terrestrial and marine protected areas, providing both geographic as well as descriptive information about each area (UNEP-WCMC, 2015). A map indicating all federal protected areas designated between 1997 and 2012 appears in Figure 3. In total there are 89 federal protected areas that were approved in the Brazilian Amazon in this time period, and of these 71 protected areas (79.8 percent) are covered by our data set. The median area of a protected area is 2,110.64 square kilometers—considerably larger than a single grid cell in our data set but comparable to the size of the median municipality (2,060 square kilometers). Importantly, most protected areas either do not cross municipal boundaries or do so only marginally.

[Figure 3 about here.]

There are two subtypes of areas protecting the environment. Strictly protected areas ban any form of extraction and preserve biodiversity, whereas areas for sustainable use aim to protect the environment by regulating extractive activities and promoting local communities' livelihoods. We evaluate whether federal-municipal alignments between the President and mayors shape federal protection in each of these two subtypes separately.

Figure 4 below show the evolution of protected areas over the fourteen years of our data set. As can be seen, the general trend is for a monotonic increase the amount of protected areas declared with a precipitous drop in new areas after 2009. During the entire length of our dataset, only new areas. Although there seems to be a sharp uptick in new protected areas declared during the presidential election years of 2002 and 2006, there does not seem to be a noticeable pattern of declarations of protected areas with the electoral cycles.

As a placebo test, we also estimate similar models with other kinds of protected areas. Given that our focus is on alignment with the federal government, protected areas declared

[38]WPDA 1.0, 2015: `https://www.protectedplanet.net`

by Brazilian states offer us a simple but powerful placebo test: a municipal-federal alignment should not have any impact on the expansion of protected areas that state governors declared.

[Figure 4 about here.]

A second type of federal protection, indigenous areas, provides an additional placebo test. As described, increasing judicialization may obstruct the designation of these areas. Indigenous groups can mobilize their claims in court and force the federal government to initiate demarcation or grant official recognition. Mayors and economic interests can also appeal FUNAI projects, prolonging its creation for long periods of time. Thus, we believe a federal-municipal alignment should not have any effect on the creation of indigenous areas.

Although our focus is on federal protection, we also evaluate the impact of state-municipal party alignments on state protected areas given the marked influence governors have in the Brazilian federal system (e.g., Cheibub, Argelina, and Limongi, 2006). We anticipate that co-partisanship between governors and mayors should have no effect on the creation of state conservation units. Governors are less motivated to forgo opportunities for extraction because the land assets they control are scarcer than those of the federal government. Moreover, Presidents can designate protected areas on state lands, further reducing the amount of land available to them.

4.4 Explanatory Variable: Political Alignment

Our primary explanatory variable is partisan political alignment between the mayor and the President during a given year. We test two measures of political alignment for their impact on the location of new protected areas. First, out principal measure is a dichotomous indicator for membership of a mayor's party within the President's coalition, which we define as the mayor hailing from the same party as any of the parties in the President's cabinet at a given year. Electoral coalitions are particularly important in Brazilian politics due to the highly fragmented nature of Brazil's party system. Although Brazil's two most prominent national parties, the Workers Party (PT) and the Social Democracy Party (PSDB), were in control of the federal executive office for the entirety of our dataset (1997-2012), both parties frequently formed coalitions to mobilize votes and political support. This dynamic frequently influenced policymaking by the federal government, and as has been shown in other studies, decisions on budget allocation and federal transfers (Pereira and Mueller, 2002; Brollo and Nannicini, 2012). The second measure we employ is a simple indicator for direct partisan alignment, in which cases the mayor belongs specifically to the president's party, either the PSDB (Cardoso, 1994-2002) or the PT (da Silva, 2003-2010; Rousseff, 2011-2016). We utilize the equivalent indicators for measuring partisan alignments between the mayor and the state governor.

We draw electoral data from the Superior Electoral Tribunal of Brazil and borrow coalition alignment data from Slough, Urpelainen, and Yang (2017). We plot coalitional patterns between the President and mayors over time in Figure 5 for the included municipalities, distinguishing those did not change (remained allied to the President or in the opposition) from those that shifted their alignment status (became aligned to the President or went to the opposition) from one election to the other. Municipal and federal elections in Brazil occur in October and the change of power begins with the following calendar year, therefore we code alignment beginning in the year following each election.

[Figure 5 about here.]

4.5 Identifying Assumptions

Our research design combines variation from two sources: across space and over time. The core of the design is the geographic regression discontinuity design that compares grid cells right at the border of a municipality to those on the other side of the border. This geographic proximity ensures that the two grid cells are geographically similar to each other, so that differences between them can be attributed to differences created by the municipal boundary.[39]

An essential assumption for any regression discontinuity design is that all other variation in observable and unobservable covariates should be smooth across the cutoff point—here, the municipal boundary. Researchers in econometric analyses typically interpret this assumption as the inability of subjects to have precise control over the running variable (Lee and Lemieux, 2010). As grid cells are attributes fixed in space, our concern is not with sorting of subjects around the boundary but with unobservable variation in factors unrelated to a mayor's political alignment that are predictive of whether or not central authorities will declare a new protected area over a grid cell. While the smoothness of unobserved variation over the cutoff point is not directly testable (Lee and Lemieux, 2010), a common check for this assumption is to conduct a balance test for observable covariates to test if any discontinuity exists in these variables. A statistically significant correlation between treatment assignment and a set of covariates would indicate that values of those covariates are not smooth across the discontinuity, and that the fundamental assumption of the regression discontinuity design has been violated.

To check this assumption, we conduct a balance test by running the same model as describe in equation (1) above but replacing the dependent variable with one of 36 different pre-treatment covariates that are likely predictive of the designation of new protected areas. The balance tests for the 1996 elections are exhibited in Figure 6; Section A2 offers additional detail on variables used and shows a set of tables with similar balance statistics for the other elections (2000, 2004, 2008) in the sample. As graph and the tables show, very few of the covariates differ across aligned versus non-aligned grid cells, consistent with the

[39]In GRD, a common problem is that of compound treatments (Keele and Titiunik, 2015). For example, observations on different sides of a national boundary could be different for many reasons so that causal interpretations of the discontinuity would be difficult to sustain. In our case, we have over 2,000 municipality pairs and our specifications include pair fixed effects to remove any cross-sectional differences. Thus, the issue of compound treatment is unlikely to arise in our setting.

core assumption of the GRD: the municipal boundary discontinuity removes any imbalances between units in the treatment and control groups.

[Figure 6 about here.]

The geographic discontinuity itself can be strengthened by exploiting variation over time (Cooper, Kim, and Urpelainen, 2018). Municipal boundaries create differences for many reasons, among which political alignment is only one. If we only had a cross-section of municipalities, we might face a situation in which variation in political alignment would be associated with other municipal characteristics, such as public opinion or economic structure.

To overcome this issue, we can exploit variation over time from elections. In many of our models, we either include grid-cell fixed effects or control for the fraction covered by protected areas before 1997. These models allow us to compare changes in the *expansion* of protected areas over time as patterns of political alignment change. In essence, we conduct the following thought experiment: if elections lead to federal-municipal political alignment in one municipality, how does the coverage of protected area change relative to the business-as-usual change in a neighboring municipality? To conduct the thought experiment as rigorously as possible, we only focus on grid cells that are very close to the border. This thought experiment is based on the GRD, but it allows us to rule out potential cofounders and also increases the precision of our estimates by ruling out cross-municipal differences. In these specifications, the effect of alignment is identified based on variation over time within a given municipality.

We further test the theoretical assumptions underpinning of our research design with two placebo tests. Given that our focus is on the President's regulatory choices, we test whether political alignment shapes the creation of state protected areas and indigenous peoples' areas. These two types of protected areas are not fully controlled by the President, so we would expect political alignment, as we have defined it, not to have any impact on their creation.

While focusing our empirical analysis on border regions sharpens our causal identification and reduces the need for modeling assumptions, it could introduce bias through spillover effects from neighboring municipalities. However, given our design we argue that spillovers across borders should not affect our results. Unlike the siting and allocation of environmentally harmful activities (Rasmussen, 1992; Helland and Whitford, 2003), the economic "costs" associated with conservation are limited to areas directly affected by the protected area designation. Therefore, protected areas along a municipal border should have no adverse consequences on resources extractive activities in the neighboring, non-protected municipality.

5 Findings

We begin with the primary analysis of federal protected areas and then contrast the results with indigenous areas and state protected areas as a placebo test. Lastly, we discuss the results on governor-mayor alignments and state protected areas.

5.1 Main Results

The results are shown in Table 2. The unit of analysis is a cell-year and the dependent variable the fraction of the cell-year covered by federal protected areas. The models vary by the inclusion of a control variable and fixed effects. All models include municipality-pair fixed effects which capture the effect of lying upon each unique municipal border segment. We also cluster standard errors by municipality-pair in all models. Model 1 includes a control covariate for the proportion of the grid cell covered by federal protected areas declared prior to 1997, the first year in our dataset. Models 2 and 3 also incorporate grid cell fixed effects, which account for prior years of protected area designation within a grid cell, and Model 3 includes state-year fixed affects to control for state-level time trends.

[Table 2 about here.]

The table offers robust support for the hypothesis that political alignment shields municipalities from the local burden of federal protected areas. Across all three models, the mayor's alignment with a party from the president's coalition reduces the incidence of protected areas by 1.0 to 1.2 percentage points. The substantive effect is very large relative to the sample mean for protected area coverage, which is 0.038 of a grid's total area. While results from geographic discontinuity designs need to be extrapolated to other territories with care, these results suggest that municipalities with political alignment have anywhere between 26-32% less protected area than the average municipality in Brazilian Amazon. Substantively, a decrease of 1.2 percentage across the entire Amazon—an area of 5.5 million square kilometers—would amount to 66,000 square kilometers, a large difference.

We also test whether different types of federal protected areas present higher or lower incidence of political manipulation by subsetting our dependent variable for strict protection (which excludes all economic activities) and more lenient sustainable use areas, which permits limited, small-scale agricultural use. Although all coefficient estimates for these alternative subsets of our dependent variable are in the same (negative) direction, they are no longer statistically significant (results are included in Appendix Table A6). These results indicating that the exclusion of large development projects (cattle, soy, etc.) is likely the main driver of the political decisions influencing protected area declarations.

5.2 Exploring Incentives for Environmental Protection and Causal Mechanisms

In this section we explore additional evidence on the causal mechanisms and incentives behind our main finding that political alignment affects the specific placement of protected areas. We begin by testing the different economic drivers which underlie our proposed theoretical model. If political incentives affect the targeting of protected areas as we predict, then we would expect to see greater bias in favor of political allies in areas with higher economic potential. This is an intuitive prediction, as national politicians would avoid limiting economic gains of local allies only in areas in which the potential for economic development, and not in areas which would otherwise be unsuitable for exploitation.

We test this mechanism by interacting model (1) above with three different measures of economic potential. The first is the percentage of a grid-cell deforested prior to 1997. This measure captures total economic potential for exploitation through either timber extraction or agricultural development. The second and third measures test the specific impact of the agro-climatically attainable yield a grid-cell for cattle pastures or soybean cultivation, two of the main drivers of deforestation in the Brazilian Amazon, in the 1961-1990 period. They are suitability measures expressed in potential kilograms per hectare. They come from Food and Agricultural Organization workability data set.[40] All models use municipal pair fixed effects and control from pre-1997 federal protected areas.

[Table 3 about here.]

Results in Table 3 show that prior deforestation has a statistically significant and positive interaction effect with alignment, while the coefficient estimate on Coalition Alignment maintains its direction and significance as well. This indicates that the political incentives for targeting protected areas only operates in grid-cells that have potential for economic development, that is, areas that can be exploited for timber extraction or agricultural use. To better illustrate this interaction, we plot the marginal effect of prior deforestation on the effect of coalition alignment in Figure 7. As can be seen in the chart, as the proportion of a grid-cell deforested approaches 1, the effect of political bias on targeting reduces to zero, as predicted by our theory. However, suitability for pastures and soybean production produce null effects. This indicates while the economic incentives are likely at play, there is no one particular land use which is the main driver of political targeting.

[Figure 7 about here.]

[40] GlobalAgro-EcologicalZones(FAO),http://www.fao.org/nr/gaez/en/

Next, we examine the dynamics of establishing protected areas for lower levels of government. In Table 4 we examine the impact of alignment between state governors and mayors on state protected areas. These models provide a test for the impact of positive incentives for environmental protection, specifically—the role of international actors and civil society organizations promoting the creation of new protected zones. We expect that state governors are more isolated from broader national and international pressure to dedicate new protected regions. Due to lack of incentives favoring conservation for governors, we expect political alignment—i.e., the mayor is from the same party of the governor—to have no effect on the area under subnational protection. As we did for federal protected areas, we subset our dependent variable and distinguish between strictly protected and sustainable use areas (Table A7 in appendix).

[Table 4 about here.]

The table shows that state protected areas are not affected by governor-mayor alignment—coefficients have a positive sign and are indistinguishable from zero. Hence, the party of the mayor does not have an impact on the governor's decision to create state protected areas. This result could be indicative that the positive pressure to protect the environment is not operable on the state level, or at least is not strong enough to counteract the economic incentives to maintain access to lands for economic development. However, it could also reflect the lack of political structures linking state and local politicians in Brazilian politics. Future studies could further explore this interaction of state and local politicians to understand why political targeting does not occur on the regional level.

5.3 Placebo Test – State and Indigenous Protected Areas

Finally, we conduct a placebo test to check if the results change for different types of protected areas for which the federal government does not have similar discretion regarding targeting and approval. In Table 5, we compare federal protected areas to indigenous lands and state protected areas. Given Brazil's rules for the designation of indigenous and state protected areas, political alignment should have no effect on them, as the President's cabinet has little or no influence whatsoever on their creation. The table shows the results from regression analyses of different types of protected ares depending for three models from our main analysis. Figure 8 provides a visual comparison of the main coefficient estimates and 95% confidence interval bounds for the coalition alignment indicator from each model.

[Table 5 about here.]

[Figure 8 about here.]

The results of this analysis are consistent with our expectations. While political alignment has a large and negative effect on the creation of federal protected areas, neither indigenous nor state protected areas change because of political alignment. The coefficients for the latter two types are both positive but very small and with wide confidence bounds. Thus, mayor-coalition political alignment has a negative effect on those types of protected areas that the president can declare under the Brazilian Constitution and legislation, but not on other types.

6 Conclusion

For political scientists, the declaration of protected areas to conserve biodiversity and natural resources offers opportunities to learn about the politics of multi-level governance. Protected areas demonstrably produce public goods at the global, regional, and national levels, but they also constrain livelihood activities at the global level. When governments grapple with these issues, they must thus balance political and economic considerations across different levels. Here we have found that local politics plays a major role in this process in Brazil: to avoid an electoral backlash, the federal government allocates protected areas to municipalities with opposition mayors.

Ours is among the first attempts to identify the causal effect of political alignment—a major topic in general political science—on environmental policy. Drawing inspiration from the literature on fiscal federalism, we have found that central governments can be quite sophisticated in their design of protected areas. While earlier generations of environmental federalism assumed that central policies must be uniform and are difficult to tailor to local conditions (Oates, 2005: e.g.,), our results suggest otherwise. Political alignments between local and federal governments lead to a politically motivated allocation of protected areas. Thus, earlier studies have possibly underestimated the ability of central governments – whether in federal or other polities – to tailor their policies for concrete political gain.

The normative implications, however, are troubling. If political alignment drives the declaration of protected areas, then there is a real risk that protected areas are not cost-effective in protecting the environment. Earlier studies in Brazil have already found suggestive evidence for protected areas that appear ineffective (Joppa and Pfaff, 2009), and our study offers a potential explanation for this pattern. When the federal government shields politically aligned mayors from the local costs of protected areas, the distribution of protected areas is skewed. The federal government's pursuit of political gains from favoring co-partisan mayors means that protected areas are not necessarily placed in locations that produce the greatest gains in reduced deforestation, conversed biodiversity, indigenous livelihoods, and other social goals.

The two negative consequences of politically motivated designation are (i) conservation of areas that do not warrant it and (ii) the lack of conservation in environmentally important areas. The former could hurt local economies and even mobilize a political backlash against protected areas in general. The latter could allow the irreversible destruction of biodiversity and habitat where the economic gains fall well below the conservation value. In an extreme case, politicians could even decide to remove previously protected areas, creating the kind of policy uncertainty and unpredictability that hurts the environment and makes economic planning difficult at the municipal level.[41]

Ours is an early effort to understand these dynamics, and we see many future opportunities for rigorous political science research on this frontier. Political alignments across levels of government are globally important, as almost all countries in the world have multiple levels of government. Brazil is the world's most important host of protected areas, but studying the distribution of protected areas elsewhere in Latin America or perhaps in China, India, Russia, and the United States, could offer valuable insights into the generalizability and external validity of our findings, as well as the modifying effects of variation in political institutions.

[41]For example, in February 2017, state legislators proposed to President Michel Temer the removal of one million hectares of protected area in five designations. See https://news.mongabay.com/2017/03/new-bill-aims-to-cut-protection-to-1m-hectares-of-brazilian-rainforest/ (accessed May 14, 2018).

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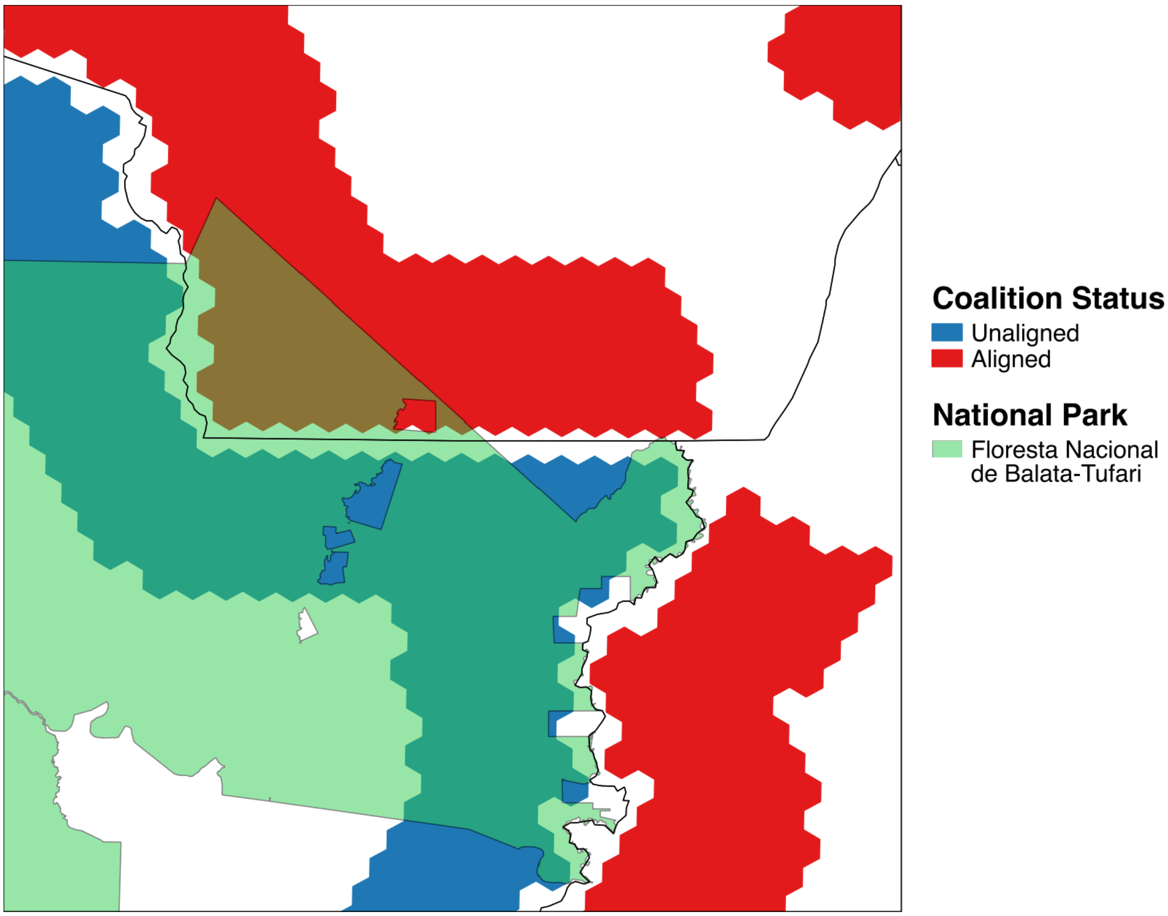

Figure 1: Map of sample grid-cells overlapping the Balata-Tufari National Forest, designated in 2006 in the Amazonas State. Blue cells represent areas in the non-coalition municipality of Cautama, while red cells represent neighboring coalition municipalities of Tapau and Humait.

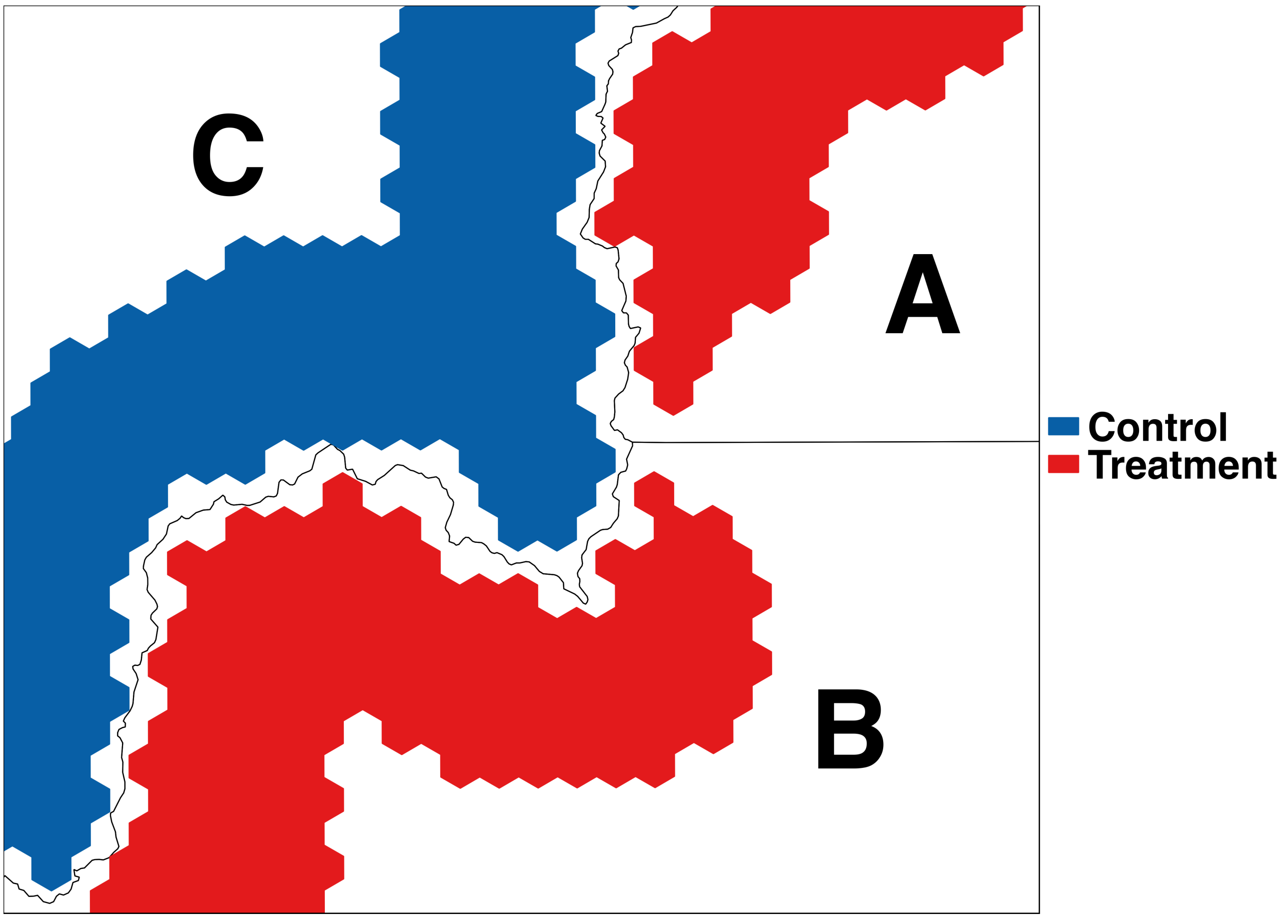

Figure 2: Diagram of sample selection along border between three municipalities. Sample grid hexes are indicated by red (treatment) and blue (control) colors. Hexes along the A-B municipal border are dropped as they have the same treatment status.

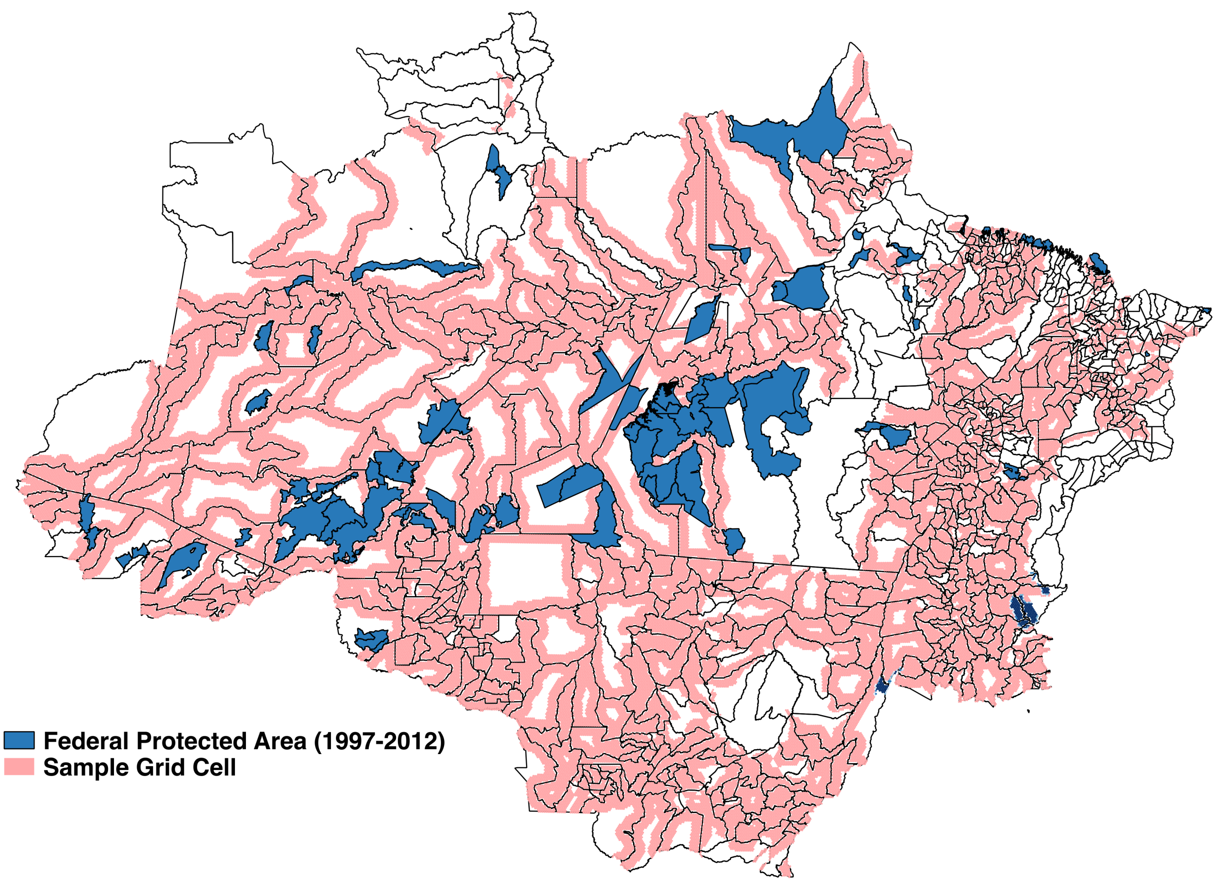

Figure 3: Map of Federal Protected Areas designated between 1997 and 2012 in the Legal Amazon with sample grid cells.

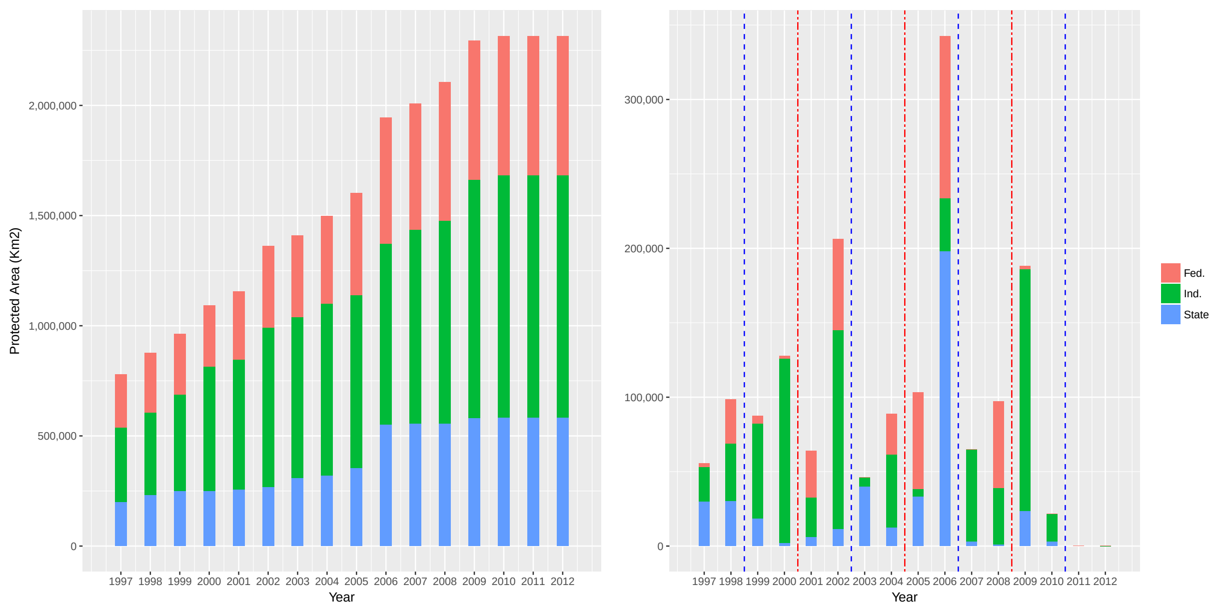

Figure 4: Time series of protected areas declared in the Legal Amazon by km^2 of land and differentiated by Federal, Indigenous, or State protected area from 1997-2012. **Left:** Includes a cumulative count of protected hectares. **Right:** Shows only newly declared protected areas for that year. Blue dashed lines represent years of presidential elections and red dashed lines show years of municipal elections.

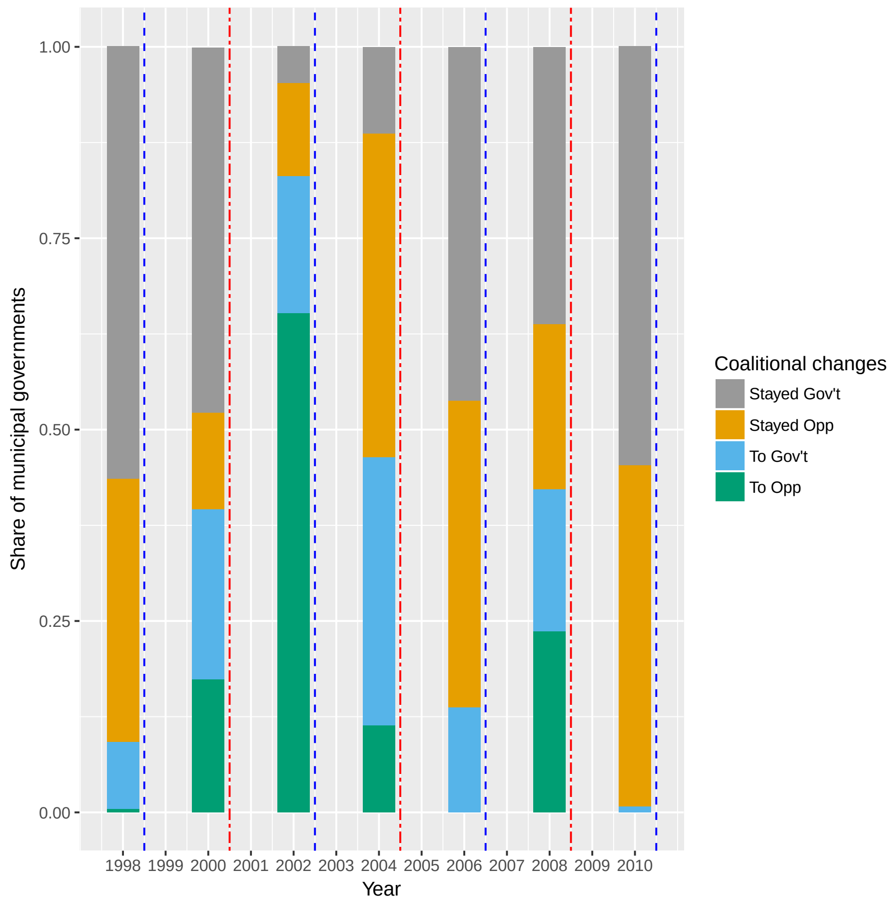

Figure 5: Time series of shifts in coalitional alignments between the President and mayors from 1997-2012 for the 666 unique municipalities. Blue dashed lines represent years of presidential elections and red dashed lines show years of municipal elections. Re-alignments usually occur every two years when either national or local elections take place.

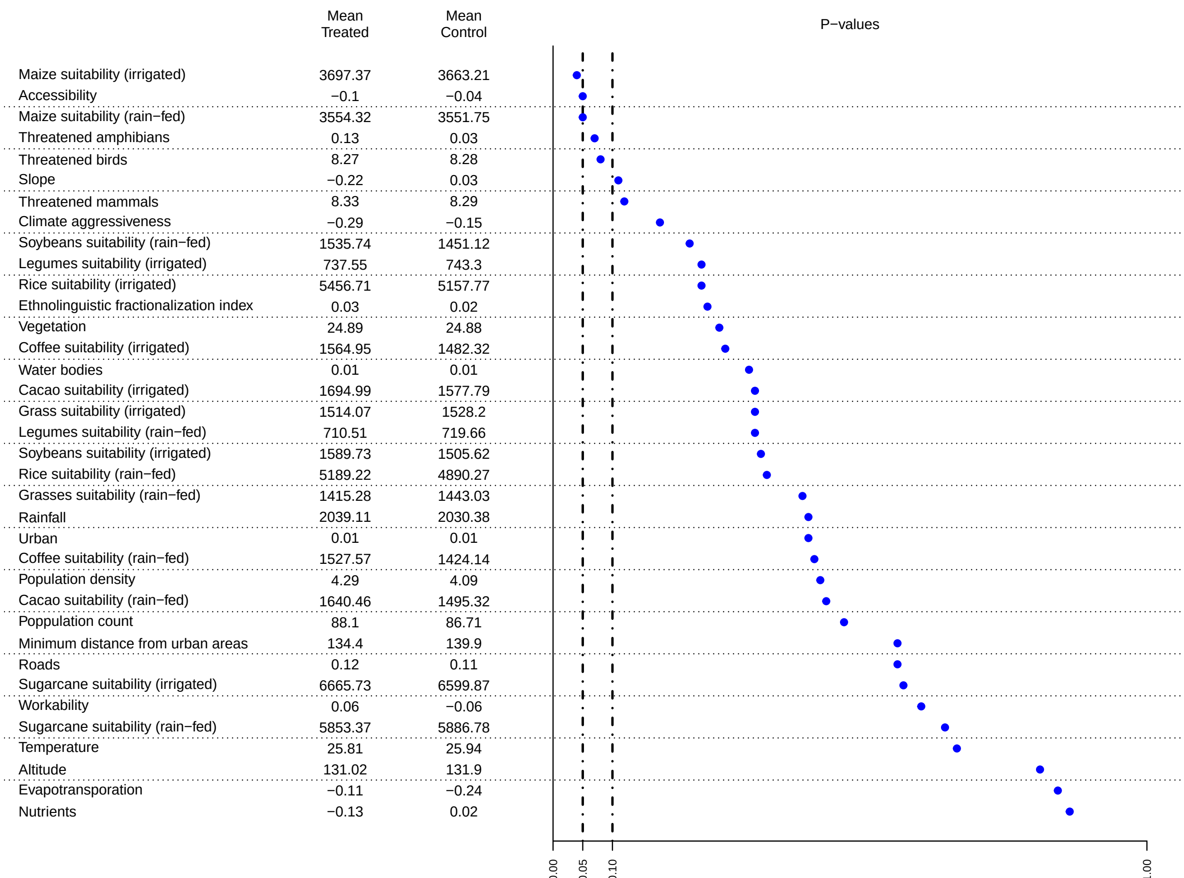

Figure 6: Balance test for 36 pre-treatment covariates

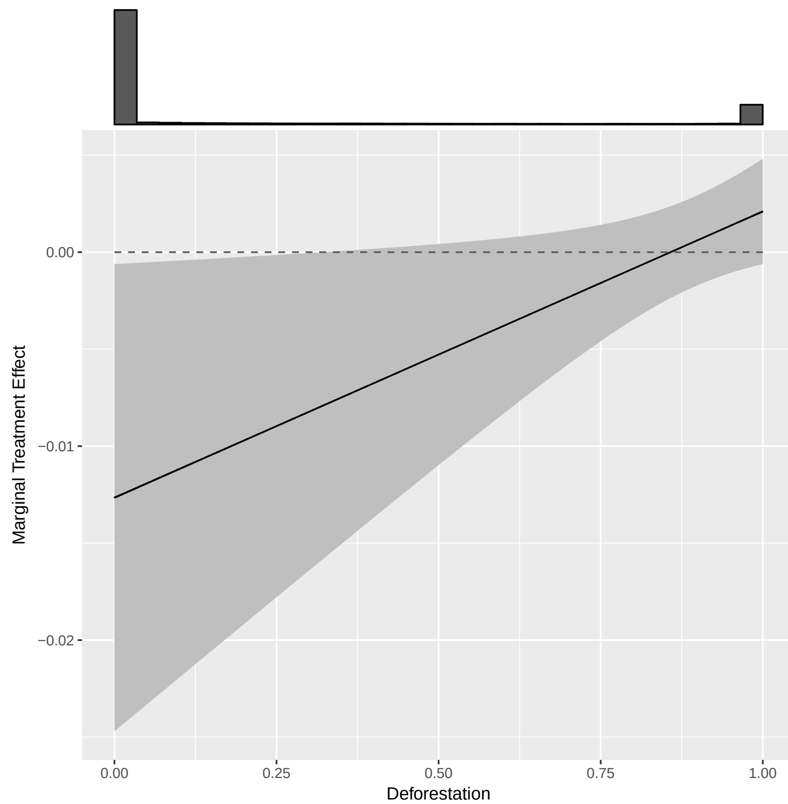

Figure 7: Plot of the marginal effect of prior deforestation on the impact of Coalition Alignment. Grey bands represent 95% Confidence Interval estimates.

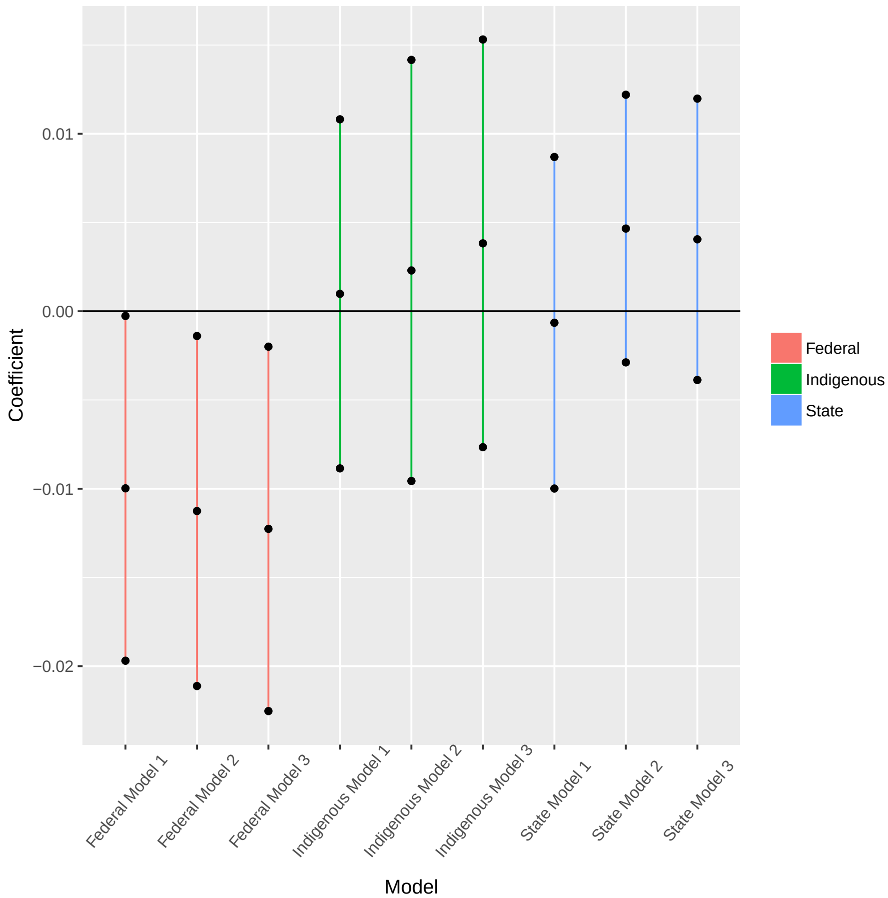

Figure 8: Coefficient plot comparing treatment effect for different dependent variables (Federal Protected Areas, Indigenous Areas, and State Protected Areas).

	Coalition Alignment
Years	1997 - 2012
All Observations	
Observations	870,719
Grid Cells	121,141
Municipalities	790
Muni. Pairs	2,075
Protected Area	40,232
Treated Observations	
Observations	434,076
Protected Area	17,731

Table 1: Summary statistics for border grid cells in the entire sample (All Observations) and for only treated observations (grid cells in aligned municipalities).

	Dependent variable:		
	Federal Protected Area		
	(1)	(2)	(3)
Coalition Alignment	-0.010^{**}	-0.011^{**}	-0.012^{**}
	(0.005)	(0.005)	(0.005)
Fed. Prot. Area ('97)	-0.027^{***}		
	(0.010)		
Muni. Pair FE	Yes	Yes	Yes
Grid FE	-	Yes	Yes
State-Year FE	-	-	Yes
Cluster SE	Yes	Yes	Yes
Muni. Pairs	2075	2075	2075
Unique Grids	121,141	121,141	121,141
Observations	870,719	870,719	870,719
Adjusted R^2	0.310	0.644	0.683
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table 2: Effect of coalition alignment on area covered by federal protected area. The unit of analysis is a cell-year. The standard errors of the linear model are clustered by municipality-pair to account for the clustering of the treatment, as well as possible spatial correlation between treatment and control units.

	Dependent variable:		
	Federal Protected Area		
	(1)	(2)	(3)
Coalition Alignment	-0.013^{**}	0.023	-0.018
	(0.006)	(0.023)	(0.011)
Fed. Prot. Area ('97)	-0.029^{***}	-0.027^{***}	-0.028^{***}
	(0.010)	(0.010)	(0.010)
Deforested	-0.029^{***}		
	(0.008)		
Alignment:Deforested	0.015^{**}		
	(0.007)		
Pastures		0.0001	
		(0.0002)	
Alignment:Pastures		-0.00003	
		(0.00002)	
Soybean			-0.00004
			(0.0001)
Alignment:Soybean			0.00001
			(0.00000)
Muni. Pair FE	Yes	Yes	Yes
Grid FE	-	-	-
State-Year FE	-	-	-
Cluster SE	Yes	Yes	Yes
Muni. Pairs	2075	2075	2075
Unique Grids	121,141	121,141	121,141
Observations	870,719	870,719	870,719
Adjusted R^2	0.310	0.310	0.310
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table 3: Triple interaction models with proportion of grid cell deforested, suitability for soybean production, and suitability for cattle pasture (pre-1997).

	Dependent variable:		
	State Protected Area		
	(1)	(2)	(3)
State Coalition Alignment	-0.005	-0.004	-0.001
	(0.004)	(0.004)	(0.004)
State Prot. Area ('97)	-0.047^{*}		
	(0.026)		
Muni. Pair FE	Yes	Yes	Yes
Grid FE	-	Yes	Yes
State-Year FE	-	-	Yes
Cluster SE	Yes	Yes	Yes
Muni. Pairs	2040	2040	2040
Unique Grids	114,441	114,441	114,441
Observations	788,707	788,707	788,707
Adjusted R^2	0.359	0.709	0.734
Note:	*p<0.1; **p<0.05; ***p<0.01		

Table 4: Effect of governor-mayor party alignment on area covered by state protected area. The unit of analysis is a cell-year. The standard errors of the linear model are clustered by municipality-pair (only within state boders) to account for the clustering of the treatment, as well as possible spatial correlation between treatment and control units.

	Dependent variable:								
	Federal Protected Area			Indigenous Lands			State Protected Area		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Coalition Alignment	-0.010^{**}	-0.011^{**}	-0.012^{**}	0.001	0.002	0.004	-0.001	0.005	0.004
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.004)	(0.004)
Fed. Prot. Area ('97)	-0.027^{***}								
	(0.010)								
Indigenous Lands ('97)				-0.111^{***}					
				(0.028)					
State Prot. Area ('97)							-0.044^{**}		
							(0.020)		
Muni. Pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grid FE	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes
State-Year FE	-	-	Yes	-	-	Yes	-	-	Yes
Cluster SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Muni. Pairs	2075	2075	2075	2075	2075	2075	2075	2075	2075
Unique Grids	121,141	121,141	121,141	121,141	121,141	121,141	121,141	121,141	121,141
Observations	870,719	870,719	870,719	870,719	870,719	870,719	870,719	870,719	870,719
Adjusted R^2	0.310	0.644	0.683	0.377	0.723	0.764	0.326	0.733	0.754
Note:									*p<0.1; **p<0.05; ***p<0.01

Table 5: Effect of coalition alignment on area covered by federal protected area by type of area (strict protection vs. sustainable use). The unit of analysis is a cell-year. The standard errors of the linear model are clustered by municipality-pair to account for the clustering of the treatment, as well as possible spatial correlation between treatment and control units.