30º Prêmio Tesouro de Finanças Públicas

Revista
Cadernos de Finanças Públicas

2026

Edição Especial

TESOURONACIONAL

Farmers and environmental management expenditures: An analysis of Brazilian municipalities between 2004 and 2020

Bruno Thadeu Correa Miranda

Universidade de São Paulo - USP

ABSTRACT

This dissertation investigates the impact of electing Brazilian mayors with agricultural backgrounds on budgetary expenditures for environmental management from 2004 to 2020. To address potential endogeneity issues, since factors that influence the election of farmer mayors may also affect the outcomes analyzed, we employ a regression discontinuity design (RDD) focusing on close elections. The results indicate that municipalities governed by mayors with agricultural backgrounds experience larger reductions in environmental expenditures compared to those led by mayors from other sectors. Finally, we explore the heterogeneity of the effect across different contexts, considering possible variations in median voter preferences.

Keywords: Farmer Mayors, Close Elections, Budgetary Expenditures, Brazil..
JEL: H72, D72, Q58

SUMMARY

1. INTRODUCTION 4
2. CONTEXT 7
2.1 Decentralization of Brazilian Environmental Policy *7*
2.2 Environmental Management Expenditures *10*
2.3 Brazilian Farmers *13*
3. THEORETICAL BASIS 15
3.1 Model *16*
4. EMPIRICAL STRATEGY AND DATA 19
4.1 RDD *19*
4.2 Data Source *21*
4.3 Sample Selection *21*
5. RESULT 27
5.1 Main *27*
5.2 RDD Validity *29*
5.3 Robustness *31*
5.4 Heterogeneity *31*
6. CONCLUSION 34
BIBLIOGRAPHICAL REFERENCES 36
Appendix A – Supplementary figures and tables 43
Appendix B – Budget expenditure execution 50

1. INTRODUCTION

The concept of a benevolent political agent who seeks to maximize social welfare is widely adopted in traditional models of public sector economics. However, this assumption can be revisited using alternative approaches that consider this agent as someone who acts to maximize their own welfare by capturing private benefits through their position in public office. Brazilian environmental policy offers us a scenario for analyzing this problem, since environmental preservation is a responsibility shared by all federal entities in the country, while the exploitation of natural resources may serve the individual interests of local government officials.

In this context, this dissertation examines whether a certain profile of government official acts differently from others. More specifically, we investigate whether Brazilian mayors with direct links to the agricultural sector adopt different patterns of municipal public budget allocation for environmental management.

The profile chosen is that of mayors with direct links to the agricultural sector, classified as farmers based on the methodology of Bragança and Dahis (2022), based on the occupations declared by the candidates. These politicians comprise an influential interest group in Brazil, historically opposed to environmental conservation policies (Helfand, 1999; Richardson, 2012; Bruno, 2017; Milmanda, 2019; Bragança; Dahis, 2022). Their political and economic consolidation intensified after the 1988 Brazilian Federal Constitution, drafted in the context of redemocratization and marked by increased civil society participation. This new institutional environment was strategically exploited by these actors, who managed to overcome obstacles such as territorial dispersion and productive diversity. On the other hand, the same environment favored achievements by the environmental movement, such as the incorporation of Article 225 into the Constitution, which recognizes the right of all to an ecologically balanced environment, in addition to providing, in Article 23, for the common responsibility among federal entities for environmental protection and preservation (Brazil, 1988). In the following years, the legal framework for environmental policy was regulated to enable, in practice, the decentralization of management among federal entities.

We obtained data from the Superior Electoral Court (TSE) on all candidates in the 2004, 2008, 2012, and 2016 municipal elections. The information includes age, gender, education (level of schooling completed or not), marital status, occupation, and campaign financing. Candidates who declared themselves to be farmers accounted for 16.2% of the mayors elected in these elections.

The TSE data also includes the number of votes received by each candidate in each election, both in the first and second rounds, when applicable. Based on this information, we calculated each candidate's margin of victory over the runner-up. We then filtered the municipal elections in which the top two candidates were a farmer and a non-farmer, regardless of their order of placement. On this basis, we implemented the Regression Discontinuity Design (RDD) method to explore close electoral contests between these candidate profiles. Unlike traditional RDD designs, the treatment here is defined by a predetermined characteristic of the candidate, in this case, their occupation as a farmer.

We start from the understanding that the distribution of the public budget largely reflects the priorities of the government, even though it may be conditioned by institutional norms and limitations. That said, we use the expenditures executed under the Environmental Management function, defined by the functional classification of budget expenditures of Brazilian federal entities, as an indicator of a municipality's commitment to environmental preservation. Unlike education and health expenditures, which are budget-linked and partly mandatory, spending on environmental management, especially in the context of the decentralization of environmental policy in Brazil, is discretionary. Additionally, we consider the overlap between the exploitation of natural resources and the responsibility for environmental preservation as a potential conflict of interest that a mayor would face. Therefore, we assessed whether those with direct links to the agricultural sector allocate their budgets differently from others, as they would have specific incentives to reduce the priority given to the environmental agenda.

The results indicate that municipalities with elected farmer mayors showed, on average, annual reductions of 7.69% in per capita spending on environmental management, compared to an average of 0.80% for non-farmer mayors, resulting in a difference of 6.9 percentage points. Considering the total level of expenditure, the difference between the groups was 7.15 percentage points. In the heterogeneity analysis, we examined how the effect of the election of farmer mayors on environmental spending varies according to municipal and political characteristics. In municipalities with higher gross value added from agriculture and livestock, the estimated effect does not differ significantly from the general sample. In municipalities with greater electoral support for a national environmentalist leader, the effect on per capita spending was greater in magnitude. Non-reelectable farmer mayors showed more pronounced reductions in environmental spending compared to reelectable ones. The results suggest variations in the effect associated with electoral incentives and the profile of the local electorate in interaction with the preferences of those who occupy the municipal executive branch.

We performed the tests commonly used in the literature to assess the validity of the method for identifying the effect, including the margin of victory density test proposed by McCrary (2008), the covariate continuity test, and the bandwidth variation test. The presence of outliers in environmental expenditures, associated with an asymmetric distribution with a concentration of values in a few observations, required specific treatment, with the exclusion of these extreme values. We also tested alternative specifications, varying the presence of fixed effects and control variables.

This dissertation relates to literature that examines budget expenditures, specifically those classified under Environmental Management, which has documented the low representation of these expenditures in the public budget. Some of these studies adopt a descriptive approach, using indicators in absolute and relative values, both nationally (Amarante; Moreira, 2009; Tridapalli et al., 2012; Bueno; Oliana; Borinelli, 2013; Dantas et al., 2015; Cota, 2017; Pereira; Neto, 2020) and regionally, such as in the Legal Amazon (Avelino et al., 2021) and state capitals (Guandalini; Borinelli; Godoy, 2013), also focusing on the proportion of sub-functions within the category. The contribution of this research differs in that it employs econometric methods of causal inference to investigate political determinants of environmental budget allocation.

In this sense, this research contributes to the literature on the determinants of environmental policy by considering the position of farmer as a characteristic that influences the behavior and decisions of a mayor. The literature indicates that individual attributes of government officials also shape policy formulation (Bruce et al., 2022; Alesina; Cassidy; Troiano, 2019; Besley; Montalvo; Reynal-Querol, 2011; Pettersson-Lidbom, 2008). Politicians respond strategically to electoral incentives, including on issues often treated as secondary, such as the environment (List; Sturm, 2006). The interaction between voters, elected officials, and institutions in the formulation of these policies is highlighted by Oates and Portney (2001), Stokes (2016), and examined empirically by Fredriksson, Wang, and Mamun (2011) using a regression discontinuity design. Within the same theoretical framework of political economy and also using RDD, Beland and Oloomi (2017) demonstrate that Democratic governors are associated with lower levels of pollution, highlighting the effects of different characteristics of governors on environmental policies, as well as demonstrating that these governors prioritize social areas in budget allocation. Similarly, Pacca et al. (2021) also explore the influence of party affiliation, but with a specific focus on environmental spending and incorporating lobbying and electoral incentives. Finally, by providing empirical evidence on this process, this dissertation dialogues with theoretical models of political economy that formalize how the individual preferences of

political actors, when interacting with electoral and interest group pressures, shape their public decisions (Grossman; Helpman, 1994; Bardhan; Mookherjee, 2000; Yu, 2005).

The dissertation is organized as follows: after this introduction, the second section briefly presents a contextualization of decentralized environmental policy in Brazil, the framing of environmental management as a budgetary subfunction, and the role of farmers as an interest group. In the following section, we present the theoretical model that guides the analysis. The fourth section details the data used and the empirical strategy adopted. The results are presented and discussed in the fifth section. The conclusion is the subsequent section, and the appendix brings together complementary materials.

2. CONTEXT

2.1 Decentralization of Brazilian Environmental Policy

According to Moura (2016), Brazil's current environmental policy can be understood as the result of a process that began in the 1930s, when pioneering milestones such as the Water Code and the Forest Code, both from 1934, established the regulatory basis for natural resource management. Between 1930 and 1960, however, the country lacked a structured environmental policy and specialized state agencies. The issue appeared only tangentially in sectoral policies aimed at resource exploitation, guided by the principle of rational use to maximize economic returns and, on certain occasions, influenced by multilateral organizations such as the World Bank and the United Nations system. In 1967, the Brazilian Institute of Forest Development (IBDF) was created, linked to the Ministry of Agriculture, with the task of enforcing the Forest Code, promoting forestry, and managing conservation units. A few years later, in 1973, the Special Secretariat for the Environment (Sema) was established at the federal level, linked to the Ministry of the Interior, responsible for controlling industrial and urban pollution, generally in response to complaints. Sema also structured its own program of protected areas, whose powers were later incorporated by the Brazilian Institute of the Environment and Renewable Natural Resources (Ibama). This model of federal organization served as a reference for the creation of state environmental agencies (Moura, 2016; Lima, 2016).

In the 1980s, with the enactment of the National Environmental Policy (Brazil, 1981), the National Environmental System (Sisnama) and the National Environmental Council (Conama) were established, which defined principles, guidelines, and instruments of environmental po-

licy, distributed powers among federal entities, institutionally organized the sector, controlled pollution and environmental degradation, and strengthened social participation (Araújo, 2013). According to Moura (2016) and Lima (2016), environmental policy was elevated to ministerial level in 1985 with the creation of the Ministry of Urban Development and the Environment, whose responsibility was to formulate guidelines and coordinate government actions in the sector, while Conama issued resolutions that structured the environmental licensing system still in force today.

According to Maria Osmarina Marina da Silva Vaz de Lima (Marina Silva), the 1987/1988 National Constituent Assembly marked the transition from understanding the environment as merely the protection of fauna and flora to recognizing its centrality in the country's development model. This was largely the result of the coordinated efforts of the Green Parliamentary Front and the National Ecological Action Front, which mobilized parliamentarians and civil society around the environmental agenda (Lima, 2008). The most significant outcome of this process was the inclusion of a chapter on the environment in the 1988 Federal Constitution, in Article 225, which enshrined an "ecologically balanced environment" as a right for all and imposed related duties on the state and the community (Brazil, 1988). According to Moura (2016), the defense of the environment was also enshrined as a fundamental principle of the economic order (Article 170, Item VI) and relevant references were inserted in provisions relating to property, urban management, and water resources. The new constitution also prompted important infra-constitutional improvements, such as the National System of Conservation Units Law, the Environmental Crimes Law, and the Water Law, and favored the decentralization of environmental policy by assigning joint executive authority to the federal government, states, and municipalities (Lima, 2008; Araújo, 2013).

In 1989, the "Nossa Natureza" (Our Nature) program unified the sectoral agencies within Ibama, centralizing environmental policing, licensing, authorization for the use of natural resources, and federal oversight, while the National Environment Fund (FNMA) was created in the same year to finance, with social participation, the implementation of the National Environment Policy that had already been created in 1981. The expectations surrounding Rio-92 led to the creation of the Secretariat of the Environment of the Presidency (Semam/PR) in 1990, whose debates during the 1992 conference consolidated guidelines that are still in force in the Brazilian environmental agenda. Subsequently, the Ministry of the Environment (MMA) replaced Semam/PR in 1992, becoming the core of Sisnama. Finally, in 2007, the Chico Mendes Institute for Biodiversity Conservation (ICMBio) was separated from Ibama, which retained

licensing and enforcement responsibilities, while the new institute took over the management of conservation units systematized in the National System of Conservation Units (Beskow; Mattei, 2012; Moura, 2016; Lima, 2016).

This Brazilian environmental policy, characterized by shared and decentralized jurisdiction between the federal government, states, and municipalities, as established in the 1988 Constitution, was further regulated by Complementary Law 140/2011, which established rules for cooperation between these entities. According to Moura (2016), it consolidated the joint responsibility of the federal government, states, and municipalities for environmental management within Sisnama. In this line of evolution of decentralized and shared environmental management, the active role of municipalities in the formulation and execution of environmental policies stands out. This process depends on local institutional structuring, federal autonomy, and the strengthening of social control instruments. Since the creation of Sisnama, municipalities have been local bodies responsible for protecting and promoting environmental quality, although the issue was not yet fully incorporated into the agenda of local governments (Leme, 2016). This situation began to change progressively, accompanied by the strengthening of municipal institutional organization. A milestone in this process was the creation, in 1986, of the National Association of Municipal Environmental Agencies (ANAMMA). According to Leme (2016), the entity expanded its representativeness and consolidated itself as an important forum for coordination and defense of municipal environmental agencies.

In Brazil's federal system, states and municipalities have the autonomy to define public policies according to their priorities, within the limits of their constitutional and territorial powers. In the field of environmental management, this autonomy is expressed in the installed capacity of city governments, which involves the creation of environmental agencies, secretariats, and departments, the allocation of qualified technical personnel, the establishment of municipal environmental councils, the allocation of specific financial resources, and the drafting of specific environmental legislation (Leme, 2016). However, as environmental issues involve shared powers between the three levels of government, their governance cannot be attributed exclusively to a single federal entity: policies formulated at the federal level depend on the adherence and cooperation of state and municipal governments, both in the drafting and implementation phases. Although these entities are legally obliged to comply with national legislation, their participation in federal programs is generally voluntary. In this sense, the effectiveness of environmental policies requires the construction of cooperative institutional arrangements and the strengthening of the institutional capacities of subnational environmental

agencies, since the simple decentralization of responsibilities alone does not guarantee positive results in environmental management (Moura, 2016).

2.2 Environmental Management Expenditures

Based on the understanding that responsibility for environmental protection in Brazil is shared between municipalities, the Federal District, states, and the federal government, we can look at environmental management expenditures to obtain some measure of the implementation of this public policy. The effectiveness of these policies is conditioned on the exercise of the exclusive powers of local entities and the allocation of their own resources, with municipalities playing a central role in the implementation of actions such as inspection, enforcement of sanctions, land use planning, control of urban land use, and provision of environmental infrastructure (Carvalho et al., 2005; Neves, 2012; Moura, 2016).

As heads of the municipal executive branch, mayors have considerable autonomy in defining the public budget, including the function of environmental management. Although municipalities are subject to various mandatory expenses, such as those associated with education and health functions, as well as current personnel and operating expenses, environmental policy does not, as a rule, constitute a compulsory expenditure, as it does not have a specific revenue link[1] or a minimum application requirement. Therefore, we can understand that the execution of the expense depends, to some extent, on the mayor's ability to mobilize their own resources or obtain financing, reflecting their autonomy and fiscal capacity.

Based on the National Environmental Policy Law, function 18 – Environmental Management was established in the public budget, in accordance with the functional classification established by Ordinance SOF/SETO/ME No. 42, of April 14, 1999[2] , which organizes public expenditure into 28 functions according to the powers and purposes of the federal entities (Brazil, 1999). This budgetary function corresponds to a category of the public expenditure execution structure in Brazil[3] and comprises a standardized accounting structure among the entities of the federation.

1 Except when the budget law approved by the Legislature indicates a specific link or when the funds come from contributions or fees established for that specific purpose.

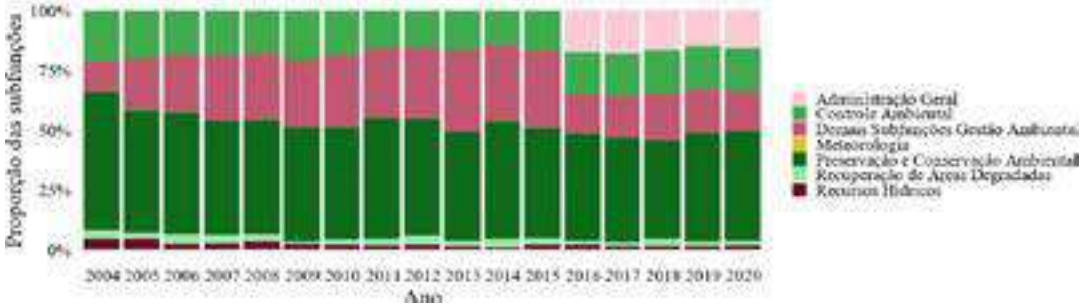
2 Ordinance No. 42 was originally issued on April 14, 1999, by the then Ministry of Budget and Management. It was subsequently updated and consolidated by Ordinance SOF/ME No. 2,520, dated March 21, 2022, and amended by Ordinance SOF/MPO No. 221, dated August 7, 2023. This regulation governs the classification of public expenditure by function, as provided for in Articles 2 and 8 of Law No. 4,320 of 1964.

3 In Appendix B, we present a brief description of the main concepts and stages of the budget execution process in the context of Brazilian federal entities.

More specifically, Environmental Management comprises a set of actions aimed at protecting and preserving the environment, systematic monitoring through data collection and analysis, and control of environmental conditions. It is subdivided into specific sub-functions. Environmental Preservation and Conservation covers the planning, implementation, coordination, and maintenance of initiatives aimed at defending fauna and flora, protecting areas and ecosystems, as well as preventing damage in urban and rural areas caused by droughts, floods, and soil degradation. Environmental Control includes actions aimed at preventing and mitigating noise, water, air, and soil pollution. Recovery of Degraded Areas includes actions aimed at utilizing areas that are constantly flooded or subject to erosion for urban or rural purposes. Water Resources aims at the planning, coordination, control, and supervision of the harmonious use and utilization of water resources in multiple applications. Meteorology encompasses actions aimed at the implementation, coordination, and maintenance of agencies and mechanisms for the study of climate variations and meteorological conditions (Moura, Adriana Maria Magalhães de et al., 2017). General Administration and the subfunction Other Subfunctions correspond to programs and actions with indirect impacts on the environment.

Between 2004 and 2020, the subfunction Environmental Preservation and Conservation had the largest relative share. Starting in 2016, the subfunction "General Administration" emerged, which began to concentrate records previously classified as "Other Subfunctions." In general, the share of each subfunction is stable over the period.

Figure 1 – Proportion of budget expenditures on environmental management in relation to total budget expenditures – Brazilian municipalities from 2004 to 2020



Source: Own elaboration based on municipal budget expenditure data obtained from the National Treasury Secretariat (STN).

Table 1 briefly presents the distribution of environmental management expenditure data at December 2020 prices. Between 2004 and 2020, the median was considerably lower than the average (especially in 2004, when it was zero), which shows a strongly right-skewed dis-

tribution, with few municipalities recording high expenditure values. There was an increase in both the mean and the quartiles and in the maximum value observed, indicating that more municipalities began to incur expenditures, and in higher volumes, for the variable. In addition, the number of municipalities without information was substantially reduced, from 392 to 11 between 2004 and 2020.

Table 1 – Distribution of budget expenditures on environmental management — Brazilian municipalities in 2004 and 2020

Statistics	2004	2020
Minimum	0	0
1st Quartile	0	0
Median	0.0	82.2
3rd Quartile	25.1	469.2
Maximum	215,364.2	271,569.8
Average	494.0	1,214.5
Number of municipalities	5,563	5,570
Municipalities without information	392	11

Source: Prepared by the authors based on municipal budget expenditure data obtained from the National Treasury Secretariat (STN). Values in R$ thousand.

Figure 2 shows the evolution of the ratio between total expenditures on environmental management and the sum of expenditures on all budgetary functions of Brazilian municipalities from 2004 to 2020. This ratio shows a stable trajectory, remaining above 0.75% throughout almost the entire period, with the exception of 2005. From 2010 onwards, the value stabilizes at around 0.80%, which is in line with the literature (Guandalini; Borinelli; Godoy, 2013; Pereira; Neto, 2020; Avelino et al., 2021).

For comparative purposes, based on the same source of expenditure data by function, it appears that municipal budget expenditures on health correspond to approximately 20% to 30% of total expenditures, with relative consistency and a slight upward trend between 2016 and 2020. Education shows similar behavior, although with a slight decline in the same period mentioned above. Expenditures on culture continue to decline, falling from 1.15% to 0.7%. Public safety and social security vary between 0.6% and 0.9% and between 5% and 7.5%, respectively.

Figure 2 – Evolution of budget expenditures on environmental management – Brazilian municipalities from 2004 to 2020

(a) Environmental management expenditures (% of total) (b) Per capita expenditures on environmental management

Source: Own elaboration based on municipal budget expenditure data obtained from the National Treasury Secretariat (STN).

2.3 Brazilian Farmers

Based on the idea that politicians with autonomy over the environmental budget are subject to pressure from different interest groups, as argued by Pacca et al. (2021) in the case of governors, in this dissertation we apply this logic at the municipal level, with a specific focus on mayors. We consider that, in this context as well, budgetary autonomy can be influenced by self-interest as well as by external pressures from different sources. Among these, the agricultural sector stands out, relevant not only for its economic weight, but also because mayors may have occupational backgrounds linked to the area. In addition, local governments can influence the implementation of federal policies: bribes, lobbying, or other pressure mechanisms can be used to reduce the enforcement of environmental regulations, facilitate access to credit for local farmers and ranchers, or increase the volume of voluntary transfers for productive activities in the countryside (Bragança; Dahis, 2022). The decision to adopt such measures, in turn, tends to reflect the political and economic costs and benefits associated with prioritizing (or not) environmental management in municipalities. At the same time, while corporate groups may try to weaken environmental regulations, there is also political pressure in the opposite direction, driven by sensitized voters and environmental organizations working to build a “green” electoral base (List; Sturm, 2006; Herrnstadt; Muehlegger, 2014).

To identify the influence of these interests at the local level, we adopted the classification of mayors with agricultural occupations proposed by Bragança and Dahis (2022), which considers politicians who have declared that they work in the agricultural sector to be farmers.

According to the authors, this typology remains stable throughout their terms of office and provides information about the political orientation of those elected: mayors with previous occupation in the agricultural sector are more likely, when subsequently elected to the National Congress, to join the Parliamentary Agricultural Front. This result indicates that links to the agricultural sector, even if declared at the time of municipal candidacy, already signal political affinities with ruralist agendas.

To understand the political relevance currently exercised by the agricultural sector in Brazil, we can briefly contextualize its constitution as an organized interest group. This influence was consolidated especially from the 1980s onwards, with the emergence of the ruralist caucus in the national legislative scene (Helfand, 1999; Milmanda, 2019). The period was marked by economic crisis, coinciding with the relative decline of agriculture in the country's GDP and the process of redemocratization. It was in this scenario that the agricultural sector consolidated itself as a broad and influential political coalition.

The formation of political representation for the agricultural sector in Brazil began with the creation of the Rural Democratic Union (UDR) in 1985, which focused primarily on defending against agrarian reform (Weller; Limongi, 2024)[p.65], without focusing on the formulation of broader agricultural policies. The following year, in 1986, the Broad Front of Brazilian Agriculture (FAA) emerged, aiming to organize the rural sector to exert political pressure in the context of drafting the new Constitution, while also seeking to modernize its representation through more open and democratic practices. In 1987, the FAA began to coordinate ruralist deputies and senators within the National Congress, structuring a base of political support. After the definition of the treatment of agrarian reform in the 1988 Constitution, the FAA redirected its activities towards the reform and modernization of agricultural policy. In this process, the National Council for Agricultural Policy (CNPA) was created by the first agricultural law, institutionalizing the participation of the private sector in the formulation of these policies. The FAA then began to coordinate the sector's demands mainly through the CNPA, functioning as a formal channel of dialogue with the Executive Branch. In the 1990s, the Ruralist Caucus, the direct successor to the FAA, was consolidated in the National Congress, reinforcing legislative coordination in defense of agribusiness interests. Currently, this articulation is formalized under the name Parliamentary Front for Agriculture and Livestock (Helfand, 1999; Richardson, 2012; Bruno, 2017; Milmanda, 2019).

The political activity of the agricultural sector in Brazil dates back to the imperial period, but it was during the redemocratization of the 1980s that the sector organized itself in a more

structured way, overcoming obstacles such as the geographical dispersion of producers and consolidating itself, through associations and parliamentary fronts, as one of the most influential interest groups in national politics (Helfand, 1999). This consolidation was also accompanied by concentrative agrarian policies, a lack of flexible markets, and strong union organization, leading capitalized farmers to invest in politics as a form of risk management (Richardson, 2012).

3. THEORETICAL BASIS

The theoretical model used in this dissertation is adapted from that developed by Pacca et al. (2021) based on the contributions of Grossman and Helpman (1994) and Yu (2005) on electoral incentives and lobbying as determinants of political economy. In a democratic regime, the behavior of representatives of the executive branch in the construction of public policies can be modulated based on the expected effect of their electoral performance (reelection, for example) and/or the satisfaction of interest groups with their preferences. In this sense, we understand politicians as agents who maximize their own interests, rather than benevolent agents focused on maximizing aggregate welfare.

Bragança and Dahis (2022) define Brazilian farmers as an interest group and, also based on a political economy model, explore the impacts of the trade-off between agricultural expansion and environmental preservation. According to the authors, politicians can implement policies that provide them with direct financial benefits. In the case of environmental degradation through deforestation, there is an expansion in the supply of arable land, which reduces its market price and increases profits from agricultural activity. This suggests that engaging in environmental management actions implies an opportunity cost for farmer mayors, since restrictions on the use and conversion of rural areas, as well as the costs of complying with environmental standards, can reduce revenue from agribusiness.

With these analytical elements, we adjusted the theoretical model presented by Pacca et al. (2021), and the three groups addressed are: the public, environmentalists, and farmers, instead of industrialists. The exploration of the explanatory channels through which agents capture private benefits in the political process does not change with this alteration, as the central point of the formulation is not to specifically characterize the nature of the "industry" that has preferences that conflict with those who advocate for environmental policies. However, the choice of farmers as an interest group is not random or merely illustrative; the hypothesis is that, because of their preferences, the execution of environmental management expenditures is affected.

Finally, agriculture can be classified as a type of industrial activity, given its scale, productive structure, economic impact, and the negative environmental externalities it generates.

3.1 Model

Suppose that the production of a private good x generates pollution for the environment and that the volume of pollution is affected by the total level of environmental spending in such a way that

$$e = Z(g), \quad (1)$$

where e represents pollutant emissions per unit of good, g represents public environmental expenditure, and Z represents a decreasing function of g.

Given that $F(K, L)$ is a production function with constant returns to scale that uses labor and capital as inputs to generate x, the net production X of the good is defined by:

$$X = [1 - A(e)]\, F(L, K), \quad (2)$$

where $A(e)$ represents the cost of environmental regulations, in units produced. $A(e)$ is decreasing in emissions ($A'(e) < 0$) which, as a consequence and given the definition of emissions in 1, we obtain by the chain rule that $dA/dg > 0$.

Individuals have identical preferences regarding the good x and separable preferences regarding the public good (bad). Let us consider the quasi-linearity of the utility function, so that the good x represents a small portion in relation to the rest of the economy, allowing us to disregard the income effect on its demand (Yu, 2005). Specifically, we assume that individuals have the following utility function:

$$U_i = x_0 + u(x) - D_i(eX). \quad (3)$$

Let us adopt $x0$ as the consumption of the monetary good x and $u(x)$ as the utility derived from this consumption, where $u'(.) > 0$ and $u''(.) < 0$, that is, the utility is increasing and concave. The disutility generated by the volume of pollution eX, resulting from the production of the private good, is given by $D(eX)$. This disutility is specified as $Di(eX) = \mu i\, d(eX)$, with $d'(.) > 0$ and $d''(.) > 0$, indicating that the discomfort caused by pollution increases progressively with eX. The parameter μi represents the individual's perception i of the impacts of environmental pollution. Therefore, an individual with a high μi will be more sensitive to environmental issues than someone with a low μi.

The indirect utility function corresponding to equation 1 is:

$$Vi(Yi, e) = s(e) + Yi - \mu i\ \ d(e) \quad (4)$$

where *Yi* is income and $s(e) = u\{x\,[\,p\,(e)]\} - p\,(e)x\,[\,p\,(e)]$ represents the consumer surplus associated with the consumption of the good *x*, increasing in *e*, given that the price of the good decreases with *e* ($dp < 0$). And from this equation, we can see that μi can also be interpreted as the marginal willingness to pay for the reduction of pollution.

If each individual offers one unit of labor and normalizes the wage to 1, then the emission volume for the individual *i* will be given by:

$$e_i = \underset{e}{\text{argmax}}\{V_i = s(e) + 1 - \mu_i d(e)\}, \qquad (5)$$

As already mentioned, there are three groups in society: the general public, environmentalists, and farmers. The median voter is indicated as *m*, environmentalists as *A* and farmers as *F*. The environmental policy preferred by the median voter is defined as *em* and their subjective belief as μm (for simplicity, all voters share the same belief). Environmentalists have a stronger subjective belief, $\mu A > \mu m$. This group will prefer a lower volume of emissions than the median voter ($eA < em$) and, as a consequence, a higher level of environmental spending ($gA < gm$). The third group, farmers, hold the specific factor of production and will therefore have the following optimal volume of emissions:

$$V_i = \underset{e}{\text{argmax}}\left\{s(e) + 1 + \frac{\pi(p(e), c)}{N_F} - \mu_i d(e)\right\}, \qquad (6)$$

where π is the profit obtained by farmers *NF*. The volume of emissions preferred by this third group, *eF*, is higher than the volume preferred by the median voter, *em*.

Both farmers and environmentalists are organized as interest groups that lobby the mayor. In addition to political contributions, the representative takes into account the political cost of adopting a measure that deviates from the preferences of the median voter, rather than considering social welfare.

When setting the total level of environmental spending, the mayor is influenced by several forces:

$$G_j = b_{Aj}C_A(e_j) + b_{Fj}C_F(e_j) - a_j M(e_j - e_m) \qquad (7)$$

where *G j* is the mayor's objective function *j* ; *C* represents the contributions of interest groups (*F*, farmers, and *A*, environmentalists); *M* is the political cost, defined as a function in the form of *U*; and the last term in parentheses is the measure of deviation from the pollution volume preferred by the median voter, *em*. Since *a j* is the weight assigned to the political cost by the mayor *j* and if *j* is the mayor of a municipality with an electorate that is very concerned about the environment, then *em* will be lower and the political cost higher. The same reasoning applies to a region with a strong agribusiness presence, where *em* may be higher. In summary, the political pressure exerted on the governor can come both from direct contributions from

interest groups and from the formation of *em* itself.

Individual preference is captured by the specific parameters of the mayor, *bF* and *b A*, which represent the relative power of the two interest groups in their attempts to influence environmental policy. If the mayor *j* is strongly ideologically oriented in favor of the environment, he will be more sensitive to pressure from the environmentalist group (*bAj* > *bFj*). On the other hand, if the mayor is ideologically closer to farmers (or is a farmer himself), then *bAj* will be greater than *bFj*. We will assume that these parameters vary according to the mayor's occupation: farmer mayors would exhibit significantly higher values of *bF* and lower values of *bA*, while non-farmer mayors would exhibit the opposite configuration.

Finally, equation 7 can be rewritten as follows:

$$G_j = b_{Aj}C_{Aj}[Z(g_j)] + b_{Fj}C_{Fj}[Z(g_j)] - a_jM[Z(g_j) - e_m]. \quad (8)$$

Therefore, the equilibrium level of environmental expenditures will be given by:

$$g^* = \text{argmax}_g \{b_{Aj}C_{Aj}[Z(g_j)] + b_{Fj}C_{Fj}[Z(g_j)] - a_jM[Z(g_j) - e_m]\}. \quad (9)$$

The equilibrium spending policy *g** will be determined by the following first-order condition:

$$b_{Aj}W'_A[Z(g^*)] + b_{Fj}W'_F[Z(g^*)] - a_jM'[Z(g^*) - e_m] = 0, \quad (10)$$

which comes from the simplification of

$$b_{Aj}W'_F[Z(g^*)] \cdot Z'(g^*) + b_{Fj}W'_F[Z(g^*)] \cdot Z'(g^*) - a_jM'[Z(g^*) - e_m] \cdot Z'(g^*) = 0. \quad (11)$$

Above, we apply the "true contribution rule," i.e., $C' = W'$ for $\omega = A, F$ (Yu, 2005). The derivatives of the welfare of interest groups in relation to environmental spending represent the "economic interest" of each group in environmental policy. The greater the marginal welfare gain from the policy, the greater the marginal contribution of the interest group. The political influence of pressure groups depends not only on their relative interest in environmental policy, but also on the magnitude of *bFj* and *bAj*, which is related to the mayor's preferences *j*. In other words, the same amount of contribution will have less effect on an environmentalist mayor than on a mayor with neutral preferences regarding the environment.

Based on these mechanisms, the model provides a useful framework for empirically interpreting the variation in budgetary decisions observed throughout the study. Three elements, in particular, help explain the results found: the role of campaign donations, electoral incentives, and the private benefits of the manager.

Political campaign donations. In the model, electoral contributions act as a mechanism to encourage mayors to prioritize private production over environmental protection, aligning their actions with the preferences of interest groups. By allocating resources to candidates who-

se agenda already reflects these interests, donors would reduce the marginal cost of persuasion and consolidate their control over municipal decisions.

Electoral incentive. The possibility of reelection and the preferences of the median voter would create an incentive for the mayor to modulate his political behavior. When the electorate values environmental protection, for example, reducing spending in this area can represent a political cost. However, the effect of this mechanism may vary depending on the intensity of the mayor's preferences and his perception of electoral risks.

Preferences and private benefits. Assuming that mayors do not act as benevolent agents, municipal environmental policy, as expressed in levels of environmental spending, results from a balance between the mayor's individual preferences and the private benefits he can capture. These benefits include both direct economic gains linked to specific interests, such as agricultural expansion, and political advantages derived from the support of interest groups and the electorate. This balance influences the direction and intensity of environmental policies adopted in different local contexts.

4. EMPIRICAL STRATEGY AND DATA

4.1 RDD

Estimating the effect of electing a farmer mayor on environmental spending is subject to endogeneity, which would compromise causal identification. The literature exploring gubernatorial elections documents that determinants of dependent variables may be correlated with factors that influence the election of the governor himself (Fredriksson; Wang; Mamun, 2011; Beland; Boucher, 2015; Bragança; Dahis, 2022; Bruce et al., 2022). In particular, economic shocks, demographic characteristics, political preferences, campaign resources, labor market conditions, voter profiles, and candidate quality can simultaneously affect both the outcome of contests and the total level of spending on environmental management (Beland; Oloomi, 2017; Pacca et al., 2021).

We adopt the regression discontinuity design (RDD) to estimate the causal effect of interest to mitigate this problem. By exploiting very close elections, cases immediately above and below the winning threshold, the approach approximates a local randomized experiment, as the treatment can be understood as randomly assigned in the vicinity of the cutoff point. Since candidates cannot precisely manipulate the margin of votes around the cutoff point, there would

be local random assignment and mitigation of endogeneity biases arising from unobserved characteristics (Fredriksson; Wang; Mamun, 2011; Beland; Boucher, 2015).

However, as discussed by Marshall (2024), when treatment in RDD is defined by a pre-existing characteristic of the candidate, the estimated effect captures not only the direct impact of the attribute of interest, but also potential compensatory differentials, i.e., other characteristics (observable or not) that contributed to their competitiveness in close elections. This is because voters evaluate the candidate's "complete package." Despite this limitation, RDD remains the most appropriate strategy for mitigating possible biases in this context.

The main specification adopted to estimate the local average treatment effect at the cutoff point (LATE) of a farmer mayor's election on the environmental expenditures of Brazilian municipalities is:

$$Y_{mt} = \alpha + \beta D_{mt} + F(MV_{mt}) + \gamma_m + \phi_t + \varepsilon_{mt}, \qquad (12)$$

where *Ymt*, the dependent variable, represents environmental spending for the municipality *m* in the year *t*. The coefficient of interest is β and the component *Dmt* is an indicator variable that takes the value 1 when a farmer is elected, and 0 otherwise. *F* (.) represents a function of the margin of victory *MVmt*, specified in linear and quadratic forms, as discussed below. The cutoff variable is the percentage difference in votes between the farmer candidate and the main opponent. The treatment is assigned to municipalities where this margin is positive, i.e., where the farmer candidate won. The terms *ym* and ϕt represent fixed state and time effects, respectively, while εmt is the error term.

Fixed effects are widely used in specifications that employ RDD with close elections (List; Sturm, 2006; Fredriksson; Wang; Mamun, 2011; Beland; Boucher, 2015; Beland; Oloomi, 2017; Pacca et al., 2021; Bruce et al., 2022). Therefore, we employ fixed state and year effects to control for unobservable factors that are invariant over time or across regional units, such as state environmental legislation, historical spending trends, and national shocks that affect all municipalities simultaneously.

In line with the practice of empirical literature that adopts RDD, we follow Imbens and Lemieux (2008) as a reference to validate the model's hypotheses, including the *running variable* manipulation test proposed by McCrary (2008) and covariate balancing tests at the municipal level and in relation to the observable characteristics of candidates around the cutoff point. The main estimates are obtained with linear and quadratic specifications instead of high-order polynomials, as recommended by Gelman and Imbens (2019). The optimal bandwidth is selected based on the nonparametric procedure of Calonico, Cattaneo, and Farrell (2020) and used

to define the range of observations considered in the estimation.

4.2 Data source

This section presents the public data sources used in the dissertation. Below, we detail the databases used.

Public finances. For municipal expenditures, we used Finbra (Finanças do Brasil), a database that compiles accounting and budgetary records reported by federal entities to the STN (Secretaria do Tesouro Nacional) through SICONFI (Sistema de Informações Contábeis e Fiscais do Setor Público Brasileiro). The data were accessed in the organized and pre-processed version made available by the Database platform (Dahis et al., 2022). We selected expenditures classified by budgetary function for the period from 2004 to 2020. All financial data were deflated to December 2020 prices to ensure comparability between them.

Elections. Data on election results, candidate characteristics, and campaign financing were obtained from the Superior Electoral Court (TSE) and accessed through the Base dos Dados platform. The analysis covers four election periods: 2005–2008, 2009–2012, 2013–2016, and 2017–2020. Based on the electoral data and the definition proposed by Bragança and Dahis (2022), we identified as farmer candidates those who self-declared occupations linked to agricultural activity[4].

Municipalities.[5] The socioeconomic characteristics of the municipalities, such as population, gross domestic product (GDP), and predominant biomes, were obtained from the Brazilian Institute of Geography and Statistics (IBGE). All monetary data were deflated to December 2020 prices to ensure comparability.

Table A1 presents the description of the variables used in municipal aggregation by year that are listed in the descriptive statistics in the next subsection.

4.3 Sample selection

4 The occupations listed by Bragança and Dahis (2022) are: “farmer,” “agronomist,” “rancher,” “farmer,” “cattle rancher,” “agricultural producer,” “owner of an agricultural, livestock, and forestry establishment,” “agricultural, livestock, and forestry equipment operator,” “agricultural technician,” “surveying technician,” “agronomy and surveying technician,” “agricultural worker,” “livestock worker,” “rural worker,” and “cowboy.”

5 The total number of municipalities in Brazil rose from 5,563 in 2004 to 5,570 in 2020, according to information from the IBGE. These updates reflect changes in municipal boundaries resulting from processes such as dismemberments and emancipations, for example. However, the Federal District and Fernando de Noronha do not hold municipal elections, which reduces the sample to 5,568 municipalities.

The database used in the dissertation was constructed from the results of the Brazilian municipal elections of 2004, 2008, 2012, and 2016, corresponding to the political cycles mentioned in the previous section. Of the 5,570 municipalities, only the Federal District and Fernando de Noronha do not hold mayoral elections. Our sample brings together observations aggregated by municipality and year of term, in other words, municipality-year aggregation. We selected only regular elections with first and second rounds and restricted the sample to cases in which the two most voted candidates, in any order, were a farmer and a non-farmer. We call this subset of contests.

In the complete sample, 13.9% of the elected mayors were farmers. The contests correspond to 21.2% of the total observations. Within the contest subsample, 49.2% of those elected were farmers, while in municipalities outside the contests, only 4.5% of those elected were farmers. There is also a slight downward trend in the proportion of farmer mayors over the cycles. These and other statistics are found in Table 2, which shows the percentages of each category of elected mayor in each year in relation to the total number of candidates elected in the period analyzed.

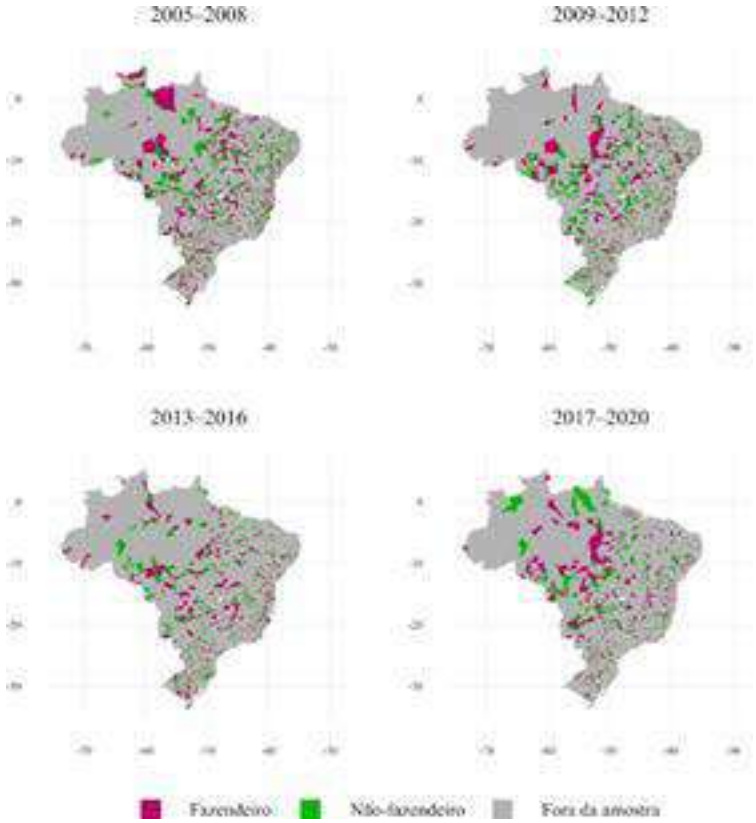
Table 2 – Proportion of mayors elected by category and year of election

	Disputa				Fora da disputa			
	Fazendeiro		Não-Fazendeiro		Fazendeiro		Não-Fazendeiro	
Ano	Total	%	Total	%	Total	%	Total	%
2004	723	3,25	734	3,30	277	1,24	3.834	17,21
2008	562	2,52	668	3,00	203	0,91	4.135	18,57
2012	523	2,35	554	2,49	147	0,66	4.344	19,50
2016	509	2,29	437	1,96	159	0,71	4.463	20,04

Source: Own elaboration based on municipal election results obtained from the Superior Electoral Court (TSE).

The distribution of mayors elected in contested races (farmers *vs.* non-farmers) across Brazil is shown in Figure 3. The sample selected for identification in the RDD is defined by the estimated optimal band; thus, in each regression result table, we indicate the number of observations corresponding to this interval.

Figure 3 – Farmer and non-farmer mayors elected in contested elections by electoral cycle



Source: Own elaboration based on municipal election results obtained from the Superior Electoral Court (TSE).

In Table 3, we observe that among elected mayors, classified as farmers and non-farmers throughout the electoral cycles from 2004 to 2016, there was a gradual increase in the average age. We also identified that farmers are, on average, older than the others. The proportion of male mayors is high in all profiles and years, always exceeding 87.3% (value observed in 2012). The color variable has gaps in the early years due to the unavailability of data from the TSE, but we observe a predominance of white mayors in 2016. With regard to marital status, the proportion of self-declared married elected officials decreased over time in both profiles. In terms of education, farmer mayors had lower proportions of higher education compared to non-farmers, a profile in which this degree exceeded 50% in 2012 and 2016. On the other hand, the proportion of mayors with only elementary school education is always higher among farmers. Even so, the highest concentration in this profile is in high school education, with growth observed in virtually all levels throughout the period analyzed. Finally, the proportion of incumbent mayors is consistently lower among farmers.

Table 3 – Descriptive statistics for the category of mayor elected per electoral cycle

	2004		2008		2012		2016	
	Fazendeiro	N-Fazendeiro	Fazendeiro	N-Fazendeiro	Fazendeiro	N-Fazendeiro	Fazendeiro	N-Fazendeiro
Idade	49,3	47,3	50,2	48,0	51,4	47,9	52,3	48,8
	(10,2)	(9,5)	(9,8)	(9,4)	(10,3)	(10,0)	(10,0)	(10,7)
Masculino	97,9%	91,4%	98,2%	89,7%	96,7%	87,3%	97,6%	87,3%
Branco	-	-	-	-	-	-	73,2%	69,9%
Casado	80,6%	80,4%	81,5%	76,0%	80,1%	76,0%	78,9%	73,4%
Fundamental	12,2%	6,4%	12,6%	6,5%	14,2%	5,3%	14,7%	5,4%
Médio	30,5%	25,3%	33,9%	25,8%	35,5%	26,5%	36,8%	24,0%
Superior	16,3%	47,0%	15,1%	49,4%	19,6%	53,2%	21,1%	56,9%
Incumberde	20,6%	25,2%	24,5%	40,2%	12,1%	25,4%	12,6%	23,2%

Source: Own elaboration based on municipal election results obtained from the Superior Electoral Court (TSE). Note: The mean and standard deviation, in parentheses, are presented for continuous variables. The proportion is presented for categorical variables. Educational levels are defined as follows: *Elementary* refers to mayors who have only completed elementary school; *Secondary* refers to mayors who have completed high school; and *Higher* refers to those who have completed higher education..

Table 4 presents descriptive statistics for mayors elected between 2004 and 2020, based on three categories: contested election sample, uncontested election sample, and complete sample. Each category presents separate data for farmers and non-farmers, organized into four panels. The following four paragraphs summarize some patterns observed in each of these panels.

Territorial characteristics of municipalities. In the contested sample, municipalities with elected farmer mayors have a higher average population and total area. In the other samples, the averages are higher among municipalities with non-farmer mayors. In all cases, the area occupied by agriculture and livestock is, on average, more extensive in municipalities that elected farmers. The urban area has a higher average among non-farmers, especially outside the contest and in the complete base. The average forest area is larger in municipalities with farmer mayors only in the contest segment.

Economic and environmental characteristics of municipalities. Municipal GDP is, on average, higher in municipalities with farmers elected as mayors in contested elections, while in the other segments it is higher among non-farmers. The gross value added of agriculture and livestock farming shows similar averages between the groups, with the exception of the contested segment, where it is higher among farmers. Total municipal expenditures are higher, on average and in dispersion, in municipalities with farmers elected in contested elections, but this pattern is reversed in the other categories. When considered per capita, total expenditures are higher in municipalities with non-farmer mayors in all categories. Expenditures on environmental management, both total and per capita, are lower in municipalities that elected farmers.

Finally, total pollutant gas emissions are higher among farmers only in the contested category, while agricultural emissions are higher on average in municipalities with farmer mayors in all categories.

Profile of elected mayors. The characteristics of those elected remain relatively stable, on average, across the sample categories, as well as across different electoral cycles, as already shown in Table 3.

Campaign characteristics of elected mayors. The total amount raised by non-farmers tends to be higher in non-contested races and races with a complete base, while in contested races the averages for farmers and non-farmers are closer; donations from legal entities are higher for non-farmers in all races; self-financing, in contested races, has a higher average for farmers and a lower average for others.

Using the variables presented in the descriptive statistics, we tested the difference in means between farmer and non-farmer mayors. Tables A2 and A3 present the results in detail for the contested subsample and the complete sample, respectively. In the complete sample, almost all variables show statistically significant differences. In the dispute segment, only three differences remained statistically significant: total area, agricultural area, and age. The three variables were used as controls in the robustness analysis (Section 5.3).

Table 4 – Descriptive statistics

	Disputa		Fora de disputa		Base completa	
	Fazendeiro	N-Fazendeiro	Fazendeiro	N-Fazendeiro	Fazendeiro	N-Fazendeiro
Características territoriais dos municípios						
População (milhares de hab.)	15,0 (38,9)	13,9 (19,0)	9,1 (9,9)	42,1 (237,0)	13,5 (34,1)	38,5 (222,0)
Área (km²)	1.435,2 (4.597,4)	1.231,5 (3.047,5)	1.163,2 (3.544,1)	1.566,3 (6.071,3)	1.366,3 (4.356,3)	1.550,8 (5.782,1)
Agropecuária (mil hectares)	53,5 (91,6)	49,1 (74,0)	49,2 (92,9)	43,7 (75,5)	52,4 (91,9)	44,4 (75,3)
Urbana (mil hectares)	0,3 (0,8)	0,3 (0,5)	0,2 (0,2)	0,7 (2,4)	0,3 (0,7)	0,7 (2,2)
Floresta (mil hectares)	78,4 (391,3)	64,0 (257,0)	58,3 (268,5)	102,3 (552,8)	73,3 (364,3)	97,5 (525,2)
Características econômicas e ambientais dos municípios						
PIB (em R$ milhão)	248,5 (1.250,5)	213,1 (608,4)	135,5 (275,8)	1.061,6 (10.297,5)	219,9 (1.090,6)	955,7 (9.640,0)
VAB da agropec. (em R$ milhão)	41,5 (76,6)	38,2 (75,5)	38,8 (73,3)	40,3 (81,4)	40,8 (75,8)	40,0 (80,7)
Despesa total (em R$ milhão)	40,9 (125,7)	37,6 (57,2)	26,7 (25,6)	126,8 (975,9)	37,4 (109,6)	115,7 (913,8)
Despesa total per capita (R$)	3.355,8 (1.669,7)	3.417,2 (1.816,4)	3.914,3 (2.050,1)	3.210,1 (1.969,1)	3.496,6 (1.789,8)	3.235,9 (1.951,9)
Gestão ambiental (em R$ mil)	179,3 (656,8)	218,2 (1.536,3)	117,8 (393,5)	1.142,0 (8.913,3)	163,8 (601,9)	1.026,9 (8.362,7)
Gestão amb. per capita (R$)	14,7 (41,8)	15,5 (47,9)	14,7 (35,4)	18,8 (50,6)	14,7 (40,3)	18,4 (50,2)
Emissão total (milhares de ton.)	300,4 (1.028,8)	278,6 (897,9)	277,7 (1.126,7)	328,4 (1.176,4)	294,6 (1.054,6)	321,9 (1.144,1)
Emissão agro (milhares de ton.)	109,0 (204,2)	101,3 (170,9)	97,8 (220,3)	88,9 (177,8)	106,1 (208,5)	90,5 (177,0)
Perfil dos prefeitos eleitos						
Idade	50,9 (10,2)	47,4 (9,5)	50,0 (9,8)	48,1 (10,0)	50,6 (10,1)	48,0 (10,0)
Masculino	97,5%	88,4%	98,0%	88,9%	97,6%	88,9%
Branco	72,2%	71,2%	74,8%	69,7%	73,2%	69,8%
Casado	81,1%	78,7%	82,3%	76,6%	81,4%	76,9%
Ensino fundamental completo	12,7%	7,2%	14,9%	5,7%	13,3%	5,9%
Ensino médio completo	34,4%	28,3%	33,6%	25,0%	34,2%	25,4%
Ensino superior completo	18,2%	45,9%	16,4%	52,6%	17,7%	51,7%
Características de campanha dos prefeitos eleitos						
Incumbente	16,7%	32,9%	21,8%	27,8%	18,0%	26,5%
Total arrecadado (em R$ mil)	70,1 (125,8)	66,5 (112,6)	49,1 (99,5)	154,2 (757,1)	64,9 (120,1)	143,0 (708,7)
Doações de PJ (em R$ mil)	9,6 (40,1)	11,6 (60,5)	6,7 (49,7)	36,2 (183,4)	8,9 (42,7)	33,0 (173,3)
Autofinanciamento (em R$ mil)	25,0 (65,6)	20,4 (41,5)	21,6 (50,7)	29,5 (137,1)	24,1 (65,9)	28,5 (129,4)

Source: Prepared by the authors based on municipal election results obtained from the

Superior Electoral Court (TSE). Note: The mean and standard deviation, in parentheses, are presented for continuous variables. The proportion is presented for categorical variables. Table A1 presents the description of the variables used in municipal aggregation by year. Tables A2 and A3 present in detail the mean test for the contest subsample and the complete sample, respectively.

5. RESULT

5.1 Main

In this section, we present the estimated results and evidence that the annual variation in budget expenditures for environmental management, per capita and in total, was lower in Brazilian municipalities where farmer mayors were elected during the period from 2004 to 2020.

Equation 12 was estimated considering the municipalities where there was a close election for mayor between a farmer candidate and a non-farmer candidate. We used a triangular kernel, as is common in the related literature, and the bandwidth is set to minimize the mean square error. Table 1 shows how asymmetric the expenditure data are, so we chose to exclude extreme values and performed the regressions with municipality-year observations that fall between the first and third quartiles. As mentioned in the previous section, we used fixed year and state effects. The results are shown in Table 5 and Figure 4 (items a and b) for the per capita variable. Municipalities with elected farmer mayors showed an annual reduction of 7.69% in per capita spending on environmental management. Among non-farmers, the average was 0.80%, which corresponds to a difference of 6.89 percentage points.

Table 5 – Impact of the election of farmer mayors on per capita spending on environmental management

	Variação das despesas per capita com gestão ambiental		Variação das despesas com gestão ambiental	
	Linear	Quadrática	Linear	Quadrática
Fazendeiro	−7,69***	−7,69***	−7,01***	−7,01**
	[−12,67; −2,70]	[−13,18; −2,19]	[−11,86; −2,16]	[−12,49; −1,60]
Média Não-Fazendeiro	−0,80	−0,91	0,14	−0,26
Kernel	Triangular	Triangular	Triangular	Triangular
Largura da banda	0,096	0,168	0,106	0,179
No. efetivo de observações	1.897	2.711	2.018	2.794

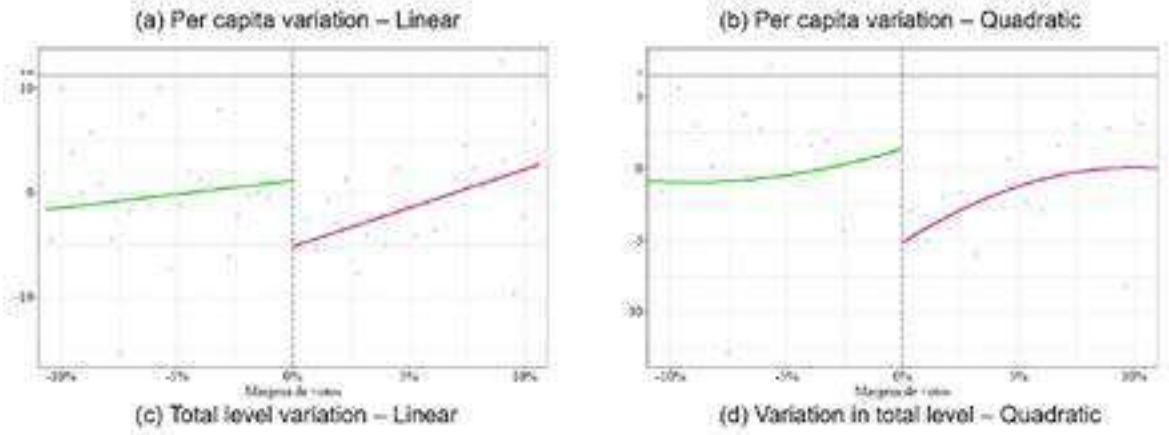
Note: This table presents our estimated results for the impact of the election of a farmer mayor on the annual variation (in %) in budgetary expenditure, per capita and at the total level,

on environmental management in Brazilian municipalities between 2005 and 2020. For each polynomial specification, the coefficients and 95% confidence intervals (in brackets) are presented. All estimates use a triangular kernel and control for fixed effects by state and year. The bandwidths, defined according to Calonico, Cattaneo, and Farrell (2020) to minimize the mean square error of the estimator, determine the sample size used in each regression, which is also reported in the table. Significance levels: $p < 0.01$ ***; $p < 0.05$ **; $p < 0.1$ *.

The results for the variation in the total level of expenditure are also shown in Table 5 and Figure 4 (items c and d). They maintain the pattern of magnitude, significance, and sign obtained with the per capita variable: an annual reduction of 7.01% in municipalities governed by farmers, while among non-farmers the variation was positive, at 0.14%, resulting in a difference of 7.15 percentage points between the groups.

Between 2005 and 2020, spending on environmental management expanded, surpassing other areas with similar levels of per capita spending or budget share, such as culture, sports and leisure, trade and services, energy, public safety, and the judiciary. In the complete sample and in the sample restricted to the optimal bandwidth, these budgetary functions showed trajectories of stability, modest growth, or slight decline. These patterns contrast with environmental expenditures, which, despite their upward trend over the period (Figure 2), showed a negative variation in municipalities where the mayors were farmers.

Figure 4 – Impact of farmer mayors on environmental management expenditures



Note: Results correspond to the specifications presented in Table 5.

The reduction identified showed distinct patterns between municipal terms. According to Table 6, during the periods 2009–2012 and 2013–2016, the election of farmer mayors was

associated with statistically significant annual reductions of 10.48% and 10.96%, respectively, in per capita environmental management expenditures, compared to municipalities under the management of non-farmers. In the 2005–2008 and 2017–2020 terms, although the estimated coefficients also have a negative sign, they are not statistically significant. Similar results are observed when the dependent variable is expressed at the total level, as in the main specification.

Table 6 – Impact of the election of farmer mayors on per capita spending on environmental management – By municipal term

	Variação das despesas per capita com gestão ambiental			
	2005-2008	2009-2012	2013-2016	2017-2020
Fazendeiro	-7,34 [-21,02; 6,35]	-10,48* [-22,44; 1,49]	-10,96*** [-19,01; -2,91]	-5,90 [-13,97; 2,17]
Média Não-Fazendeiro	-4,56	-0,73	-2,58	2,70
Kernel	Triangular	Triangular	Triangular	Triangular
Largura da banda	0,096	0,096	0,096	0,096
No. efetivo de observações	290	418	589	600

Note: This table presents our estimated results for the impact of the election of a farmer mayor on the annual variation (in %) in per capita budget expenditures on environmental management in Brazilian municipalities between 2005 and 2020, broken down by the four municipal terms covered by the period. For each polynomial specification, the coefficients and 95% confidence intervals (in brackets) are presented. All estimates use a triangular kernel and control for fixed effects by state and year. The bandwidths of the main regression presented in Table 5 are used. Significance levels: $p < 0.01$ ***; $p < 0.05$ **; $p < 0.1$ *.

5.2 RDD validity

In order to verify the validity of the hypotheses necessary for causal identification in the regression discontinuity design, we performed three complementary tests. First, we evaluated the continuity of the density of the running variable at the cutoff point. Next, we analyzed the robustness of the results against different bandwidth choices. Finally, we tested the balance between treated and untreated groups of municipalities based on observable characteristics, both at the municipal level and in the individual attributes of farmer mayors.

To verify the hypothesis of no manipulation at the cutoff point, we applied McCrary's (2008) density test, see Figure A1. With a p-value of 0.459, we did not reject the null hypothesis of continuity in the distribution of the choice variable around the cutoff point, allowing us to conclude that the results do not indicate evidence of manipulation. Figure A2 shows the robustness of the estimated effect at different bandwidth choices, demonstrating that the results remain stable in the face of variations in this parameter.

Balancing of municipal characteristics. To support the causal interpretation of the estimated effect, the sample must be balanced between treated and control units in municipal characteristics previously defined for the treatment. We verified that the variables are balanced. The detailed results are presented in Table A4 and Figure A3. The coefficients are not statistically significant at the 10% level, reinforcing the validity of our identification strategy.

Balance of characteristics of mayors. The literature indicates that individual attributes of government officials influence policy formulation, such as age (Alesina; Cassidy; Troiano, 2019), education (Besley; Montalvo; Reynal-Querol, 2011), and party ideology (Pettersson-Lidbom, 2008). Bruce et al. (2022) expand this debate by demonstrating that gender is also a relevant determinant of government performance. In close elections, differences in these characteristics between winners and losers can compromise the validity of the RDD in purely identifying the effect of the attribute of interest (such as being a farmer). Given this, we also evaluated the balance of observable variables of the candidates using the margin of victory of the farmer candidate. According to the main specification, we maintained the linear polynomial adjustment, inclusion of fixed state and year effects, uniform kernel, and optimal bandwidth. In close races, mayors with a farmer profile are associated, on average, with being 5.3 years older, 9 percentage points more likely to be male, 10 percentage points less likely to belong to a left-wing party, and 28 percentage points less likely to have completed higher education, relative to non-farmers. All of these differences are statistically significant, as shown in Table A5.

Given this asymmetry, we re-estimated our main specification controlling for age, gender, education, and political party ideology, considered individually and in combinations. The estimates maintained their sign and significance, with magnitudes between 7.0% and 7.7% (close to the reference value of 7.69%, estimated in the regression where the dependent variable is the variation in per capita expenditure), strongly suggesting that these observable variables are not conditioning the identified effect. In line with Marshall (2024), we interpret that the RDD captures the effect of electing a farmer profile together with unobservable compensatory differentials that sustain their competitiveness in close contests. This reading indicates that the esti-

mated effect stems mainly from unobservable factors of the farmer profile, even though they are correlated with the four dimensions analyzed here. In fact, our interpretation is reinforced by descriptive statistics, which already anticipated these differences between profiles. Additional robustness tests are presented in the following section.

5.3 Robustness

The robustness tests presented aim to verify the consistency of the results in the face of methodological variations. In Tables A6 and A7, we present the estimated effects without control for fixed effects. In Tables A8 and A9, the effects were obtained using a uniform kernel, replacing the triangular kernel adopted in the main specification. The assessment of the robustness of the bandwidths has already been presented in the previous section, see Figure A2. The robustness in relation to the functional form of the polynomial is addressed in the main results tables, which present linear and quadratic estimates with similar effects.

Additionally, we evaluated the incorporation of pre-treatment covariates: total area, area occupied by agriculture and livestock, area occupied by forest, population density, gross value added from agriculture and livestock, total population, and candidate age. Similar empirical strategies, which assess the robustness of estimates by controlling for additional observable characteristics, are adopted in studies such as Pacca et al. (2021), Beland and Oloomi (2017), Beland and Boucher (2015), and List and Sturm (2006). With variation in per capita expenditure as the dependent variable and using a triangular kernel, the results obtained with the inclusion of pre-treatment variables, both individually and in combinations, remained close in magnitude, sign, and statistical significance to those estimated in the main specification. The configuration with these covariates and fixed effect also remained stable. Finally, the difference between the estimated values and the observed averages among non-farmer mayors remains stable, varying between 6 and 7 percentage points.

5.4 Heterogeneity

The heterogeneity analysis presented in this section develops the argument in Section 3, according to which the behavior of government officials results from the interaction between their individual preferences, represented by specific parameters in equation 10, and incentives that can modulate their performance. To enable this analysis, we focus on the sample delimi-

ted by the bandwidth defined in the main RDD specification, ensuring that heterogeneity is assessed locally at the cutoff point. Due t[6], we adjusted the empirical strategy to estimate linear models with interaction terms that identify the conditional effects associated with heterogeneity variables.

In the case of electoral incentives, we adopted two strategies. The first considers eligibility for reelection, captured by an indicator variable called reelectable. This is a pre-treatment characteristic, defined by the condition that the elected mayor did not hold office in the previous term. As Brazilian law allows only one consecutive reelection, this condition identifies mayors eligible to run for a second term. The second strategy is based on the assumption that the median electorate can impose political costs on mayors who adopt measures contrary to the environmental agenda. To capture local support for the environmental agenda, we use as a proxy the percentage of votes obtained by Marina Silva in the presidential elections[7] prior to the municipal elections. This choice follows Araujo, Santarrosa, and Pereira (2024), who recognize her as a prominent environmental political leader in Brazil. The 2010 votes are used as a pre-treatment characteristic for the observations determined by the 2012 municipal election, whose term corresponds to the period from 2013 to 2016. Similarly, the 2014 votes are used as a pre-treatment characteristic for the 2016 municipal election, relating to the 2017-2020 term. In addition to the percentage of votes, we use a binary variable that classifies municipalities based on the median percentage of votes obtained by Marina Silva.

Table A10 shows the heterogeneous effects of the election of farmer mayors according to their eligibility for reelection. Although the estimated effect for the entire period (2004 to 2020) is not statistically significant, in the 2013–2016 term, non-reelectable farmer mayors reduced spending by 11.95% per year. The statistically significant difference of −4.24 percentage points between non-reelectable and reelectable farmer mayors suggests that the possibility of reelection mitigated the negative impact of the election of farmers on environmental spending.

The estimated effects of the election of farmer mayors, conditioned on the proportion of electoral support for the environmental agenda, are presented in Table A11. The variable is

6 The main current R packages for discontinuous regression, such as rdrobust, do not allow the direct inclusion of interactions or heterogeneity variables. To circumvent this limitation, the estimation was replicated by OLS, maintaining the linear specification with fixed effects for year and state. As verified in the robustness analysis, the use of a uniform kernel produces results very similar to those of the main specification with a triangular kernel, with a difference only in the magnitude of the coefficients, without changing the sign or statistical significance. For this reason, we adopted a uniform kernel as the basis for the estimation. This configuration is presented in Table A8, which uses the per capita variation in environmental expenditures as the dependent variable.

7 The candidate ran in the 2010, 2014, and 2018 presidential elections, obtaining 19.3%, 21.3%, and 1.0% of the valid votes, respectively.

operated in two ways: as a binary indicator (above or below the median percentage of votes for Marina Silva—8.68% in the first period analyzed and 9.67% in the second) and as a continuous variable. Between 2013 and 2016, in municipalities with less environmental support, the effect was not statistically significant; in municipalities with greater support, farmer mayors reduced environmental spending by 7.67% per year with statistical significance. The difference between the two groups, −9.12 percentage points and statistically significant, suggests that the mayor's behavior responds to the profile of the local electorate. This interpretation is reinforced by the result of the estimation with the continuous variable: for each additional percentage point in support for the environmentalist candidate, the estimated effect of the election of a farmer mayor is a 0.85 percentage point reduction in environmental management expenditures.

To assess possible private gains associated with alignment with interest groups, we used the gross value added of the agricultural sector in relation to municipal GDP as an indicator of the economic importance of the activity in the municipality. This variable was categorized based on the sample median, allowing us to estimate the effect of the treatment separately for contexts with greater and lesser presence of the agricultural sector. We also examined whether the effect is influenced by the composition of campaign financing. We constructed continuous variables representing the percentage of self-financing and the percentage of private donations in the total amount raised by the candidate, as well as binary versions that identify the predominant type of financing.

Table A12 presents the results of the heterogeneity analysis associated with the relevance of the agricultural sector in the municipality. The differences between the coefficients are not statistically significant, which limits our conclusions about the presence of this mechanism. Therefore, we cannot conclude that the relative importance of agribusiness in the municipal economy is a determining factor for lower adherence to environmental protection. On the other hand, the hypothesis that farmer mayors act more intensely in municipalities where the agricultural sector is less relevant in order to expand production frontiers is not confirmed. This hypothesis is supported by the perspective of Bragança and Dahis (2022), which highlights the weakening of environmental enforcement as a means for this advancemen[8]. Finally, the composition of campaign financing sources as a factor in modulating the effect of the election of farmer mayors on environmental spending did not show consistent or statistically significant

8 As a complement, we explored two related patterns: the distribution of elected officials in relation to gross agricultural value added and land cover transitions (from forest to agricultural use and vice versa) in municipalities with farmer mayors. In both cases, the results also do not indicate statistically significant differences, which reinforces the absence of conclusive evidence on this channel.

coefficients, as shown in Table A13. Our empirical results are not conclusive about the heterogeneity associated with this channel.

In summary, our results reveal two patterns: first, the more pronounced reduction in environmental spending among non-reelectable mayors suggests that personal preferences predominate in political decisions in the absence of electoral pressure; second, the amplified effect in municipalities with greater support for environmentalist candidates suggests that farmer mayors tend to resist more strongly where this agenda has greater support from the electorate. We understand that this latter pattern may indicate that the political cost of antagonizing environmentally sensitive voters does not outweigh the ideological alignment of mayors, or it may also reflect the fragility of environmental mobilization in many municipalities, which would reduce the electoral consequences of such decisions. As already mentioned, our econometric specification does not identify statistically significant effects related to the relative economic importance of local agribusiness or the composition of campaign donations. Thus, we understand that direct economic interests seem to have less influence on municipal environmental decisions than political and ideological factors.

6. CONCLUSION

In this dissertation, we present evidence indicating that the election of mayors with direct links to the agricultural sector is associated with a reduction in environmental management expenditures in Brazilian municipalities between 2004 and 2020. As discussed in Section 2, the role of farmers as a relevant political group allowed us to investigate how individual preferences and sectoral alignments can influence budgetary choices for a given agenda.

Municipalities where farmers were elected as mayors, according to the classification used, showed a negative annual variation in environmental management expenditures, with a magnitude of around 7 percentage points, lower than that observed in municipalities governed by mayors with other profiles, both in per capita and total terms. The results remain similar in terms of magnitude, sign, and statistical significance when varying bandwidth, kernel, polynomial adjustment, and addition of controls.

The validity of the causal effect is supported by a series of tests commonly used in discontinuous regression literature, such as the density test on the margin of victory and the balancing of observable pre-treatment variables.

Our estimates reveal differentiated effects conditioned on previous characteristics sug-

gested by the theoretical model: while non-reelectable mayors and municipalities with greater electoral support for the environmental agenda showed more pronounced reductions in spending, variables related to the relative economic importance of local agribusiness and campaign financing did not show statistically significant associations. The results suggest the relevance of individual preferences and ideological alignments in the implementation of environmental policy in municipalities where farmer mayors were elected during the period studied.

Although the results indicate the influence of individual characteristics of mayors on environmental decisions, some limitations should be considered when interpreting the estimated effects. As the treatment is defined based on a pre-existing characteristic of the candidate, it cannot be ruled out that the observed impact reflects, at least in part, other correlated attributes that also contributed to their election in close races. In addition, the data used to capture the influence of the agricultural and environmental sectors may not fully reflect the intensity of the links between mayors and these interest groups. Nevertheless, the theoretical model developed provides support for interpreting the results in light of the preferences and ideological orientation of mayors. In line with this argument, the literature shows that politicians respond strategically to electoral incentives, including in relation to issues often treated as secondary, such as the environment.

Based on this dissertation, it is possible to develop a research agenda aimed at a more robust understanding of the channels through which personal and sectoral ties influence local environmental policy. Future investigations may explore the internal heterogeneity of the group of farmer mayors, given the structural diversity of gross agricultural value added among municipalities. In addition, it would be relevant to examine institutional connections with the ruralist caucus, representative entities of the sector, voluntary transfers, and parliamentary amendments, which can act as indirect mechanisms of influence. Finally, further insights can be gained by investigating the impacts of the election of farmer mayors on environmental enforcement policies, investments in environmental management infrastructure, and changes in land use and land cover, dimensions over which a mayor also has agency.

BIBLIOGRAPHICAL REFERENCES

Alesina, A.; Cassidy, T.; Troiano, U. Old and Young Politicians. Economica, v. 86, n. 344, p. 689–727, out. 2019. ISSN 0013-0427, 1468-0335. Disponível em: <https://onlinelibrary.wiley.com/doi/10.1111/ecca.12287>.

Amarante, P. A.; Moreira, I. T. A EVOLUÇÃO DOS GASTOS PÚBLICOS POR FUNÇÃO E POR GRUPO DE DESPESAS NO PERÍODO DE 1980 A 2006. In: Anais do XII Encontro de Iniciação a docência. Paraíba: Universidade Federal da Paraíba, 2009. Disponível em: <http://www.prac.ufpb.br/anais/xenex_xienid/xi_enid/monitoriapet/ANAIS/Area8/8CCSADEMT-05-P.pdf>.

Araujo, R.; Santarrosa, R.; Pereira, L. SSRN Scholarly Paper, Voting in the Heat of the Moment: Climate Change Salience and Electoral Behavior. Rochester, NY: Social Science Research Network, 2024. Disponível em: <https://papers.ssrn.com/abstract=4912460>.

Araújo, S. M. V. G. d. Caderno 1 - FUNDAMENTOS CONSTITUCIONAIS E LEGAIS. In:- Ganem, R. S. (Ed.). Legislação brasileira sobre meio ambiente. [S.l.]: Câmara dos Deputados - Coordenação Edições Câmara, 2013. ISBN 978-85-402-0139-2.

Avelino, E. F. et al. Despesas com gestão ambiental nos estados da Amazônia Legal.Desenvolvimento em Debate, v. 9, n. 2, ago. 2021. ISSN 21769257, 27637778. Disponível em:<https://inctpped.ie.ufrj.br/desenvolvimentoemdebate/pdf/dd_v9_n2_elenize_freitas_avelino_ et_al.pdf>.

Bardhan, P.; Mookherjee, D. Capture and Governance at Local and National Levels. American Economic Review, v. 90, n. 2, p. 135–139, maio 2000. ISSN 0002-8282. Disponível em: <https://pubs.aeaweb.org/doi/10.1257/aer.90.2.135>.

Beland, L.; Oloomi, S. PARTY AFFILIATION AND PUBLIC SPENDING: EVIDENCE FROM U.S. GOVERNORS. Economic Inquiry, v. 55, n. 2, p. 982–995, abr. 2017. ISSN 0095-2583, 1465-7295. Disponível em: <https://onlinelibrary.wiley.com/doi/10.1111/ecin.12393>.

Beland, L.-P.; Boucher, V. Polluting politics. Economics Letters, v. 137, p. 176–181, dez.

2015. ISSN 01651765. Disponível em: <https://linkinghub.elsevier.com/retrieve/pii/S0165176515004632>.

Beskow, E.; Mattei, L. Notas sobre a trajetória da questão ambiental e principais temas em debate na conferência Rio + 20. Revista NECAT - Revista do Núcleo de Estudos de Economia Catarinense, v. 1, n. 2, p. 4–12, 2012. ISSN 2317-8523. Number: 2. Disponível em: <https://ojs.sites.ufsc.br/index.php/revistanecat/article/view/4525>.

Besley, T.; Montalvo, J. G.; Reynal-Querol, M. Do Educated Leaders Matter? The Economic Journal, v. 121, n. 554, p. F205–227, ago. 2011. ISSN 0013-0133, 1468-0297. Disponível em: <https://academic.oup.com/ej/article/121/554/F205/5079434>.

Bragança, A.; Dahis, R. Cutting special interests by the roots: Evidence from the Brazilian Amazon. Journal of Public Economics, v. 215, p. 104753, nov. 2022. ISSN 00472727. Disponível em: <https://linkinghub.elsevier.com/retrieve/pii/S0047272722001554>.

Brasil. Lei de orçamento No. 4.320. 1964. Disponível em: <https://www.planalto.gov.br/ccivil_03/leis/l4320.htm>.

Brasil. Lei No. 6.938. 1981. Disponível em: <https://www.planalto.gov.br/ccivil_03/leis/l6938.htm>.

Brasil. Constituição da República Federativa do Brasil. 1988. Disponível em: <https: //www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm>.

Brasil. Portaria SOF/SETO/ME No. 42. 1999. Disponível em: <http://www.orcamentofederal.gov.br/orcamentos-anuais/orcamento-1999/Portaria_Ministerial_42_de_140499.pdf/>.

Brasil. Lei complementar No. 101. 2000. Disponível em: <https://www.planalto.gov.br/ccivil_03/leis/lcp/lcp101.htm>.

Brasil. Portaria SOF/ME No. 2.520. 2022. Disponível em: <https://in.gov.br/web/dou/-/ portaria-sof/me-n-2.520-de-21-de-marco-de-2022-387374808>.

Brasil. Manual de Contabilidade Aplicada ao Setor Público. 11. ed. Brasília: Secretaria do Tesouro Nacional. Ministério da Fazenda, 2024. Disponível em: <https://www.tesourotransparente. gov.br/publicacoes/manual-de-contabilidade-aplicada-ao-setor-publico-mcasp/2025/26>.

Bruce, R. et al. Under pressure: Women's leadership during the COVID-19 crisis. Journal of Development Economics, v. 154, p. 102761, jan. 2022. ISSN 03043878. Disponível em: <https://linkinghub.elsevier.com/retrieve/pii/S0304387821001243>.

Bruno, R. Bancada ruralista, conservadorismo e representação de interesses no Brasil contemporâneo. In: Maluf, R. S.; Flexor, G. (Ed.). Questões agrárias, agrícolas e rurais: conjunturas e políticas públicas. Rio de Janeiro: E-Papers, 2017. ISBN 978-85-7650-561-7.

Bueno, W.; Oliana, F.; Borinelli, B. O Estudo do Gasto Público em Meio Ambiente. Economia & Região, v. 1, n. 1, p. 118–133, maio 2013. ISSN 2317-627X. Number: 1. Disponível em: <https://ojs.uel.br/revistas/uel/index.php/ecoreg/article/view/12711>.

Calonico, S.; Cattaneo, M. D.; Farrell, M. H. Optimal bandwidth choice for robust bias-corrected inference in regression discontinuity designs. The Econometrics Journal, v. 23, n. 2, p. 192–210, maio 2020. ISSN 1368-4221, 1368-423X. Disponível em: <https://academic.oup.com/ectj/article/23/2/192/5625071>.

Carvalho, P. G. M. D. et al. Gestão local e meio ambiente. Ambiente & Sociedade, v. 8, n. 1, p. 121–140, jan. 2005. ISSN 1414-753X. Disponível em: <http://www.scielo.br/scielo.php? script=sci_arttext&pid=S1414-753X2005000100008&lng=pt&tlng=pt>.

Cota, R. T. C. UMA IMERSÃO NAS CONTAS PÚBLICAS BRASILEIRAS. n. IPEA, 2017.

Dahis, R. et al. Data Basis (Base Dos Dados): Universalizing Access to High-Quality Data. SSRN Electronic Journal, 2022. ISSN 1556-5068. Disponível em: <https://www.ssrn.com/ abstract=4157813>.

Dantas, M. K. et al. ANÁLISE DOS GASTOS PÚBLICOS COM GESTÃO AMBIENTAL NO

BRASIL. Revista de Gestão Social e Ambiental, v. 8, n. 3, p. 52, abr. 2015. ISSN 1981-982X. Disponível em: <http://www.revistargsa.org/rgsa/article/view/959>.

Fredriksson, P. G.; Wang, L.; Mamun, K. A. Are politicians office or policy motivated? The case of U.S. governors' environmental policies. Journal of Environmental Economics and Management, v. 62, n. 2, p. 241–253, 2011. ISSN 00950696. Disponível em: <https://linkinghub.elsevier.com/retrieve/pii/S0095069611000325>.

Gelman, A.; Imbens, G. Why High-Order Polynomials Should Not Be Used in Regression Discontinuity Designs. Journal of Business & Economic Statistics, v. 37, n. 3, p. 447–456, jul. 2019. ISSN 0735-0015, 1537-2707. Disponível em: <https://www.tandfonline.com/doi/full/10.1080/07350015.2017.1366909>.

Grossman, G. M.; Helpman, E. Protection for Sale. The American Economic Review, v. 84, n. 4, p. 833–850, 1994. ISSN 00028282. Publisher: American Economic Association. Disponível em: <http://www.jstor.org/stable/2118033>.

Guandalini, N. N.; Borinelli, B.; Godoy, D. F. d. S. Gastos Públicos Ambientais nas Capitais dos Estados Brasileiros: Um Estudo Exploratório no Período de 2002 a 2010. Revista de Ciências Jurídicas e Empresariais, v. 14, n. 2, 2013. ISSN 2448-2129. Number: 2. Disponível em: <https://revistajuridicas.pgsscogna.com.br/juridicas/article/view/406>.

Helfand, S. M. The Political Economy of Agricultural Policy in Brazil: Decision Making and Influence From 1964 to 1992. Latin American Research Review, v. 34, n. 2, p. 3–41, 1999. ISSN 0023-8791, 1542-4278. Disponível em: <https://www.cambridge.org/core/product/identifier/S0023879100038565/type/journal_article>.

Herrnstadt, E.; Muehlegger, E. Weather, salience of climate change and congressional voting. Journal of Environmental Economics and Management, v. 68, n. 3, p. 435–448, nov. 2014. ISSN 0095-0696. Disponível em: <https://www.sciencedirect.com/science/article/pii/S0095069614000758>.

Imbens, G. W.; Lemieux, T. Regression discontinuity designs: A guide to practice. Journal of

Econometrics, v. 142, n. 2, p. 615–635, fev. 2008. ISSN 0304-4076. Disponível em: <https://www.sciencedirect.com/science/article/pii/S0304407607001091>.

Leme, T. N. Capítulo 6: Governança Ambiental no Nível Municipal. In: Moura, A. M. M. d. (Ed.). Governança ambiental no Brasil: instituições, atores e políticas públicas. Brasília: Instituto de Pesquisa Econômica Aplicada (Ipea), 2016. p. 147–174. ISBN 978-85-7811-275-2.

Lima, L. H. Capítulo 2: Atuação do Tribunal de Contas da União no Controle Externo da Gestão Ambiental. In: Moura, A. M. M. d. (Ed.). Governança ambiental no Brasil: instituições, atores e políticas públicas. Brasília: Instituto de Pesquisa Econômica Aplicada (Ipea), 2016. p. 45–58.

Lima, M. O. M. S. V. d. Meio Ambiente na Constituição de 88 - Lições da História. Volume V - Constituição de 1988 : O Brasil 20 anos depois. Os Cidadãos na Carta Cidadã, 2008. Disponível em: <https://www12.senado. leg.br/publicacoes/estudos-legislativos/tipos-de-estudos/outras--publicacoes/volume-v-constituicao-de-1988-o-brasil-20-anos-depois.-os-cidadaos-na-carta-cidada/ meio-ambiente-meio-ambiente-na-constituicao-de-88-licoes-da-historia/view>.

List, J. A.; Sturm, D. M. How Elections Matter: Theory and Evidence from Environmental Policy. The Quarterly Journal of Economics, v. 121, n. 4, p. 1249–1281, nov. 2006. ISSN 0033-5533, 1531-4650. Disponível em: <https://academic.oup.com/qje/article-lookup/doi/10.1093/qje/121.4.1249>.

Marshall, J. Can Close Election Regression Discontinuity Designs Identify Effects of Winning Politician Characteristics? American Journal of Political Science, v. 68, n. 2, p. 494–510, abr. 2024. ISSN 0092-5853, 1540-5907. Disponível em: <https://onlinelibrary.wiley.com/doi/10.1111/ajps.12741>.

McCrary, J. Manipulation of the running variable in the regression discontinuity design: A density test. Journal of Econometrics, v. 142, n. 2, p. 698–714, fev. 2008. ISSN 0304-4076. Disponível em: <https://www.sciencedirect.com/science/article/pii/S0304407607001133>.

Milmanda, M. B. F. Agrarian Elites and Democracy in Latin America after the Third Wave. Tese (Doutorado) — Oxford University Press, jun. 2019. Disponível em: <https://oxfordre.com/ poli-

tics/view/10.1093/acrefore/9780190228637.001.0001/acrefore-9780190228637-e-1652>.

Moura, A. M. M. d. Capítulo 1: Trajetória da política ambiental federal no Brasil. In: Moura, A. M. M. d. (Ed.). Governança ambiental no Brasil: instituições, atores e políticas públicas. Brasília: Instituto de Pesquisa Econômica Aplicada (Ipea), 2016. p. 13–43. ISBN 978-85-7811-275-2.

Moura, Adriana Maria Magalhães de et al. Gastos ambientais no Brasil: proposta metodológica para aplicação no orçamento federal. Texto para Discussão 2354, v. 2354, n. IPEA, dez. 2017. Disponível em: <https://repositorio.ipea.gov.br/bitstream/11058/8201/1/TD_2354.pdf>.

Neves, E. M. S. C. Política ambiental, municípios e cooperação intergovernamental no Brasil. Estudos Avançados, v. 26, n. 74, p. 137–150, 2012. ISSN 0103-4014. Disponível em: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103=40142012000100010-&lng=pt&tlng-pt>.

Oates, W. E.; Portney, P. R. The Political Economy of Environmental Policy. nov. 2001.

Ogeda, P.; Ornelas, E.; Soares, R. R. Labor Unions and the Electoral Consequences of Trade Liberalization. Journal of the European Economic Association, v. 23, n. 1, p. 236–280, fev. 2025. ISSN 1542-4766, 1542-4774. Disponível em: <https://academic.oup.com/jeea/article/23/1/236/7628306>.

Pacca, L. et al. The Role of Party Affiliation, Lobbying, and Electoral Incentives in Decentralized US State Support of the Environment. Journal of the Association of Environmental and Resource Economists, v. 8, n. 3, p. 617–653, abr. 2021.

Pereira, P. V. D. M.; Neto, L. F. F. Evolução dos gastos públicos ambientais dos municípios brasileiros: uma análise no período de 2005 a 2015. Engenharia Sanitaria e Ambiental, v. 25, n. 2, p. 425–437, mar. 2020. ISSN 1809-4457, 1413-4152. Disponível em: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-41522020000200425&tlng=pt>.

Pettersson-Lidbom, P. Do Parties Matter for Economic Outcomes? A Regression-Discontinuity Approach. Journal of the European Economic Association, v. 6, n. 5, p. 1037–1056, set. 2008.

ISSN 1542-4766, 1542-4774. Disponível em: <https://academic.oup.com/jeea/article-lookup/doi/10.1162/JEEA.2008.6.5.1037>.

Richardson, N. P. The Politics of Abundance: Export Agriculture and Redistributive Conflict in South America. Dissertation, n. University of California, Berkeley, 2012.

Stokes, L. C. Electoral Backlash against Climate Policy: A Natural Experiment on Retrospective Voting and Local Resistance to Public Policy. American Journal of Political Science, v. 60, n. 4, p. 958–974, out. 2016. ISSN 0092-5853, 1540-5907. Disponível em: <https://onlinelibrary.wiley.com/doi/10.1111/ajps.12220>.

Tridapalli, J. P. et al. ANÁLISE DOS GASTOS AMBIENTAIS NO SETOR PÚBLICO BRASILEIRO: CARACTERÍSTICAS E PROPOSTAS ALTERNATIVAS. Revista de Gestão Social e Ambiental, v. 5, n. 2, fev. 2012. ISSN 1981-982X. Disponível em:<http://www.revistargsa.org/ojs/index.php/rgsa/article/view/340>.

Weller, L.; Limongi, F. Democracia negociada: Política partidária no Brasil da Nova República. Rio de Janeiro, RJ: Editora FGV, 2024. ISBN 978-65-5652-335-4.

Yu, Z. Environmental Protection: A Theory of Direct and Indirect Competition for Political Influence. The Review of Economic Studies, v. 72, n. 1, p. 269–286, jan. 2005. ISSN 1467-937X, 0034-6527. Disponível em: <https://academic.oup.com/restud/article-lookup/doi/10.1111/ 0034-6527.00332>.

Appendix A – Supplementary figures and tables

Tabela A1 – Descrição das variáveis

Variável	Descrição	Fonte
Características territoriais dos municípios		
População	Número de habitantes por município-ano	IBGE[1]
Área	Extensão territorial por município (quilômetros quadrados)	IBGE
Agropecuária	Cobertura da ocupação da agropecuária por município-ano (mil hectares) *	MapBiomas
Urbana	Área urbana em hectares por município e por ano (mil hectares) **	MapBiomas
Floresta	Cobertura de florestas naturais por município-ano (mil hectares) ***	MapBiomas
Características econômicas e ambientais dos municípios		
PIB	Produto interno bruto por município-ano (em R$ milhão)	IBGE
VAB da agropecuária	Valor adicionado bruto da atividade agropecuária por município-ano (em R$ milhão)	IBGE
Despesa total	Soma do total de todas as funções de despesa orçamentária por município-ano (em R$ milhão).	STN[3]
Despesa total per capita	Soma do total de todas as funções de despesa orçamentária por município-ano dividida pelo número de habitantes (em R$ per capita)	STN
Gestão ambiental	Despesa orçamentária da função gestão ambiental por município-ano (em R$ milhão)	STN
Gestão ambiental per capita	Despesa orçamentária da função gestão ambiental por município-ano dividida pelo número de habitantes (em R$ per capita).	STN
Emissão total	Emissões de gases poluentes por município-ano de cinco setores: produção e consumo de energia; processos industriais; mudança de uso da terra e floresta; atividade agropecuária; gestão de resíduos sólidos [Megatonelada (Mt) de CO2e]	SEEG[2]
Emissão da agropecuária	Emissões de gases poluentes da atividade agropecuária por município-ano [Megatonelada (Mt) de CO2e]	SEEG
Perfil dos prefeitos eleitos		
Idade	Idade dos prefeitos eleitos por município-ano.	TSE[4]
Gênero masculino	Prefeitos eleitos autodeclarados do gênero masculino por município-ano (em %).	TSE
Branco	Prefeitos eleitos autodeclarados brancos por município-ano (em %)	TSE
Casado	Prefeitos eleitos autodeclarados casados (em %).	TSE
Ensino fundamental completo	Prefeitos eleitos com **apenas** o ensino fundamental concluído (em %).	TSE
Ensino médio completo	Prefeitos eleitos com até o ensino médio concluído (em %)	TSE
Ensino superior completo	Prefeitos eleitos com até o ensino superior concluído (em %).	TSE
Características de campanha dos prefeitos eleitos		
Incumbente	Prefeitos reeleitos por município-ano (em %).	TSE
Total arrecadado	Valor total declarado de receita recebida para o financiamento da campanha política (em R$ mil).	TSE
Doações de PJ	Valor declarado de receita recebida de pessoas jurídicas para o financiamento da campanha política (em R$ mil).	TSE
Autofinanciamento	Valor declarado de recurso próprio utilizado para o financiamento da campanha política (em R$ mil).	TSE

Notas: A unidade de cada observação é município-ano.
* Agropecuária abrange pastagem, agricultura, silvicultura e mosaico de usos.
** Uma das categorias da classe de áreas não vegetadas. São regiões urbanizadas com predomínio de superfícies impermeáveis (edificações, estradas e vias pavimentadas).
*** O mapeamento de florestas naturais abrange tipos diversos de cobertura arbórea: formações florestais, savanas, florestas alagáveis, mangue e restinga.
[1] Instituto Brasileiro de Geografia e Estatística.
[2] Sistema de Estimativas de Emissões e Remoções de Gases de Efeito Estufa, iniciativa do Observatório do Clima. As estimativas de emissões dos gases de efeito são apresentadas em dióxido de carbono equivalente (CO2e) em termos do *Global Warming Potential* (GWP) na métrica do quinto relatório de avaliação do *Intergovernmental Panel on Climate Change* (AR5-IPCC).
[3] Secretaria do Tesouro Nacional.
[4] Tribunal Superior Eleitoral.

Tabela A2 – Teste de média para variáveis da amostra de municípios com disputa

	Fazendeiro		N-Fazendeiro			
	Média	DP	Média	DP	Dif. Média	p-valor
População (milhares de hab.)	15,00	38,90	13,90	19,90	-1,10	0,010
Área (km2)	1.435,20	4.597,40	1.231,50	3.047,50	-203,70	<0,001
Agropecuária (mil hectares)	53,50	91,60	49,10	74,00	-4,40	<0,001
Urbana (mil hectares)	0,30	0,80	0,30	0,50	-0,00	0,050
Floresta (mil hectares)	78,40	391,30	64,00	257,00	-14,40	0,001
PIB (em R$ milhão)	248,50	1.250,50	213,10	608,40	-35,40	0,010
VAB da agropecuária (em R$ milhão)	41,50	76,60	38,20	75,50	-3,40	0,001
Despesa total (em R$ milhão)	40,90	125,70	37,60	57,20	-3,30	0,020
Despesa total (em R$ per capita)	3.355,80	1.669,70	3.417,20	1.816,40	61,50	0,020
Gestão ambiental (em R$ mil)	179,30	656,80	218,20	1.536,30	38,90	0,030
Gestão ambiental (em R$ per capita)	14,70	41,80	15,50	47,90	0,80	0,200
Emissão total (kt)	300,40	1.028,80	278,60	897,90	-21,80	0,140
Emissão da agropecuária (kt)	109,00	204,20	101,30	170,90	-7,70	0,010
Idade	50,90	10,20	47,40	9,50	3,40	<0,001
Total arrecadado (em R$ mil)	70,10	125,80	66,50	112,60	3,60	0,051
Doações de PJ (em R$ mil)	9,60	40,10	11,60	69,50	-2,00	0,022
Autofinanciamento (em R$ mil)	25,00	65,60	21,60	50,70	3,40	0,001

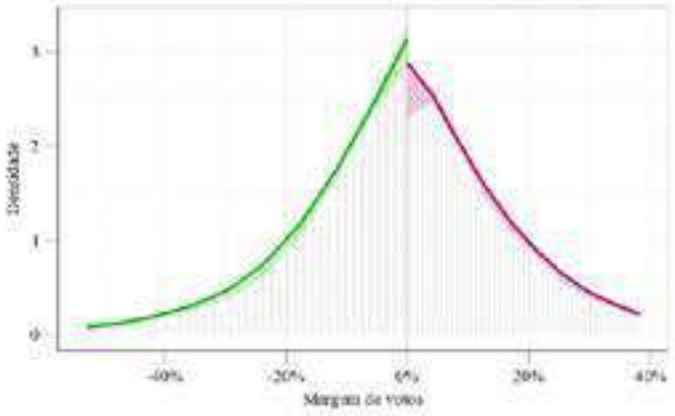
Fonte: Elaboração própria com base nos dados do TSE, IBGE, STN, MapBiomas e SEEG. A tabela apresenta a média e o desvio padrão (DP) para cada grupo, além da diferença de médias e o p-valor correspondente para o teste de hipótese entre fazendeiros e não-fazendeiros na amostra de municípios com disputa conforme definição descrita na Seção 4.3 .

Tabela A3 – Teste de média para variáveis da amostra completa

	Fazendeiro		N-Fazendeiro			
	Média	DP	Média	DP	Dif. Média	p-valor
População (milhares de hab.)	13,50	34,10	38,50	222,00	25,10	<0,001
Área (km2)	1.366,30	4.356,30	1.550,80	5.782,10	184,50	<0,001
Agropecuária (mil hectares)	52,40	91,90	44,40	75,30	-8,00	<0,001
Urbana (mil hectares)	0,30	0,70	0,70	2,20	0,40	<0,001
Floresta (mil hectares)	73,30	364,30	97,50	525,20	24,20	<0,001
PIB (em R$ milhão)	219,90	1.090,60	955,70	9.640,00	735,90	<0,001
VAB da agropecuária (em R$ milhão)	40,80	75,80	40,00	80,70	-0,80	0,270
Despesa total (em R$ milhão)	37,40	109,60	115,70	913,80	78,30	<0,001
Despesa total (em R$ per capita)	3.496,60	1.789,80	3.235,90	1.951,90	-260,80	<0,001
Gestão ambiental (em R$ mil)	163,80	601,90	1.026,90	8.962,70	863,10	<0,001
Gestão ambiental (em R$ per capita)	14,70	40,30	18,40	50,20	3,70	<0,001
Emissão total (kt)	294,60	1.054,60	321,90	1.144,10	27,30	0,010
Emissão da agropecuária (kt)	106,10	208,50	90,50	177,00	-15,60	<0,001
Idade	50,60	10,10	48,00	10,00	2,60	<0,001
Total arrecadado (em R$ mil)	64,90	120,10	143,00	708,70	-78,10	<0,001
Doações de PJ (em R$ mil)	8,90	42,70	33,00	173,30	-24,20	<0,001
Autofinanciamento (em R$ mil)	24,10	65,90	28,50	129,40	-4,40	<0,001

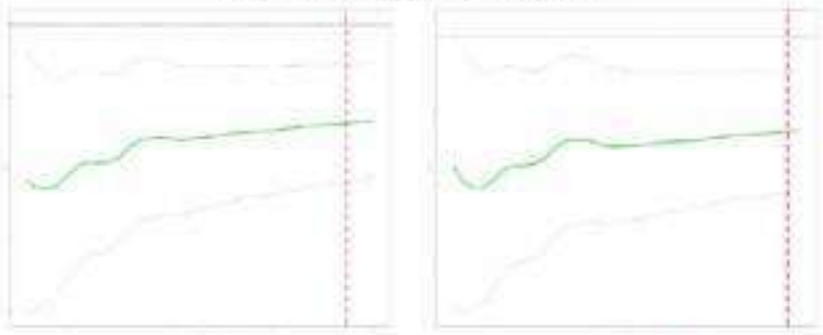
Fonte: Elaboração própria com base nos dados do TSE, IBGE, STN, MapBiomas e SEEG. A tabela apresenta a média e o desvio padrão (DP) para cada grupo, além da diferença de médias e o p-valor correspondente para o teste de hipótese entre fazendeiros e não-fazendeiros na amostra completa.

Figura A1 – Teste de densidade da margem de votos



Nota: O gráfico representa o teste de densidade de McCrary (2008) para a variável de corte ao redor do ponto de descontinuidade. A variável de corte é a margem de votos que foi calculada com base nos dados de eleições municipais obtidos do Tribunal Superior Eleitoral (TSE).

Figura A2 – Variação da banda de largura



(a) Variável per capita (b) Variável em nível total

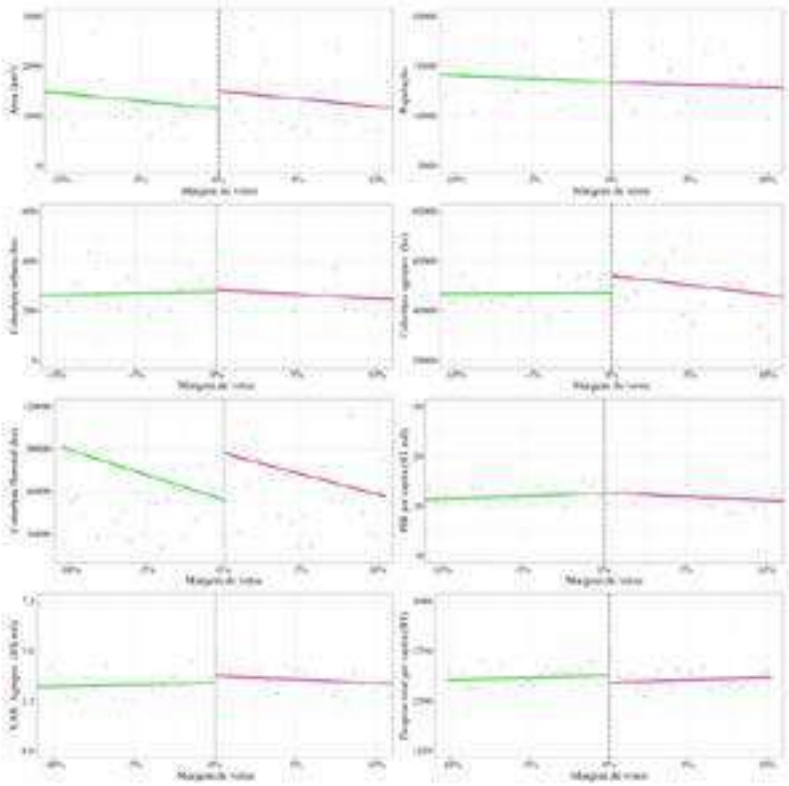
Nota: Esta figura apresenta o impacto da eleição de prefeitos fazendeiros nas despesas com gestão ambiental com larguras de banda variadas, mantendo as especificações das regressões principais e com intervalos de confiança de 95%.

Tabela A4 – Teste de balanceamento de características municipais

	Área	População	Urbana	Agro.	Floresta	PIB	VAB Agro.	Despesas
Fazendeiro	352,52	-50,97	7,45	6.665,47	32.788,35	0,07	0,35	-174,96
	[-125,61;	[-2.626,15;	[-69,21;	[-2.653,64;	[-8.464,36;	[-1,92;	[-0,22;	[-398,40;
	830,64]	2.524,21]	84,11]	16.424,58]	74.041,07]	2,06]	0,92]	48,48]
P-valor	0,15	0,97	0,85	0,16	0,12	0,94	0,22	0,12
Média N-Fazendeiro	1.265,95	13.490,99	264,25	47.262,53	68.964,38	11,97	3,37	3.126,96
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Largura da banda	0,11	0,14	0,16	0,15	0,11	0,13	0,15	0,10
No. efetivo de observações	2.501	2.927	3.108	3.034	2.371	2.777	2.961	2.166

Nota: Esta tabela apresenta os resultados estimados para o teste de balanceamento de covariadas que representam características municipais. São exibidos os coeficientes e os intervalos de confiança de 95% (entre colchetes). Todas as estimativas utilizam kernel triangular e controlam por efeitos fixos de estado e ano. As larguras de banda seguem Calonico, Cattaneo e Farrell (2020) e determinam o tamanho da amostra reportado na última linha. Níveis de significância: $p < 0,01$ ***; $p < 0,05$ **; $p < 0,1$ *.

Figura A3 – Teste de balanceamento de características municipais



Nota: Representação gráfica dos resultados apresentados na Tabela A4.

Tabela A5 – Teste de balanceamento de características dos prefeitos eleitos

	Idade (anos)	Partido de esquerda	Gênero masculino	Superior completo
Fazendeiro	5,29***	−0,10***	0,09***	−0,28***
	[3,75; 6,82]	[−0,17; −0,04]	[0,06; 0,12]	[−0,36; −0,21]
Kernel	Triangular	Triangular	Triangular	Triangular
Largura da banda	0,219	0,074	0,185	0,085
No. efetivo de observações	1.970	1.972	1.972	1.968

Nota: Esta tabela apresenta estimativas de RDD da associação entre prefeitos fazendeiros eleitos e quatro variáveis dependentes que representam suas características individuais. Na primeira coluna, o resultado corresponde à idade do prefeito eleito; na segunda, a uma variável indicadora de filiação a partido de esquerda, conforme definição de Ogeda, Ornelas e Soares (2025); na terceira, a uma variável indicadora do gênero masculino; e, na quarta, a uma variável indicadora de possuir ensino superior completo. Para cada regressão são apresentados os coeficientes e os intervalos de confiança de 95% (entre colchetes). Todas as estimativas utilizam kernel triangular, especificação polinomial linear e controlam efeitos fixos por estado e por ano. As larguras de banda, definidas conforme Calonico, Cattaneo e Farrell (2020) para minimizar o erro quadrático médio do estimador, determinam o tamanho da amostra utilizado em cada regressão que também está reportado na tabela. Níveis de significância: $p < 0,01$ ***; $p < 0,05$ **; $p < 0,1$ *.

Tabela A6 – Avaliação de robustez: estimações sem efeitos fixos (Variação per capita)

	Variação das despesas per capita com gestão ambiental			
	(1)		(2)	
	Linear	Quadrática	Linear	Quadrática
Fazendeiro	−6,12**	−6,40**	−5,84**	−6,48**
	[−11,19; −1,06]	[−11,94; −0,85]	[−10,65; −1,04]	[−11,86; −1,10]
Média Não-Fazendeiro	−0,80	−0,91	−0,80	−0,71
Kernel	Triangular	Triangular	Triangular	Triangular
Largura da banda	0,096	0,168	0,113	0,187
No. efetivo de observações	1.897	2.711	2.120	2.873

Nota: Esta tabela apresenta nossos resultados estimados para o impacto da eleição de um prefeito fazendeiro sobre a variação (em %) anual de despesas orçamentárias per capita com a função gestão ambiental nos municípios brasileiros entre 2005 e 2020. Para cada especificação polinomial são apresentados os coeficientes e os intervalos de confiança de 95% (entre colchetes). Todas as estimativas utilizam kernel triangular sem controlar por efeitos fixos. Em (1) são utilizadas as larguras de banda da regressão principal apresentada na Tabela 5. Em (2) as larguras de banda são definidas conforme Calonico, Cattaneo e Farrell (2020) para minimizar o erro quadrático médio do estimador. Níveis de significância: p < 0,01 ***; p < 0,05 **; p < 0,1 *.

Tabela A7 – Avaliação de robustez: estimações sem efeitos fixos (Variação no nível total)

	Variação das despesas com gestão ambiental			
	(1)		(2)	
	Linear	Quadrática	Linear	Quadrática
Fazendeiro	−5,50**	−5,85**	−5,39**	−5,90**
	[−10,43; −0,57]	[−11,34; −0,36]	[−10,12; −0,67]	[−11,27; −0,53]
Média Não-Fazendeiro	0,14	−0,26	−0,23	−0,14
Kernel	Triangular	Triangular	Triangular	Triangular
Largura da banda	0,106	0,179	0,122	0,194
No. efetivo de observações	2.018	2.794	2.221	2.939

Nota: Esta tabela apresenta nossos resultados estimados para o impacto da eleição de um prefeito fazendeiro sobre a variação (em %) anual de despesas orçamentárias em nível total com a função gestão ambiental nos municípios brasileiros entre 2005 e 2020. Para cada especificação polinomial são apresentados os coeficientes e os intervalos de confiança de 95% (entre colchetes). Todas as estimativas utilizam kernel triangular sem controlar por efeitos fixos. Em (1) são utilizadas as larguras de banda da regressão principal apresentada na Tabela 5. Em (2) as larguras de banda são definidas conforme Calonico, Cattaneo e Farrell (2020) para minimizar o erro quadrático médio do estimador. Níveis de significância: p < 0,01 ***; p < 0,05 **; p < 0,1 *.

Tabela A8 – Avaliação de robustez: estimações com kernel uniforme (Variação per capita)

	Variação das despesas per capita com gestão ambiental			
	(1)		(2)	
	Linear	Quadrática	Linear	Quadrática
Fazendeiro	−6,56***	−6,90**	−7,32***	−6,40**
	[−11,32; −1,81]	[−12,22; −1,57]	[−12,12; −2,52]	[−11,67; −1,13]
Média Não-Fazendeiro	−0,80	−0,91	−1,04	−0,89
Kernel	Uniforme	Uniforme	Uniforme	Uniforme
Largura da banda	0,096	0,168	0,086	0,166
No. efetivo de observações	1.897	2.711	1.752	2.693

Nota: Esta tabela apresenta nossos resultados estimados para o impacto da eleição de um prefeito fazendeiro sobre a variação (em %) anual de despesas orçamentárias per capita com a função gestão ambiental nos municípios brasileiros entre 2005 e 2020. Para cada especificação polinomial são apresentados os coeficientes e os intervalos de confiança de 95% (entre colchetes). Todas as estimativas utilizam kernel uniforme e controlam por efeitos fixos de estado e ano. Em (1) são utilizadas as larguras de banda da regressão principal apresentada na Tabela 5. Em (2) as larguras de banda são definidas conforme Calonico, Cattaneo e Farrell (2020) para minimizar o erro quadrático médio do estimador. Níveis de significância: p < 0,01 ***; p < 0,05 **; p < 0,1 *.

Tabela A9 – Avaliação de robustez: estimações com kernel uniforme (Variação no nível total)

	Variação das despesas com gestão ambiental			
	(1)		(2)	
	Linear	Quadrática	Linear	Quadrática
Fazendeiro	−5,80**	−6,20**	−5,15**	−6,03**
	[−10,41; −1,19]	[−11,47; −0,92]	[−9,56; −0,74]	[−11,28; −0,79]
Média Não-Fazendeiro	0,14	−0,26	−0,03	−0,25
Kernel	Uniforme	Uniforme	Uniforme	Uniforme
Largura da banda	0,106	0,179	0,115	0,177
No. efetivo de observações	2.018	2.794	2.133	2.779

Nota: Esta tabela apresenta nossos resultados estimados para o impacto da eleição de um prefeito fazendeiro sobre a variação (em %) anual de despesas orçamentárias em nível total com a função gestão ambiental nos municípios brasileiros entre 2005 e 2020. Para cada especificação polinomial são apresentados os coeficientes e os intervalos de confiança de 95% (entre colchetes). Todas as estimativas utilizam kernel uniforme e controlam por efeitos fixos de estado e ano. Em (1) são utilizadas as larguras de banda da regressão principal apresentada na Tabela 5. Em (2) as larguras de banda são definidas conforme Calonico, Cattaneo e Farrell (2020) para minimizar o erro quadrático médio do estimador. Níveis de significância: p < 0,01 ***; p < 0,05 **; p < 0,1 *.

Tabela A10 – Efeito heterogêneo por possibilidade de reeleição

	Variação das despesas per capita com gestão ambiental				
	Período completo	2005-2008	2009-2012	2013-2016	2017-2020
Fazendeiro*Não-Reelegível	-1,31	-	1,99	-11,95*	0,90
	(3,45)		(7,12)	(6,19)	(5,07)
Fazendeiro*Reelegível	-1,87	-	-0,51	7,71	-4,60
	(1,37)		(7,85)	(2,33)	(5,58)
Diferença dos efeitos	-0,57	-	1,48	-4,24*	-3,70
	(3,68)		(3,15)	(2,44)	(2,50)
No. efetivo de observações	1.749	-	394	542	552

Nota: Esta tabela apresenta os resultados estimados do impacto da eleição de um prefeito fazendeiro sobre a variação (em %) anual das despesas per capita com a função gestão ambiental. Os modelos exploram heterogeneidade condicional à possibilidade de reeleição. Os efeitos são estimados para o período completo e para cada mandato municipal, com apresentação dos coeficientes e erros-padrão robustos à heterocedasticidade (entre parênteses). Todas as estimativas utilizam kernel uniforme, efeitos fixos de estado e ano e a largura de banda da especificação principal (6,6%). Níveis de significância: p < 0,01 ***; p < 0,05 **; p < 0,1 *.

Tabela A11 – Efeito heterogêneo por eleitorado verde

	Variação das despesas per capita com gestão ambiental	
	2013-2016	2017-2020
Fazendeiro*Voto Verde < Mediana	-1,44	-2,60
	(2,98)	(2,97)
Fazendeiro*Voto Verde ≥ Mediana	-7,67*	1,00
	(4,28)	(4,41)
Diferença dos efeitos	-9,12***	-1,60
	(3,19)	(3,18)
Fazendeiro*Voto verde (%)	-0,85**	-0,40
	(0,41)	(0,38)
No. efetivo de observações	542	552

Nota: Esta tabela apresenta os resultados estimados do impacto da eleição de um prefeito fazendeiro sobre a variação (em %) anual das despesas per capita com a função gestão ambiental. Os modelos exploram heterogeneidade condicional ao apoio ambiental no município, utilizando como *proxy* o percentual de votos na candidata à presidência Marina Silva, operado tanto como variável binária (acima/abaixo da mediana desse percentual) quanto como variável contínua. Os efeitos são estimados para os períodos eleitorais de 2013–2016 (votos de 2010) e 2017–2020 (votos de 2014), com apresentação dos coeficientes e erros-padrão robustos à heterocedasticidade (entre parênteses). Todas as estimativas utilizam kernel uniforme, efeito fixo de estado e ano e largura de banda de 8,6%. Níveis de significância: $p < 0,01$ ***; $p < 0,05$ **; $p < 0,1$ *.

Tabela A12 – Efeito heterogêneo por importância do setor agropecuário no PIB municipal

	Variação das despesas per capita com gestão ambiental				
	Período completo	2005-2008	2009-2012	2013-2016	2017-2020
Fazendeiro*Agro < Mediana	-2,67	8,33	2,01	-7,83***	-4,84*
	(1,73)	(5,75)	(4,41)	(2,91)	(2,86)
Fazendeiro*Agro ≥ Mediana	-0,42	-0,45	1,33	-1,27	0,69
	(1,78)	(4,89)	(3,77)	(3,33)	(3,16)
Diferença dos efeitos	-2,25	-8,79	-0,68	6,56	5,53
	(2,47)	(7,22)	(5,78)	(4,37)	(4,25)
Fazendeiro*Agro (% do PIB)	0,09	-0,34	0,06	0,20	0,21
	(0,081)	(0,21)	(0,20)	(0,14)	(0,15)
No. efetivo de observações	1.750	262	394	542	552

Nota: Esta tabela apresenta os resultados estimados do impacto da eleição de um prefeito fazendeiro sobre a variação (em %) anual das despesas per capita com a função gestão ambiental. Os modelos exploram heterogeneidade condicional à importância do setor agropecuário no PIB municipal, utilizando como *proxy* o VAB da agropecuária em relação ao PIB municipal, operado tanto como variável binária (acima/abaixo da mediana desse percentual) quanto como variável contínua. Os efeitos são estimados para o período completo e para cada mandato municipal, com apresentação dos coeficientes e erros-padrão robustos à heterocedasticidade (entre parênteses). Todas as estimativas utilizam kernel uniforme, efeitos fixos de estado e ano e a largura de banda da especificação principal (8,6%). Níveis de significância: $p < 0,01$ ***; $p < 0,05$ **; $p < 0,1$ *.

Tabela A13 – Efeito heterogêneo por fonte de financiamento da campanha

	Variação das despesas per capita com gestão ambiental				
	Período completo	2005-2008	2009-2012	2013-2016	2017-2020
Fazendeiro*Doações > Autofin.	-1,58	1,38	2,70	-5,00*	-1,85
	(1,53)	(5,24)	(3,40)	(2,68)	(2,72)
Fazendeiro*Autofin > Doações	-1,95	1,51	-1,09	-4,07	-1,73
	(2,21)	(7,39)	(5,64)	(3,98)	(3,38)
Diferença dos efeitos	-0,38	0,15	-3,79	0,93	0,12
	(2,67)	(9,00)	(6,61)	(4,72)	(4,29)
Fazendeiro*% de autofin.	-0,00	0,05	-0,06	0,06	-0,02
	(0,04)	(0,11)	(0,09)	(0,07)	(0,06)
Fazendeiro*% de doações	0,00	-0,05	0,06	-0,06	0,02
	(0,04)	(0,11)	(0,09)	(0,07)	(0,06)
No. efetivo de observações	1.695	233	380	530	552

Nota: Esta tabela apresenta os resultados estimados do impacto da eleição de um prefeito fazendeiro sobre a variação (em %) anual das despesas per capita com a função gestão ambiental. Os modelos exploram heterogeneidade condicional à principal fonte de financiamento da campanha, utilizando o percentual de recursos de autofinanciamento em relação ao total, operado tanto como variável binária (campanha majoritariamente autofinanciada ou financiada por doações) quanto como variável contínua. Os efeitos são estimados para o período completo e para cada mandato municipal, com apresentação dos coeficientes e erros-padrão robustos à heterocedasticidade (entre parênteses). Todas as estimativas utilizam kernel uniforme, efeitos fixos de estado e ano e largura de banda de 8,6%. Níveis de significância: p < 0,01 ***; p < 0,05 **; p < 0,1 *.

Appendix B – Budget expenditure execution

Public disbursements are classified as budgetary or extra-budgetary [1](Brazil, 2024). In this dissertation, we are working with the budgetary type, that is, the execution of an expenditure that was established in the budget law. When executing a public expenditure, a municipality (as well as other entities of the Brazilian state) is using an allocation[2] that was assigned by the legislative branch in the Annual Budget Law (LOA) after being drafted by the executive branch. The LOA, the Budget Guidelines Law (LDO), and the Multi-Year Plan (PPA) are constitutional instruments of the Brazilian budgetary process that apply to municipalities, the Federal District, states, and the Union (Brazil, 1988).

The execution of public expenditure is organized in two phases: planning and execution. In

1 Public cash outflow not included in the annual budget law. It comprises deposits, payments of outstanding balances, redemption of credit operations through advance revenue, and transitional resources (Brazil, 2024).

2 An appropriation is the amount allocated to cover a specific expense, which can be classified as either initial budgetary credit—approved in the annual budget law—or additional credit. According to the Budget Law (Law Number 4,320 of March 17, 1964, Brazil (1964)), the latter may be supplementary, to reinforce the initial appropriation; special, for expenses that do not have a specific appropriation; or extraordinary, for urgent and unforeseen events. For all types, legislative approval is required.

the planning stage, expenditure is set according to the mandatory instruments mentioned above: the PPA, which defines medium-term programs, objectives, and targets; the LDO, which establishes fiscal targets and guides budget preparation; and the LOA itself, which authorizes expenditure for the fiscal year. Planning also includes the movement of credits between management units, budgetary and financial programming, and the bidding procedure for the procurement of goods, services, and works (Brazil, 2024).

While budgetary credit represents legislative authorization to spend, financial resources correspond to the amount actually available for expenditure. It is important to highlight these two dimensions, as no expenditure can be made based solely on authorized credit; there must be or be expected to be resources available to cover it. This articulation is operationalized by the Source of Funds (FR) code: for revenue, it indicates the destination of the amounts collected; for expenditure, it reveals the origin of the resources used, ensuring correspondence between collection and public spending (Brazil, 2024).

Funding sources allow revenues to be classified according to their link to expenditure. This link can be of two types: (a) earmarked, when there is a legal obligation to apply certain resources for specific purposes, such as Public Health Actions and Services (ASPS) and Education Maintenance and Development (MDE); and (b) free allocation, when resources can be allocated according to the manager's decision, within the legal limits of the agency's activities. This structure seeks to ensure consistency between the origin of the resources and their application (Brazil, 2024). Among the classifications of public expenditure are institutional, functional, programmatic, and by nature. The institutional classification structures appropriations by agency and unit responsible for execution. The functional classification organizes expenditures into functions and sub-functions, as determined by Ordinance SOF/SETO/ME No. 42/1999 (Brazil, 1999) and updated by Ordinance SOF/ME No. 2,520/2022 (Brazil, 2022), which is mandatory for the Union, states, Federal District, and municipalities. This classification contains 28 functions [3] which are subdivided into sub-functions. The programmatic structure details expenditures in programs already listed in the PPA, actions, and subtitles, while the classification by nature separates expenditures into economic categories (current and capital), groups (personnel, interest and debt charges, costs, investments, financial investments, debt amortization), and specific elements. Personnel expenses are generally mandatory, as are part of the operating expenses

3 Legislative, judicial, essential to justice, administration, national defense, public safety, foreign relations, social assistance, social security, health, labor, education, culture, citizenship rights, urban planning, housing, sanitation, environmental management, science and technology, agriculture, agrarian organization, industry, commerce and services, communications, energy, transportation, sports and leisure, special charges (Brazil, 2022).

allocated to the maintenance and operation of public agencies (Brazil, 2024). Discretion tends to be greater in investments.

During execution, the expense follows the stages of commitment, settlement, and payment. Commitment is the act that creates the obligation to pay for the public entity, through the reservation of the corresponding appropriation, as defined in Article 58 of the Budget Law (Brazil, 1964). The settlement of expenditure, governed by Article 63 of the same law, consists of verifying the creditor's acquired right, determining the origin, object, value, and recipient of the expenditure. Payment, regulated by Article 64, is made after settlement and formalized by means of a payment order.

Expenses committed and not paid by December 31 of the same fiscal year are recorded as "Payables." These may be processed when the expense has already been settled, or not processed when it is still in the settlement phase (Brazil, 1964). The Fiscal Responsibility Law imposes restrictions on the recording of outstanding payments in the last year of the term of office, requiring financial coverage to avoid the generation of onerous liabilities (Brazil, 2000).

In Figure B1, we present, at December 2020 prices, the amount of expenditures committed to environmental management by Brazilian municipalities in the period from 2013 to 2020. The graph does not cover the entire time horizon of the dissertation, as data disaggregated by settlement and payment stage are only available from 2013 onwards. However, for the entire period analyzed, we have data referring to the commitment stage.

Two aspects can be drawn from this figure. The first is that the total value of committed expenditures remains between R$5 billion and R$7 billion, with relative stability in the 2013–2016 cycle, followed by a growth trend in the 2017–2020 cycle. The second is that the settled/committed and paid/committed ratios are high (always above 80%), follow a similar trajectory, and do not show significant fluctuations. This allows us to use the committed amount as the main variable, without any substantial loss of information on the actual expenditure.

Figure B1 – Amount of budgetary expenditures on environmental management and proportion of execution stage – Brazilian municipalities between 2013 and 2020

Source: Prepared by the authors based on municipal budget expenditure data obtained from the National Treasury Secretariat (STN). Values in R$ billion.

We emphasize that the content presented is not exhaustive, but is limited to contextualizing what is required to understand the execution of municipal expenditure in Brazil. As a result of this selection, details and concepts have been omitted.