Pontifícia Universidade Católica
do Rio de Janeiro

Wallace de Jesus Inocencio

The Effects of Electing a Miner Mayor: Evidence from Brazil

Dissertação de Mestrado

Thesis presented to the Programa de Pós–graduação em Economia, do Departamento de Economia da PUC-Rio in partial fulfillment of the requirements for the degree of Mestre em Economia.

Advisor: Prof. Ricardo Dahis

Rio de Janeiro
August 2022

Pontifícia Universidade Católica
do Rio de Janeiro

Wallace de Jesus Inocencio

The Effects of Electing a Miner Mayor: Evidence from Brazil

Thesis presented to the Programa de Pós–graduação em Economia da PUC-Rio in partial fulfillment of the requirements for the degree of Mestre em Economia. Approved by the Examination Committee:

Prof. Ricardo Dahis
Advisor
Departamento de Economia – PUC-Rio

Prof. Juliano Junqueira Assunção
Departamento de Economia - PUC-Rio

Prof. Francisco Junqueira Moreira da Costa
Departamento de Economia - FGV/EPGE

Rio de Janeiro, August the 18th, 2022

Wallace de Jesus Inocencio

B.A., Economics, Universidade de São Paulo (USP), 2014

Bibliographic data

de Jesus Inocencio, Wallace

The Effects of Electing a Miner Mayor: Evidence from Brazil / Wallace de Jesus Inocencio; advisor: Ricardo Dahis. – 2022.

48 f: il. color. ; 30 cm

Dissertação (mestrado) - Pontifícia Universidade Católica do Rio de Janeiro, Departamento de Economia, 2022.

Inclui bibliografia

1. Economia – Teses. 2. Economia Política – Teses. 3. Economia Política. 4. Economia Ambiental. 5. Mineração no Brasil. 6. Mineração de Ouro no Brasil. 7. Política Municipal. I. Dahis, Ricardo. II. Pontifícia Universidade Católica do Rio de Janeiro. Departamento de Economia. III. Título.

CDD: 620.11

Acknowledgments

First of all, I am deeply grateful to my parents, Irene and Judivan, for all their support. Although they did not attend high school and had to start working young to help support their households, they were always aware of the value of education and the countless doors it opens up. Thanks to this deep belief, they always encouraged me to study hard and, without their support, I would not be able to be where I am right now.

I am also glad to have met so many amazing people during my journey at PUC-Rio. Pursuing a Master's degree during a pandemic was not easy, but, even in the toughest moments, I always knew that I could count on my dearest friends. I thank them, especially Pedro, for all the moments we have shared together.

Finally, I would like to thank my advisor, Prof. Ricardo Dahis, for his guidance and for being so considerate during the making of this thesis. I also thank Prof. Juliano Assunção and Prof. Francisco Costa for their valuable comments. Any mistakes are my own.

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. The financial support from PUC-Rio is gratefully acknowledged.

Abstract

de Jesus Inocencio, Wallace; Dahis, Ricardo (Advisor). **The Effects of Electing a Miner Mayor: Evidence from Brazil**. Rio de Janeiro, 2022. 48p. Dissertação de Mestrado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

This paper analyses whether electing a miner as mayor in a Brazilian municipality has implications on municipal environmental expenditure and general health. First, by merging different public administrative data, this paper identifies candidates for municipal office in Brazil who hold a mining permit. Then, I use close elections to apply a regression discontinuity design to estimate the impact of electing a miner mayor on public environmental expense. Furthermore, by using a difference-in-differences approach, I focus on the election of mayors who mine gold, a highly contaminating activity, and check whether potential mercury contamination due to gold mining affects health outcomes in neighboring municipalities. In both cases, this paper does not find a statistically significant causal effect, however, the analysis lacks statistical power due to the small sample size.

Keywords

Political Economy; Environmental Economics; Mining in Brazil; Gold Mining in Brazil; Municipal Policy.

Resumo

de Jesus Inocencio, Wallace; Dahis, Ricardo. **Os Efeitos da Eleição de um Prefeito Minerador no Brasil**. Rio de Janeiro, 2022. 48p. Dissertação de Mestrado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

Este trabalho analisa se a eleição de mineradores como prefeitos em municípios brasileiros tem implicações sobre o gasto público ambiental e a saúde pública. Primeiro, ao combinar diferentes bases de dados públicas administrativas, este trabalho identifica candidatos a prefeitos que detém uma licença de mineração. Então, eu seleciono eleições com margem de vitória estreita para aplicar uma regressão com descontinuidade que estima os impactos de eleger um prefeito minerador na despesa pública ambiental. Na sequência, utilizando diferenças-em-diferenças, eu foco na eleição de prefeitos mineradores de ouro, cuja extração artesanal é altamente tóxica, e verifico se a potencial emissão de mercúrio pelos garimpos afeta a saúde pública em municípios vizinhos. Em ambos os casos, este trabalho não encontra um efeito causal estatisticamente significante, porém, a análise carece de poder estatístico por conta do tamanho reduzido da amostra.

Palavras-chave

Economia Política; Economia Ambiental; Mineração no Brasil; Mineração de Ouro no Brasil; Política Municipal.

Table of contents

List of figures

List of tables

List of Abreviations

ANA – *Agência Nacional de Águas e Saneamento Básico* (National Water and Sanitation Agency)
ANM – *Agência Nacional de Mineração* (National Mining Agency)
CPF – *Cadastro de Pessoa Física* (Brazilian Individual Taxpayer Registry Identification)
GDP – Gross Domestic Product
IPCA – *Índice Nacional de Preços ao Consumidor Amplo*(Brazilian Extended National Consumer Price Index)
LATE – Local Average Treatment Effect
RDD – Regression Discontinuity Design
SICONFI – *Brazilian Public Sector Accounting and Tax Information System*
SIM – *Sistema de Informação sobre Mortalidade* (Brazilian Mortality Information System)
SINASC – *Sistema de Informação sobre Nascidos Vivos* (Brazilian Live Birth Information System)
TSE – *Tribunal Superior Eleitoral* (Superior Electoral Court)
WHO – World Health Organization

1
Introduction

The personal characteristics of politicians affect public policy and socio-economic outcomes. Traits, such as gender (Jayasuriya & Burke, 2013; Chattopadhyay & Duflo, 2004; Brollo & Troiano, 2016; Bruce et al., 2022), education (Besley et al., 2011) and occupation (Bragança & Dahis, 2021; Novaes, 2020), can define the policy preferences of elected leaders and determine the allocation of public goods in their constituencies.

This paper focuses on a particular occupation that is steadily gaining relevance in local politics in the last years: miners. Between 2000 and 2020, the number of elected mayors that held a government license to extract minerals from the ground jumped from 49 to 93.

Despite the economic relevance of mining, it is intrinsically linked to environmental degradation. Mineral extraction contaminates water, soil, and air and leads to tropical forests' deforestation (Sonter et al., 2017; Caballero Espejo et al., 2018; Girard et al., 2022; United Nations Environment Programme, 2019).

This activity's characteristics raise questions regarding miners' policy preferences towards environmental protection. As rigid green regulation can negatively affect their business, miners may weaken environmental policies when they take office.

This paper provides empirical evidence of this phenomenon. First, it creates a unique dataset that identifies Brazilian mayors who hold a license for mineral extraction. To build this database, I match mayoral candidates' data provided by the Superior Electoral Court (TSE) with a record of emitted mining licenses from the National Mining Agency (ANM). Then, I estimate the causal effect of electing a miner mayor on green policy, using public environmental expenditure reported by municipalities to the Brazilian National Treasury as a metric. I select close election races between 2008 and 2016 in which miners finished in first or second place and follow Lee (2008) approach to applying a Regression Discontinuity Design (RDD).

I do not find a statistically significant effect on public environmental expenditure due to the election of a miner mayor. The addition of control variables and the use of alternative specifications do not change this result.

However, this does not imply that miners have similar policy preferences on environmental protection to non-miners. The green policy has many dimensions, such as regulation and surveillance, and, in this paper, I just focus on public expenditure and do not evaluate the effectiveness of this spending.

Anecdotally, the city of Itaituba, in the state of Pará, provides an example of how miner mayors can weaken municipal environmental policy. Mayor Valmir Climaco, a gold miner elected to the town hall in 2016 and reelected in 2020, said in an interview with the Brazilian newspaper *"O Globo"* that his administration had emitted more than 500 environmental licenses to gold miners and had never overseen them.[1]

Therefore, I turn my focus to gold miner mayors in the Legal Amazon[2] area and analyze whether their election affects the health outcomes of local communities.

Gold mining is a mercury-intensive activity, so, if gold miner mayors promote it in their municipalities, local communities may suffer from an increase in methylmercury contamination, which is called Minamata disease. This medical condition is associated with high fish intake and increases the risk of neurological disorders among adults, miscarriage and premature birth among pregnant, and infant mortality.

To estimate the causal effect of the election of gold miner mayors on health outcomes, I suppose their election will stimulate gold mining in their cities and, based on Lipscomb & Mobarak (2016), its expansion will occur mainly in the boundaries of the municipality. Thus, I select neighboring cities of municipalities where miners were elected in 2016 and classify them as treatment, if they share a river with a county governed by a gold miner and are downstream of it, and control, if they are upstream of it. That is, I suppose that mercury will follow the river flow and only affect downstream communities, while the upstream ones will remain unaffected.

Then, I run a difference-in-differences on relevant health outcomes, such as premature births, infant mortality, and reproductive-aged women. Again, the estimation of the model does not show a statistically significant effect of the election of gold miner mayors on health outcomes in downstream municipalities. However, the sample is relatively small and comprises only 144 observations, so the analysis lacks statistical power.

[1] "'Demos mais de 500 licenças e nunca fomos fiscalizar', diz prefeito da cidade campeã em autorizações de garimpo de ouro no Brasil", *O Globo*, February 23, 2022

[2] Legal Amazon is a socio-geographic division established by the Law nº 1.806/1953 to promote well-being and economic development in the Brazilian Amazon municipalities. The current area comprises Amapá, Amazonas, Mato Grosso, Pará, Rondônia, Roraima, Tocantins, and part of the state of Maranhão.

This paper is organized into seven sections. After the Introduction, Section 2 offers a literature review on the role of politicians' identity in public policy implementation and the consequences of gold mining in emergent nations. Section 3 explains the background of this paper, pointing out the relevance of mining to the Brazilian economy and the risks of gold mining to public health. Section 4 details the data used in this paper and presents relevant summary statistics of Brazilian mayors' characteristics. Section 5 outlines the empirical strategy adopted in this paper. Section 6 provides the main results and alternative specifications. Section 7 concludes.

2
Literature Review

This paper relates to two different strands of the literature.

First, it relates to the growing literature on the identity of politicians and their public policy choices, which studies how certain politicians' traits can alter the allocation of public goods and affect the design and implementation of public policy.

A theoretical economic explanation for this phenomenon lies behind the concept of "citizen candidates", a term coined by Osborne & Slivinski (1996). The main idea is that citizens have their policy preferences and must decide whether they run or not for an election. There is a trade-off to this decision: although it is costly to be a candidate, if they win the office, they can successfully implement their preferred public policy and directly benefit from being in power.[1] As political preferences may depend on several personal characteristics, such as education, gender, or occupation, a particular trait of an elected officer can indeed affect public policy.

The literature offers vast empirical evidence to support the idea of "citizen candidates". Besley et al. (2011) show that the more educated the leader of a nation is, the more economic growth their country experiences; so does the higher share of women in the parliament (Jayasuriya & Burke, 2013). Gender also affects the allocation of public goods. In India, Chattopadhyay & Duflo (2004) reveal that the election of female leaders in local communities increases the offer of public goods that are more demanded by women.

Brazil is no exception. Brollo & Troiano (2016) finds that cities where women are elected as mayors improve their health outcomes during their term: mothers do more prenatal visits and fewer babies are born prematurely. A similar result is found by Bruce et al. (2022), during the COVID-19 pandemic, cities governed by female leaders imposed more preventative policies against the spread of the disease, such as mask mandates and prohibition on gathering, and suffered less from deaths and hospitalizations compared to counties governed by men.

The occupation of elected representatives matters for public policy

[1] Osborne & Slivinski (1996) refer to these benefits as "office perks" or "ego-rents", that is, the prestige and honor a politician gets when they hold office.

as well. Bragança & Dahis (2021) report that before the implementation of a federal policy to prevent and control deforestation in the Brazilian Amazon cities governed by farmers in the region got more federal resources to promote agriculture, which may explain why they had more deforestation, CO_2 emissions, and land conflicts compared to other municipalities. Meanwhile, the election of law enforcement agents as municipal councilors in Brazil increases public expenditure on security and homicides among non-white men (Novaes, 2020).

Second, this paper also relates to the literature on the socio-economic effects of gold mining in developing countries. The abundance of natural resources[2] is by no means a guarantee of economic development and welfare. The literature calls this phenomenon "resource curse"[3], that is, resource-rich areas tend to perform politically and economically worse than poorer ones.

Besley & Persson (2008) argue that, without adequate institutional constraints, the government can appropriate natural resource rents and redistribute them to groups of interest. So, when the prices of exported commodities surge, the economic gains from holding power also rise, which makes taking power more attractive to the opposition and increases the risk of civil war. In Africa, Berman et al. (2017) find that a one standard deviation hike in mineral prices leads to an increase in 5.6 p.p. in the likelihood of an armed conflict in mining areas.[4] Moreover, bribery increases after opening a new mine (Knutsen et al., 2017).

Gold extraction causes environmental degradation as well. Artisanal gold mining was responsible for more than 30% of the total deforestation in Southern Peruvian Amazon between 2001 and 2017 (Caballero Espejo et al., 2018) and the appreciation of gold accounts for 20% tropical deforestation in African gold-prone regions (Girard et al., 2022) between 2001 and 2018. It also pollutes and affects other economic activities, Aragón & Rud (2016) report a fall of 40% in agricultural productivity in Ghana due to contamination by nearby gold mines.

However, some studies show that there is a silver lining to mining gold, at least in the short term. Despite increasing tropical deforestation, the appreciation of gold increases household wealth in gold-prone regions in Africa (Girard et al., 2022). In Peru, the higher demand for local inputs by the second greatest gold mine in the world rose real income for households living within

[2]As natural resources, I refer to natural resources as non-renewable resources, such as oil, coal, and minerals.

[3]For a detailed and extensive discussion on the topic, refer to Ross (2018).

[4]Although the authors take other minerals into their analysis, gold is the main mineral in their sample, being present in one-third of African mining regions.

100 km from the mine, including those not working in the mining or public sector (Aragón & Rud, 2013).

The effects of gold extraction on health are ambiguous. On one hand, the higher income and new economic opportunities brought by mining are expected to improve health outcomes in local communities. On the other hand, this economic activity uses mercury, a highly toxic heavy metal, which affects the nervous system and poses a significant risk to general health. It is not clear which effect is dominant.

Tolonen (2015) attributes a fall of two-thirds in infant mortality nearby gold mines in Africa to the inclusion of women in the job market, while Von der Goltz & Barnwal (2014) does not find any effect on child mortality, despite the increase in household income due to gold mining.

The medical literature reports that residents who live nearby artisanal gold mines have levels of mercury in their bodies higher than what is considered safe by the World Health Organization (WHO) and even those who are not directly involved with gold mining suffer from it too (Gibb & O'Leary, 2014). Newborns are more likely to have a low Apgar score[5] (Romero & Saavedra, 2016), which signals possible future health concerns, and infants are more susceptible to have anemia (Von der Goltz & Barnwal, 2014) due to possible heavy metal contamination from mining activity.

In this context, this paper aims to make two contributions to the existing knowledge. First, it identifies Brazilian mayors who hold a mineral permit and analyses their role in the execution of public environmental policy. Additionally, it explores whether the election of gold miner mayors affects health outcomes due to mercury contamination by a possible increased gold mining activity. These topics, as far as I am concerned, have not been analyzed by the literature yet.

[5]The Apgar score is a metric ranging from 0 to 10 that allows doctors to assess newborn's health at the first and fifth minute after the birth and is based on five characteristics of the infant: activity, pulse, grimace, appearance, and respiration. A low (0 - 3) and intermediate (4 - 6) score correlates with a higher risk of infant mortality (Iliodromiti et al., 2014).

3
Background

3.1
Mining in Brazil

Since colonial times, mining has played a significant role in the Brazilian economy and it has been intrinsically linked to the expansion and occupation of the country. The first major mineral discovery in Brazil occurred at the end of the 17^{th} century, when Portuguese and local explorers found alluvial gold in an interior region that now constitutes the state of Minas Gerais, leading to the settlement of Portuguese colonizers in the area.

Since then, Brazil has revealed immense natural resource potential. Nowadays, the country is among the top 5 producers of iron, bauxite, and manganese ores in the world, and, in 2020, mining accounted for approximately 1.3% of the Brazilian GDP (Santos, 2021) and 9.7% of the exports. The main extracted mineral is iron ore, which made up 66.4% of the total sector revenue in 2020, followed by gold (11.12%) and copper (6.6%) (IBRAM, 2021).

To extract minerals from the ground in Brazil, miners must comply with the Mining Code[1] and have authorization from the National Mining Agency (ANM), a federal authority.

In case of a large metal mining activity, miners need first to request the ANM to emit a research permit that will allow them to investigate the mining site, identify its mineral potential, and estimate the economic viability of a mine in the area. This permit lasts up to three years and can be indefinitely renewed, but it does not allow mineral extraction. Mining can only legally start after they submit a final research report to the ANM. Once it is approved by the agency, they have a one-year priority to request a mining concession to start their mining activities in the area. To grant this concession, which lasts indefinitely, the federal authority requires an environmental license emitted by the state or municipality of the mining area.

The Brazilian mining regulation offers a different license for small and artisanal miners (*"garimpeiros"*). In this case, the ANM emits an artisanal

[1]Decree Law No. 227/1967. Available at `http://www.planalto.gov.br/ccivil_03/decreto-lei/del0227.htm`

mining permit, which requires an environmental license, but not a research report of the area.[2] This permit lasts five years and can be renewed indefinitely.

However, illegal artisanal mining still occurs in Brazil. Manzolli et al. estimate that 28% of the gold extraction in the country between 2019 and 2020 is irregular and most of it comes from *"garimpeiros"* in the Legal Amazon, where 43.9% of the territory consists of conservation units and indigenous lands (Veríssimo et al., 2011). The Brazilian legislation establishes that mining activities are forbidden in these areas, but MapBiomas (2021) points out that half of the small and artisanal mining in Brazil happens there.

3.2 The Use of Mercury in Gold Mining and its Health Risks

Gold is usually found in nature in the form of small particles mixed with soil and sediments. To extract gold from ore, miners resort to mercury because this substance holds a special chemical property called amalgamation. When in contact with gold, mercury combines with it and forms an amalgam, effectively separating gold from ore. To get pure gold, miners heat the amalgam to evaporate mercury.

However, mercury is considered by the WHO as one of the top ten most dangerous chemicals to general health. In this context, the process of amalgamation poses several risks to miners and communities living nearby gold mines. First, vaporizing mercury is a direct form of poisoning by this substance. Second, the improper use of mercury can contaminate the soil and rivers surrounding the mine. In the water, microbes convert mercury into methylmercury, which has the property to accumulate in aquatic animals.

The consequences of methylmercury exposure to human health are well-documented in the literature. In the early 1950s, Japanese doctors were puzzled by the increased number of neurological disorders among the population of fishing communities in the Minamata Bay area. After conducting face-to-face interviews among residents of these villages, Kitamura et al. (2020)[3] were the first to document that the most likely reason of this unknown disease was poisoning due to fish consumption. However, it was only in 1967 that the medical literature successfully found the source of this contamination: methylmercury, which was the byproduct of a local chemical factory and was released in the sea Ekino et al. (2007). This finding led to the closure of the factory, after almost 20 years of continuous pollution.

[2] A mineral research would be economically unfeasible due to the scale of the activity.

[3] This paper is a reprint of the first epidemiological study on the Minamata disease, published in January of 1957.

Nowadays, the medical literature refers to this medical condition as the Minamata disease. By 2000, roughly 17,000 patients, about 10% of the population of Minamata Bay in 1960, had requested the Japanese government to certify their condition, but only 2,264 cases were officially recognized. Cases are difficult to be recognized because, although the victims were exposed to the substance in the 1950s and 1960s, methylmercury is unlikely to be found in their blood, as the half-life of methylmercury in the human body is no more than 90 days. Besides that, there is some degree of subjectiveness in the symptoms of this disease. Among adults, acute exposition to methylmercury can cause blurred vision, and neurological disorders, such as dysarthria[4] and ataxia[5], paralysis, and death. Methylmercury poses a threat to developing brains, fetal exposition to the substance can cause birth defects and mental and motor difficulties. In pregnant women, methylmercury is reported to increase the likelihood of miscarriage, stillbirth, premature birth, low birth weight, and congenital conditions (Bjørklund et al., 2019).

Signals of the Minamata disease due to gold mining activity have already been pointed out in the Brazilian Amazon. In the Tapajós River basin, high levels of methylmercury were found in the hair of residents who live downstream of gold mining sites (Lebel et al., 1996) and adults with higher levels of methylmercury contamination performed worse in neurological clinical tests(Lebel et al., 1998). In a survey with 132 volunteers, Harada et al. (2001) confirmed three cases of mild Minamata disease and suspected three other cases.

Despite all these risks, artisanal gold mining is still the largest user of mercury in the world and is the largest source of mercury contamination, accounting for 38% of all emissions (United Nations Environment Programme, 2019).

[4]Difficulty in speaking due to brain damage.
[5]Lack of muscle coordination due to brain damage.

4
Data

4.1
Data Sources

To answer whether the election of a miner mayor impacts local environmental policy and affects general health in a municipality and its surroundings, this paper uses and combines several public administrative databases on elections, mining, municipal finance, and public health, among others. The sources of these datasets are further detailed below.

Elections. I use the Brazilian municipal electoral data provided by the Superior Electoral Court (TSE) and processed by *Base dos Dados* (Dahis et al., 2022). This dataset contains the full results of all municipal elections since 1996 and, for elections after 1998, it also provides individual candidates' characteristics, such as full name, age, gender, occupation, education, party affiliation, and the complete national ID number (CPF).

Mining Licenses. To conduct a legal mining activity in Brazil, miners are required to fill out a form, called *Cadastro Mineiro*, to inform the ANM, the federal authority responsible for mining regulation, of their intention to conduct mineral research or extraction in a specific area.

I use microdata from *Cadastro Mineiro*, which is publicly available on the ANM website, to identify mayors who hold a mineral permit.[1]. It is a very detailed dataset that contains approved requests since 1934 and provides information on the current status of the license, latitude, and longitude of the explored area, which mineral is extracted, and personal data of the license holder, such as full name and a partially censored national ID number.

As the ANM only reveals 6 digits out of 10 of the national ID number of the mining license holder and the name registered on *Cadastro Mineiro* may not exactly match with the one provided to the TSE[2], combining these databases is

[1]In this paper, I select mayors who hold at least one of the following mining licenses: "Alvará de Pesquisa", "Permissão de Lavra Garimpeira", "Registro de Licença", "Portaria de Lavra", "Manifesto de Mina", "Manifesto de Jazida" and "Registro de Extração"

[2]Typos are common on the ANM database, for instance, the former mayor of Goiás Velho (GO), Boadyr Veloso, has a gold mining license registered under the name of Boadyr Velos0, that is, written with the number "0" instead of the letter "o". Also, some names appear abbreviated in one database, such as the gold mining license holder and former

not a trivial task. I first filter the candidates for mayor whose CPF number on the TSE database can match with the partially censored ID number available on *Cadastro Mineiro*, then, I run a Jaro-Winkler string distance algorithm[3] on the name of the license holder and the name registered on TSE to identify how similar they are and to match the databases.[4]

Public Finance. I use data from the *Sistema de Informações Contábeis e Fiscais do Setor Público Brasileiro* (SICONFI) provided by the Brazilian National Treasury and processed by *Base dos Dados* (Dahis et al., 2022). Because this dataset reports municipal fiscal expenditure by area from 2004 to 2021, including expenses on environmental management, I focus the analysis on mayors elected between 2008 and 2016.

Public Health. I use yearly birth and mortality statistics at the municipality level that are provided by the Brazilian Ministry of Health through the *Sistema de Informação sobre Nascidos Vivos* (SINASC) and *Sistema de Informação sobre Mortalidade* (SIM). The SINASC database reports the absolute number of births by the municipality where the mother resides, how many infants were born premature or with some congenital anomaly, and birth weight in 7 different intervals. Furthermore, the SIM dataset discloses death by age and gender, which allows an analysis of mortality among infants and women of reproductive age.

Hydrography. The *Base Hidrográfica Ottocodificada* from the National Water and Sanitation Agency (ANA) is a cartographic base that maps 89.803 watercourses and 114.708 rivers in Brazil (de Amorim Teixeira et al., 2007). In this paper, I use it to identify the flow direction of a river and classify municipalities of interest as downstream or upstream relative to the one where a gold miner mayor was elected.

Other Sources. Finally, yearly socioeconomic variables at the municipality level, such as population and municipal GDP estimated by the Brazilian Institute of Geography and Statistics (IBGE), are used in this paper as additional controls.

4.2 Summary Statistics

The participation of miners in local politics has been steadily increasing since 2000. During this period, 319 miners were elected as mayors 448 times

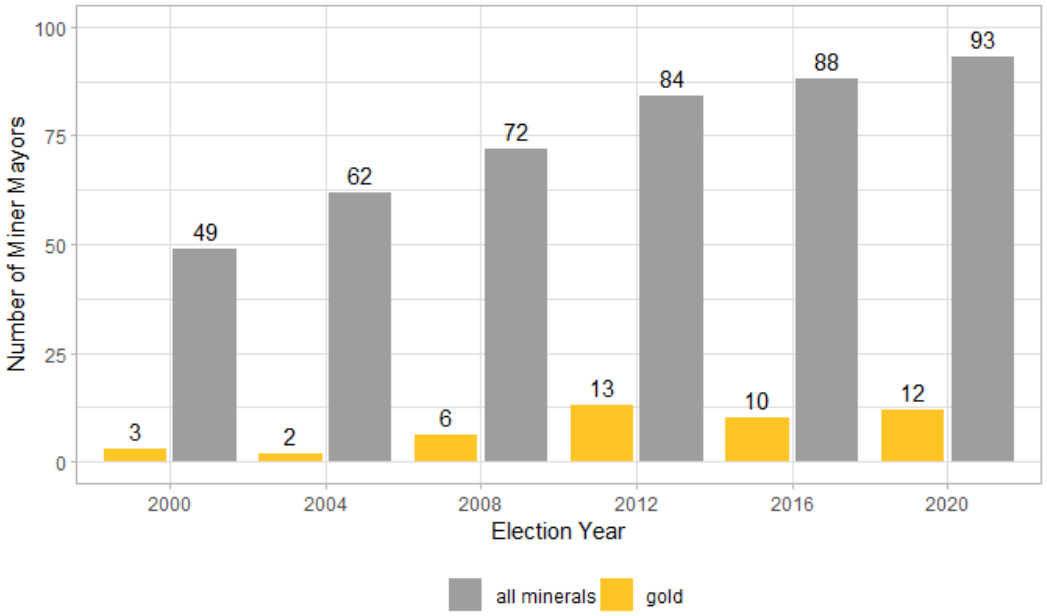
mayor of Porto Belo (SC), Sergio Luiz Biehler, registered on TSE as Sergio Biehler.

[3]Refer to the Appendix A for more details.

[4]If the distance is lower than 0.15, I assume a perfect match; if the distance is between 0.15 and 0.25, I manually check for the possibility of a match; above 0.25, the match is discarded.

in the Brazilian municipal elections and, as Figure 4.1 shows, 93 of them took office in 2020, practically doubling the number of miner mayors in 2000. Of these 93 mayors, 12 held a permit to extract gold, a figure that has been relatively stable since 2012.

Figure 4.1: Number of Miners Elected as Mayors in Brazil from 2000 to 2020



Despite gold being the most common metallic mineral extracted by mayors, it is not the most explored mineral by them. Table 4.1 reveals that the most common mineral is clay and sand, which are mainly used by the construction sector, followed by granite.

Table 4.1: Most Common Minerals Extracted by Mayors (2008-2016)

Mineral	Number of Mayors
Clay/Sand	83
Granite	40
Gold	28
Mineral Water	23
Gravel	22
Quartz	22
Limestone	21
Kaolinite	14
Beryl	10
Feldspar	10
Iron	10

Source: Author's own elaboration

Table 4.2 explores the similarities and differences among miner, gold miner and non-miner mayors elected between 2008 and 2016. It is worth noticing that, despite men being the absolute majority among mayors, the male proportion among miner and gold miner mayors is larger than among non-miner mayors and there is no woman in the group of gold miner mayors. Miners and non-miners share a similar level of schooling, while gold miners are less likely to hold a degree. Moreover, gold miner mayors are more likely to govern a municipality in Legal Amazon (28%) compared to non-miners (14%) and gold miners (9%).

Table 4.2: Characteristics of Mayors Elected between 2008-2016

	Miner	Gold Miner	Non-Miner
Male	0.97	1.00	0.89
	(0.17)	(0.00)	(0.31)
Age	54.36	51.83	48.64
	(11.52)	(8.13)	(10.08)
Primary School Completed	0.88	0.90	0.92
	(0.33)	(0.31)	(0.28)
Secondary School Completed	0.75	0.79	0.82
	(0.44)	(0.41)	(0.39)
Higher School Completed	0.46	0.28	0.49
	(0.50)	(0.45)	(0.50)
Elected in the Legal Amazon	0.09	0.28	0.14
	(0.28)	(0.45)	(0.35)
Observations	244	29	15,463

Tables 4.3 and 4.4 summarize Brazilian municipalities' characteristics and health outcomes. It is worth noting that municipalities spend, on average, only 5.5% of their budgets on enviromental management.

Table 4.3: Summary Statistics of Brazilian Municipalities' Characteristics

	Mean	St. Dev.	Min	Max
Population (in ,000)	27.84	96.47	0.83	6,429.92
Area (in km²)	1,552.64	5,755.09	3.56	159,533.30
Human Development Index	0.66	0.07	0.42	0.86
Gini Index	0.49	0.07	0.28	0.80
% of Urban Population	0.64	0.22	0.04	1.00
Per Capita Environmental Spending	21.84	53.32	0.00	1,777.00
Total Per Capita Public Spending	3,941.42	2,174.62	68.11	88,247.09
Located in the Legal Amazon	0.14	0.35	0	1

Notes: Unit of observation is the municipality. Per capita enviromental spending and public spending are in 2022 Brazilian *Real*

Table 4.4: Summary Statistics of Health Outcomes in Brazilian Municipalities (2017-2020)

	Mean	St. Dev.	Min	Max
Births (per year)	513.8	2,876.4	4.8	160,093.5
Premature Births (per ,000 births)	436.4	110.7	29.2	2,395.9
Extremely Premature Births (per ,000 births)	20.2	17.2	0.0	183.9
Low Birthweight Births (per ,000 births)	324.2	81.0	41.2	765.2
Anomaly at Birth (per ,000 births)	30.4	23.2	0.0	263.2
Infant Mortality (per ,000 births)	49.7	26.7	0.0	243.5
Men (15-49) Deaths (per year)	116.3	607.4	0	28,777
Women (15-49) Deaths (per year)	46.5	272.1	0	13,686

Notes: Unit of observation is the municipality.

5
Identification Strategy

5.1
Causal Effect of Miner Mayors' Election on Public Environmental Expenditure

To identify the causal effect of electing a miner mayor on public green policy, I focus on public environmental spending, which municipalities report yearly to the National Treasury of Brazil through SICONFI.

To estimate this impact, it is not possible to just compute the difference in expenses between municipalities where a miner was elected and where it was not. This approach will potentially result in a biased estimate, as it ignores possible selection bias in the election of these mayors, and omitted variables that could be driving the outcomes or confounders.

I will follow the approach of Lee (2008) to overcome this issue. It suggests that elections decided by a narrow margin of victory are "quasi-experiments" in which a regression discontinuity design (RDD) can be applied for causal inference. In a typical setup of RDD, the treatment is determined by a covariate and an arbitrary cut-off. An election works similarly: a candidate is elected as mayor in a municipality (treatment), whether his vote margin to the other most-voted candidate (covariate) is strictly positive (cut-off). If the final vote share depends on random chance components, such as the weather, that can affect voter turnout on election day, the winning candidate in a close election can be seen as randomly determined as if it was chosen by the toss of a coin.

The sample I select to run the regression consists of all Brazilian mayoral races between 2008 and 2016 in which a holder of a mining license finished in first or second place. Electoral races in which both first and second place are miners are excluded. In the end, the sample comprises 487 municipal elections in 351 different municipalities in which miners were elected mayors 229 times.

Then, I estimate the following equation of interest,

$$\begin{aligned} Y_{mt} = \alpha + \beta 1\{VoteMargin_{mt} \geq 0\} + \gamma VoteMargin_{mt} \\ +\delta VoteMargin_{mt} 1\{VoteMargin_{mt} \geq 0\} + \eta X_{mt} + \gamma_t + \epsilon_{mt} \end{aligned} \tag{5-1}$$

where Y_{mt} is the average real public environmental expenditure of the municipality m per year during mayor's term t; $VoteMargin_{mt}$ measures the difference in percentage points of valid votes between a miner candidate and the other most voted candidate in municipality m for term t; X_{mt} consists of covariates of municipality m during term t; γ_t is a year fixed effect; and β is the parameter of interest, the local average treatment effect (LATE) at the threshold.

It is assumed that the functional form of $VoteMargin_{mt}$ in the aforementioned equation is non-parametric, as the slope of $VoteMargin_{mt}$ is different at the left and the right of the cut-off. To estimate the regression, it is required to choose a proper bandwidth around the cut-off. There is a trade-off behind this choice: the shorter the bandwidth, the less biased will be the LATE, but the larger will be the variance. In this paper, I use Imbens & Kalyanaraman (2012) optimal bandwidth and estimate the regression using a triangular kernel, which gives more weight to observations near the cut-off. Furthermore, I test some alternative specifications with different bandwidths and kernels, whose results are shown in Appendix C.

To check whether RDD is an appropriate identification strategy, I run a Cattaneo et al. (2020) manipulation test in Appendix D to show that political agents cannot manipulate their margin of victory. The main idea behind this test is that, if elections are somehow rigged, the winning candidate of a close election is not randomly determined, so a discontinuity on the density function of the margin of victory would be expected around the cut-off. The result of the test shows that this discontinuity does not occur in my data (p-value: 0.199), so it is unlikely that Brazilian municipal elections are rigged to benefit or harm miner candidates.

As close elections are quasi-experiments, one should expect that counties where miner candidates have narrowly won are similar to the ones where they have barely lost. To check it, I run a RDD using three different bandwidths for the margin of victory on a list of covariates at the municipality level. The results are shown in Table 5.1. In general, municipalities are quite similar in terms of population and area sizes, Gini and Human Development Indices and per capita income. The most notable expection is the share of urban population. In all specifications, counties where miner mayor have won are less urbanized than the ones where they have lost and this estimate is statistically significant at the 10% level when the selected bandwidth is 15% and 5%, but not when it is 10%.

Table 5.1: Covariate Smoothness

	Sample Mean [Std. Dev.]	(1)	(2)	(3)
Population (in ,000)	31.13 [45.86]	5.37 (7.36)	10.04 (8.23)	2.46 (10.82)
Area (in km²)	1616.6 [5291.2]	−2632 (1618.7)	−2141.4 (1583.5)	1162.1 (1993.8)
Latitude (in degrees)	−16.81 [7.62]	1.55 (2.03)	3.66 (2.49)	6.7* (3.46)
Longitude (in degrees)	−45.17 [5.99]	1.44 (1.52)	2.12 (1.86)	0.12 (2.56)
HDI-M	0.67 [0.06]	−0.02 (0.02)	−0.03 (0.02)	−0.04 (0.03)
Per Capita Income (in 2010 Brazilian Real)	509.13 [221.15]	−56.68 (53.94)	−102.21 (66.91)	−160.38 (98.53)
Gini Index	0.49 [0.06]	0.01 (0.02)	0.01 (0.02)	0.02 (0.03)
Urban Population (%)	0.68 [0.21]	−0.08* (0.04)	−0.08 (0.05)	−0.13* (0.07)
Bandwidth	–	0.15	0.1	0.05
Observations	487	305	213	112

Notes: Robust standard errors are in parenthesis. The source of HDI-M, per capita income, Gini index and urban is the 2010 Atlas of Human Development from United Nations.
*p<0.1;**p<0.05; ***p<0.01

5.2 Causal Effects of Gold Miner Mayors' Election on Public Health

To identify the effect of miner mayors on health outcomes, I examine the election of gold miner mayors in the Legal Amazon region in 2016 and the health outcomes of neighboring municipalities. The idea is that, if their election promotes the expansion of gold mining in their cities, neighboring downstream counties will suffer from mercury contamination caused by this activity.

So, I apply a difference-in-differences that analyses the health outcomes of municipalities that surround their constituency and share the same river.

Municipalities that are 20km from the border of a county governed by a gold miner and are downstream of it will compose the treatment group, while the upstream ones, the control group. Figure 5.1 exemplifies it.[1]

In 2016, voters of the city of Nhamundá (red), in the state of Amazonas, elected the gold miner Gledson Hadson Paulain Machado[2], also known as Nenê Machado, as mayor. In my empirical strategy, I consider the municipality of Terra Santa (green) as a control municipality, as Urupuanã River, which flows to south, crosses both cities and Nhamundá is downstream of Terra Santa. Meanwhile, Juruti (gray) is a treated municipality, because Amazonas river crosses the city after serving as a border between Juriti and Nhamundá.

Figure 5.1: Example of Treated and Control Municipality

Note: Nhamundá is in red, Juriti (treated) is in gray and Terra Santa (control) is in green.

I assume that, if the election of a gold miner mayor promotes mining in their own county, the pollution of this activity is expected to affect those that live downstream of the municipality, while residents of upstream counties will not be impacted by this contamination. As fish consumption is the main source of mercury contamination, this assumption will not hold if fishes go upstream or are not caught locally.

[1]This strategy is based on the findings of Lipscomb & Mobarak (2016). Water pollution in Brazilian rivers increases as the watercourse approaches a city limit. Because increased economic activity is associated with contamination, local authorities are more permissive to the establishment of settlements in the downstream areas of the municipality and let neighboring cities carry the burden of pollution.

[2]In 2017, Gledson Machado was temporarially arrested by the Federal Police of Brazil for illegal pebble mining in the neighbouring municipality of Faro, in the state of Pará. The local newspaper *Brasil Norte Notícias* reports that he was also being investigated for illegal gold mining in indigenous lands ("Prefeito de Nhamundá também retira ouro de terras indígenas", *Brasil Norte Notícias*, March 16, 2017).

In this context, I build the sample based on the results of the 2016 municipal elections, when gold miners were elected as mayors in 3 municipalities in the Legal Amazon: Nhamundá (AM) and Itaituba and Aveiro, both in the state of Pará. The final sample is composed of 9 downstream (treatment) and 9 upstream (control) municipalities[3].

Then, I estimate the following difference-in-differences regression:

$$Y_{mt} = \beta_1 Post_t \times Downstream_m + \beta_2 Post_t + \beta_3 Downstream_m + \epsilon_{mt} \quad (5\text{-}2)$$

where Y_{mt} is the health outcome of interest of municipality m in year t; $Downstream_m$ is a dummy variable which takes the value of 1 if m is located downstream of a county which elected a gold miner as mayor in 2016; $Post_t$ indicates whether year t is after 2016 election; and ϵ_{mt} is the residual term of the regression. The parameter of interest is β_1, which will measure the average treatment effect of electing a gold mining mayor on the dependent variable.

Then, I add some fixed effects, a time trend and control variables and estimate the following regression:

$$Y_{mt} = \beta_1 Post_t \times Downstream_m + \gamma_m + \gamma_t + \gamma_s \times t + \epsilon_{mt}, \quad (5\text{-}3)$$

where γ_m are municipality fixed effects; γ_t, year fixed effects; and $\gamma_s \times t$ is a interaction of a state dummy with a time trend to capture different trends among states, as done by Romero & Saavedra (2016). The parameter of interest in this regression is β_1.

[3]Nhamundá does not belong to the sample; however, Itaituba and Aveiro do, as Aveiro is located downstream of Itaituba in Tapajós River.

6
Results

6.1
On Public Environmental Expenditure

To identify the environmental policy preferences of miner mayors, I estimate Equation 5-1 using average real public environmental expenditure per year during their term and during the previous one, as well their difference, as dependent variables. The graphical evidence suggests that there is no clear discontinuity in these dependent variables due to the election of a miner mayor.

Figure 6.1: Graphical Representation of Discontinuity on Current Public Environmental Expenditure

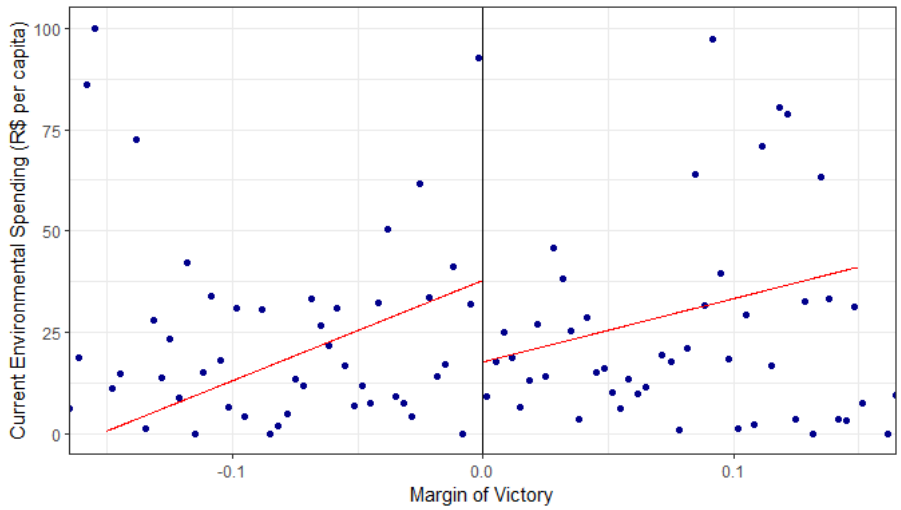


Figure 6.2: Graphical Representation of Discontinuity on Previous Public Environmental Expenditure

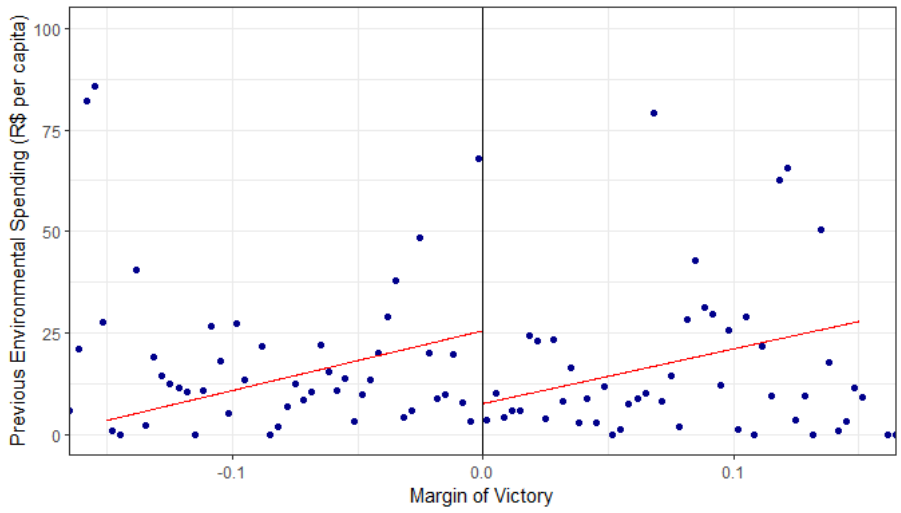


Figure 6.3: Graphical Representation of Discontinuity on the Difference of Public Environmental Expenditure between Terms

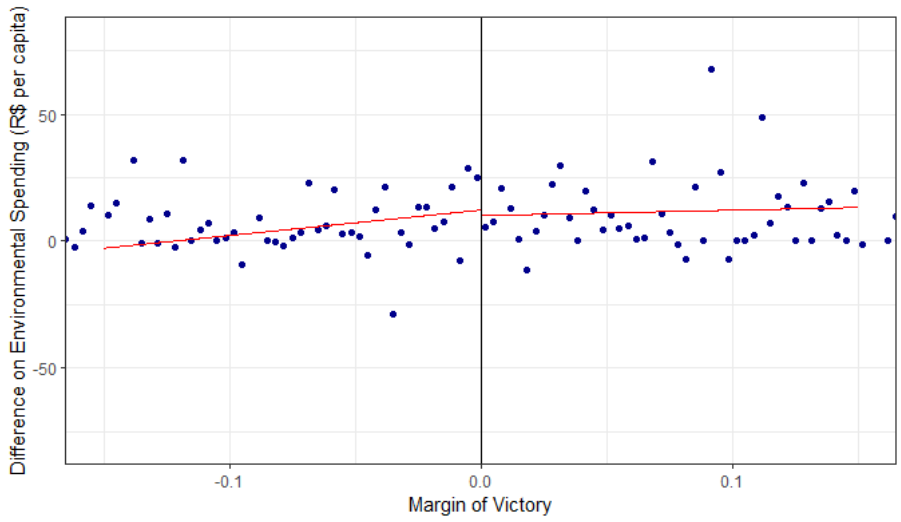


Table 6.1 shows the estimates of the regression. In the first three columns, the LATE is estimated without controls or fixed effects. In this specification, I find a negative, although statistically insignificant, effect of electing a miner mayor on public environmental expenditure: during their 4-year term, yearly per capita spending in this area decreases R$ 20.75 [1] (p-value: 0.144).

[1]This estimate implies a average total decline of R$645,953 in public spending on environment per year in municipalities governed by miner mayors during the whole term.

Table 6.1: Effect of Election of a Miner Mayor on Public Environmental Expenditure

	Dependent variable:					
	Pre-Election	Post-Election	Difference	Pre-Election	Post-Election	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
D_i	-18.07	-20.75	0.23	-12.77	-7.76	0.83
	(11.12)	(14.21)	(7.7)	(8.49)	(10.19)	(6.81)
Bandwidth	IKBW	IKBW	IKBW	IKBW	IKBW	IKBW
	[0.148]	[0.146]	[0.159]	[0.151]	[0.164]	[0.14]
Observations	487	487	487	487	487	487
Effective Observations	329	329	329	305	305	305
Specification	Linear	Linear	Linear	Linear	Linear	Linear
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Term Fixed Effects	No	No	No	Yes	Yes	Yes
State Fixed Effects	No	No	No	Yes	Yes	Yes
Controls	No	No	No	Yes	Yes	Yes

Notes: Robust standard errors are in parenthesis. RDD bandwidths are in brackets. Dependent variable is in real per capita terms. Control variables include per capita income, Human Development Index, Gini index and % of urban population in 2010, and area and population.
*p<0.1;**p<0.05; ***p<0.01

However, repeating the same specification on average yearly public environmental expenditure of the previous term, a similar association is found: counties governed by miner mayors already spent R$18.07[2] (p-value: 0.104) less in this area before their election. Since the close election of a miner mayor is not supposed to affect public policy of preceding terms, this finding suggests that the negative effect found in the first column is due to a sampling bias, that is, miners spend less on environment because they are elected in municipalities that already spend less on it.

Thus, to properly identify the effect of electing a miner mayor on environmental policy, I take the difference of local government environmental spending between the miner term and the preceding one and run it using the same specification. The result is presented in Column 3 of 6.1. The estimate shows that there is not a statistically significant variation in public spending after a miner is elected (p-value: 0.976).

The addition of term and state fixed effects and control variables in the regression does not significantly change the estimates as shown in Columns 4-6. In Appendix C, I estimate the same regression with a uniform kernel, quadratic form and different bandwidth sizes to show the results are robust to different specifications.

These findings point out that the election of miner mayors does not affect the allocation of public resources towards enviromental protection and management.

It is important to notice that this does not imply that miners have similar environmental preferences as other mayors. First, environmental policies can also be implemented through legislation changes, which are not analysed in this paper. Moreover, politicians may avoid cutting public expenditure if there are political costs involved.

For instance, public environmental expenditure is relatively low in Brazil. Between 2017 and 2020, only 0.6% of the Brazilian municipal budget was spent on environmental management and, in 43.3% of Brazilian municipalities, no expense was made in this area[3]. Given these figures, as there is little room to cut this type of expense, the benefits of doing so may not compensate the political costs associated with it.

6.2 On Public Health

[2]Average decline of R$562,606 per year
[3]Calculated by the author using SICONFI data

6.2.1 Newborn Health

Table 6.2: Effect of Election of a Gold Miner Mayor on Premature Births in Downstream Municipalities

	Dependent variable:		
	Premature Births		
	(1)	(2)	(3)
Post x Downstream$_i$	5.296	8.834	11.617
	(13.311)	(8.738)	(8.449)
Municipality Fixed Effect	No	Yes	Yes
Year Fixed Effects	No	Yes	Yes
State Time Trend	No	Yes	Yes
Controls	No	No	Yes
Observations	144	144	144

Notes: Robust standard errors are in parenthesis. Dependent variable is in per 1,000 births terms. Estimate of resident municipal population was used as control variable.
*p<0.1;**p<0.05; ***p<0.01

Table 6.3: Effect of Election of a Gold Miner Mayor on Birth Outcomes in Downstream Municipalities

	Dependent variable:			
	Extreme Premature Birth	Low Weight Birth	Birth Defects	Infant Death
	(1)	(2)	(3)	(4)
Post x Downstream$_i$	−0.13	1.395	−0.742	−0.697
	(1.388)	(5.068)	(1.273)	(2.371)
Municipality Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
State Time Trend	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	144	144	144	144

Notes: Robust standard errors are in parenthesis. Dependent variable is in per 1,000 births terms. Estimate of resident municipal population was used as control variable.
*p<0.1; **p<0.05; ***p<0.01

Although no effect was found on the public enviromental expenditure, the election of miner mayors could still incentivise illegal mining activity. So, I focus on gold miners and check whether health outcomes signals increased gold extraction activity in the region. The results from estimating Equations 5-2 and 5-3 are presented in Table 6.2.

First, I regress the number of premature births per 1,000 births on the explanatory variables using three different specifications. In Column 1, I find that the election of a gold miner mayor does not affect premature births in downstream municipalities. The inclusion of fixed effects and state-time trends increases the average treatment effect on the outcome of interest, but the estimate still remains statistically insignificant. Finally, after adding control variables, the average treatment effect reaches 11.62 prematures births per 1,000 births (p-value: 0.171).

In Table 6.3, I repeat the specification that includes fixed effects, time trends and controls using other birth health outcomes as dependent variables: extreme premature births, anomalies, low birth weight children and infant deaths per 1,000 births. For all outcomes, the average treatment effect of electing a gold mining mayor is statistically and economically insignificant.

It should be pointed out that the sample I am working with is very small, consisting of 8 years of data across 18 municipalities, that is, only 144 observations.

Table 6.4: Effect of Election of a Gold Miner Mayor on Population Aged 15-49 in Downstream Municipalities

	Dependent variable:	
	Women (15-49) Deaths	Men (15-49) Deaths
	(1)	(2)
Post x Downstream$_i$	1.262	1.86
	(1.339)	(3.258)
Municipality Fixed Effect	Yes	Yes
State-Year Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Controls	Yes	Yes
Observations	144	144

Notes: Robust standard errors are in parenthesis. Dependent variable is in per 1,000 births terms. Estimate of resident municipal population was used as control variable.
*p<0.1; **p<0.05; ***p<0.01

6.2.2
Mortality among Reproductive-Aged Women

Since exposition to mercury is associated with pregnancy complications (Solan & Lindow, 2014), I run a regression using the number of deaths of women in reproductive age (15-49)[4] as dependent variable. In addition, I do the same exercice using deaths of men of the same age group as a robustness check.

The results from estimating the effect of electing a gold miner mayor on these groups in downstream municipalities are presented in Table 6.4. Column 1 shows that the absolute number of deaths of reproductive-aged women per year increases by 1.262 (p-value: 0.348), while for men the increase is of 1.86 (p-value: 0.569)

6.2.3
2012 Election

Instead of looking at the downstream and upstream municipalities of a constituency which elected a gold mining mayor in 2016, I analyse the results of 2012 elections and their impact on birth outcomes in neighboring counties in the following four years.

Table 6.5 shows that all average treatment effects on birth outcomes are economically and statistically insignificant. However, it should be noted that the Brazilian medical literature points out that premature births were underestimated in the country before 2012 (Matijasevich et al., 2013) and the adoption of a new data collection methodology by the Brazilian Ministry of Health in 2011 could be potentially driving my estimates.[5]

[4]This is definition used by the Brazilian Ministry of Health. See *Portaria nº 1.119, of June, 5th, 2008*

[5]The Brazilian Ministry of Health started to calculate the gestational age based on the last day of menstruation, this change explains why the percentage of premature birth jumped from 5.5% to 9.9% in Northern states between 2010 and 2011.

Table 6.5: Effect of Election of a Gold Miner Mayor in 2012 in Downstream Municipalities

	Dependent variable:				
	Premature Births	Extreme Premature Births	Low Weight Births	Birth Defects	Infant Deaths
	(1)	(2)	(3)	(4)	(5)
Post x Downstream$_i$	−0.13	−1.395	0.449	−0.055	0.002
	(1.387)	(5.068)	(5.550)	(1.317)	(2.406)
Municipality Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
State Time Trend	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observations	416	416	416	416	416

Notes: Robust standard errors are in parenthesis. Dependent variable is in per 1,000 births terms. Estimate of resident municipal population was used as control variable. *p<0.1; **p<0.05; ***p<0.01

7
Conclusion

This paper identifies the role of miner mayors in the implementation of environmental policy in Brazil and their possible impact on general health.

First, I identify mayors that hold a mining license, then, I use close elections with miners in Brazilian municipalities between 2004 and 2016 to run a regression discontinuity design to identify whether the election of miners affects public expenditure on environmental management. This paper hypothesizes that, if miners prefer loose green policies, when they take office, they cut this type of public spending. My estimates show that there is no statistically significant effect of their election on public environmental spending. Nevertheless, this does not imply that miners have green policy preferences similar to non-miners, as there are other dimensions of environmental policy, which are not analysed by this paper, such as fiscalization, legislation, and regulation.

Then, I focus on the election of gold miner mayors in the Brazilian Legal Amazon region to check whether there is an impact on public health in neighboring cities. If illegal gold extraction expands under their administration, downstream counties should suffer more from methylmercury contamination. Using a difference-in-differences approach, I find no statistically significant effect of their election on birth outcomes, such as premature birth, low birthweight, and infant mortality, and reproductive-age women deaths in these cities. However, this analysis has little statistical power, as the sample consists of only 144 data points.

This topic is not exhausted in the literature yet. Despite not finding a significant effect of the election of gold miners on health outcomes in the short term, it remains unclear the long-term impact of it. Future research could explore whether their election affects children's development, as methylmercury poses a threat to their brain.

Bibliography

ARAGÓN, F. M.; RUD, J. P.. **Natural resources and local communities: evidence from a peruvian gold mine**. American Economic Journal: Economic Policy, 5(2):1–25, 2013.

ARAGÓN, F. M.; RUD, J. P.. **Polluting industries and agricultural productivity: Evidence from mining in ghana**. The Economic Journal, 126(597):1980–2011, 2016.

BERMAN, N.; COUTTENIER, M.; ROHNER, D. ; THOENIG, M.. **This mine is mine! how minerals fuel conflicts in africa**. American Economic Review, 107(6):1564–1610, 2017.

BESLEY, T. J.; PERSSON, T.. **The incidence of civil war: Theory and evidence**. Technical report, National Bureau of Economic Research, 2008.

BESLEY, T.; MONTALVO, J. G. ; REYNAL-QUEROL, M.. **Do educated leaders matter?** The Economic Journal, 121(554):F205–227, 2011.

BJØRKLUND, G.; CHIRUMBOLO, S.; DADAR, M.; PIVINA, L.; LINDH, U.; BUTNARIU, M. ; AASETH, J.. **Mercury exposure and its effects on fertility and pregnancy outcome**. Basic & Clinical Pharmacology & Toxicology, 125(4):317–327, 2019.

BRAGANÇA, A.; DAHIS, R.. **Cutting special interests by the roots: Evidence from the brazilian amazon**. Technical report, Working Paper 004. Rio de Janeiro: Climate Policy Initiative, 2021.

BROLLO, F.; TROIANO, U.. **What happens when a woman wins an election? evidence from close races in brazil**. Journal of Development Economics, 122:28–45, 2016.

BRUCE, R.; CAVGIAS, A.; MELONI, L. ; REMÍGIO, M.. **Under pressure: Women's leadership during the covid-19 crisis**. Journal of development economics, 154:102761, 2022.

CABALLERO ESPEJO, J.; MESSINGER, M.; ROMÁN-DAÑOBEYTIA, F.; ASCORRA, C.; FERNANDEZ, L. E. ; SILMAN, M.. **Deforestation and forest**

degradation due to gold mining in the peruvian amazon: A 34-year perspective. Remote Sensing, 10(12):1903, 2018.

CATTANEO, M. D.; JANSSON, M. ; MA, X.. **Simple local polynomial density estimators**. Journal of the American Statistical Association, 115(531):1449–1455, 2020.

CHATTOPADHYAY, R.; DUFLO, E.. **Women as policy makers: Evidence from a randomized policy experiment in india**. Econometrica, 72(5):1409–1443, 2004.

CHRISTEN, P.. **A comparison of personal name matching: Techniques and practical issues**. In: SIXTH IEEE INTERNATIONAL CONFERENCE ON DATA MINING-WORKSHOPS (ICDMW'06), p. 290–294. IEEE, 2006.

DAHIS, R.; CARABETTA, J.; SCOVINO, F.; ISRAEL, F. ; OLIVEIRA, D.. **Data basis: Universalizing access to high-quality data**. 2022.

EKINO, S.; SUSA, M.; NINOMIYA, T.; IMAMURA, K. ; KITAMURA, T.. **Minamata disease revisited: an update on the acute and chronic manifestations of methyl mercury poisoning**. Journal of the neurological sciences, 262(1-2):131–144, 2007.

GIBB, H.; O'LEARY, K. G.. **Mercury exposure and health impacts among individuals in the artisanal and small-scale gold mining community: a comprehensive review**. Environmental health perspectives, 122(7):667–672, 2014.

GIRARD, V.; MOLINA-MILLÁN, T.; VIC, G. ; OTHERS. **Artisanal mining in africa**. Technical report, Universidade Nova de Lisboa, Nova School of Business and Economics, NOVAFRICA, 2022.

HARADA, M.; NAKANISHI, J.; YASODA, E.; MARIA DA CONCEICÂO, N. P.; OIKAWA, T.; DE ASSIS GUIMARÂES, G.; DA SILVA CARDOSO, B.; KIZAKI, T. ; OHNO, H.. **Mercury pollution in the tapajos river basin, amazon: mercury level of head hair and health effects**. Environment international, 27(4):285–290, 2001.

IBRAM. **Mineração em números - 2020**, 2021.

ILIODROMITI, S.; MACKAY, D. F.; SMITH, G. C.; PELL, J. P. ; NELSON, S. M.. **Apgar score and the risk of cause-specific infant mortality: a population-based cohort study**. The Lancet, 384(9956):1749–1755, 2014.

IMBENS, G.; KALYANARAMAN, K.. **Optimal bandwidth choice for the regression discontinuity estimator**. The Review of economic studies, 79(3):933–959, 2012.

JAYASURIYA, D. S.; BURKE, P. J.. **Female parliamentarians and economic growth: Evidence from a large panel**. Applied Economics Letters, 20(3):304–307, 2013.

KITAMURA, S.; MIYATA, C.; TOMITA, M.; DATE, S.; KOJIMA, T.; MINAMOTO, H.; KURIMOTO, S.; NOGUCHI, Y. ; NAKAGAWA, R.. **A central nervous system disease of unknown cause that occurred in the minamata region: results of an epidemiological study**. Journal of Epidemiology, 30(1):3–11, 2020.

KNUTSEN, C. H.; KOTSADAM, A.; OLSEN, E. H. ; WIG, T.. **Mining and local corruption in africa**. American Journal of Political Science, 61(2):320–334, 2017.

LEBEL, J.; MERGLER, D.; BRANCHES, F.; LUCOTTE, M.; AMORIM, M.; LARRIBE, F. ; DOLBEC, J.. **Neurotoxic effects of low-level methylmercury contamination in the amazonian basin**. Environmental research, 79(1):20–32, 1998.

LEBEL, J.; MERGLER, D.; LUCOTTE, M.; AMORIM, M.; DOLBEC, J.; MIRANDA, D.; ARANTES, G.; RHEAULT, I. ; PICHET, P.. **Evidence of early nervous system dysfunction in amazonian populations exposed to low-levels of methylmercury.** Neurotoxicology, 17(1):157–167, 1996.

LEE, D. S.. **Randomized experiments from non-random selection in us house elections**. Journal of Econometrics, 142(2):675–697, 2008.

LIPSCOMB, M.; MOBARAK, A. M.. **Decentralization and pollution spillovers: evidence from the re-drawing of county borders in brazil**. The Review of Economic Studies, 84(1):464–502, 2016.

MANZOLLI, B.; ALCÂNTARA, G.; RAJÃO, R.; NUNES, F.; BRAGANÇ, A. C.; FILHO, B. ; OLIVEIRA, P.. **Legalidade da produção de ouro no brasil**.

MAPBIOMAS. **A expansão da mineração e do garimpo no brasil nos Últimos 36 anos**, 2021.

MATIJASEVICH, A.; SILVEIRA, M. F. D.; MATOS, A. C. G.; RABELLO NETO, D.; FERNANDES, R. M.; MARANHÃO, A. G.; CORTEZ-ESCALANTE, J. J.; BARROS, F. C. ; VICTORA, C. G.. **Estimativas corrigidas da prevalência**

de nascimentos pré-termo no brasil, 2000 a 2011. Epidemiologia e Serviços de Saúde, 22(4):557–564, 2013.

NOVAES, L. M.. **The Violence of Law-and-order Politics: the Case of Law Enforcement Candidates in Brazil**. Insper, 2020.

OSBORNE, M. J.; SLIVINSKI, A.. **A model of political competition with citizen-candidates**. The Quarterly Journal of Economics, 111(1):65–96, 1996.

ROMERO, M.; SAAVEDRA, S.. **The effects of gold mining on newborns' health**. Disucssion papers of Stanford University, 2016.

ROSS, M. L.. **The politics of the resource curse**. The Oxford handbook of the politics of development, p. 200, 2018.

SANTOS, R. C. D. V. D.. **Contribuição do setor mineral no produto interno bruto brasileiro**. 2021.

SOLAN, T. D.; LINDOW, S. W.. **Mercury exposure in pregnancy: a review**. Journal of perinatal medicine, 42(6):725–729, 2014.

SONTER, L. J.; HERRERA, D.; BARRETT, D. J.; GALFORD, G. L.; MORAN, C. J. ; SOARES-FILHO, B. S.. **Mining drives extensive deforestation in the brazilian amazon**. Nature communications, 8(1):1–7, 2017.

TOLONEN, A.. **Local industrial shocks, female empowerment and infant health: Evidence from africa's gold mining industry**. Job market paper, 2015.

VERÍSSIMO, A.; ROLLA, A.; VEDOVETO, M.; FUTADA, S. D. M. ; OTHERS. **Áreas protegidas na amazônia brasileira: avanços e desafios**. 2011.

VON DER GOLTZ, J.; BARNWAL, P.. **Mines: The local welfare effects of mineral mining in developing countries**. 2014.

WINKLER, W. E.. **String comparator metrics and enhanced decision rules in the fellegi-sunter model of record linkage.** 1990.

DE AMORIM TEIXEIRA, A.; HAUSCHILD, R. M. P. R.; MARTINS, J.; PINTO, P. ; JÚNIOR, C. B.. **Construção da base hidrográfica ottocodificada ao milionésimo**. 2007.

UNITED NATIONS ENVIRONMENT PROGRAMME. **Global mercury assessment 2018**, 2019.

A
Jaro-Winkler Distance

In different datasets, the name of the same person can differ because of typos, misspellings, abbreviations, or transpositions, which difficult for data matching.

To overcome this issue, I use the Jaro-Winkler distance (Winkler, 1990) to measure the similarity between two strings. This metric is based on the Jaro distance, which is defined by

$$sim_j(s_1, s_2) = \frac{1}{3}\left(\frac{c}{|s_1|} + \frac{c}{|s_2|} + \frac{c-t}{c}\right), \tag{A-1}$$

where $|s_i|$ is the length of string s_i, c is the number of common characters between both strings that are not separated by more than $\frac{max(|s_1|,|s_2|)}{2}$ characters, and t is the number of common characters that are in wrong order divided by two.

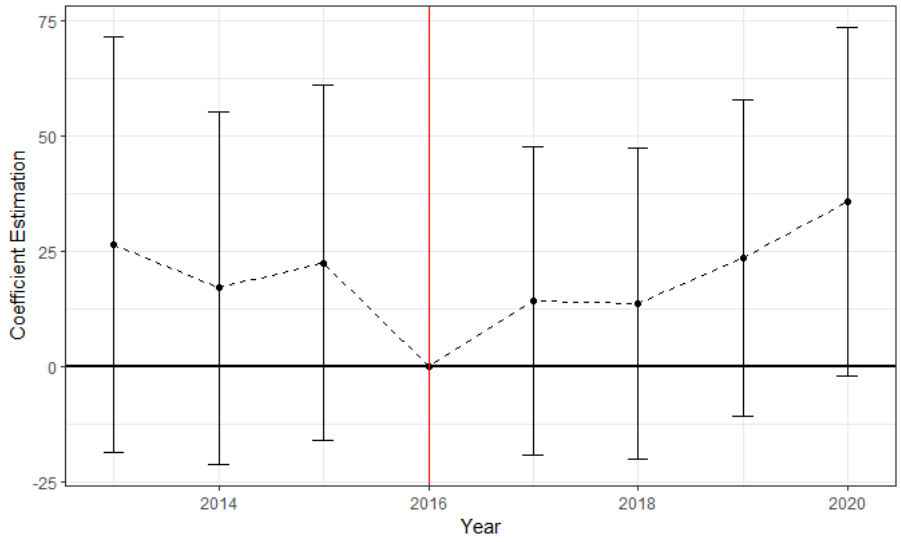
The main difference between both metrics is that the Jaro-Winkler distance puts more weight on perfect matching characters at the beginning of the string because errors are less likely to happen in the first letters of the string (Christen, 2006). The Jaro-Winkler distance is defined by

$$sim_{jw}(s_1, s_2) = sim_j(s_1, s_2) + \frac{m}{10}(1 - sim_j(s_1, s_2)), \tag{A-2}$$

where $sim_j(s_1, s_2)$ is the Jaro distance between both strings and m is the length of the sequence of perfect matching characters at the beginning of the sentence. If $m > 4$, it assumes the value of 4.

B
Graphical Representation of Parallel Trends

Figure B.1: Trends in Premature Births



C
Alternative Specifications for Regression Discontinuity

Table C.1: Alternative Specification Using Quadratic Form

	Dependent variable:	
	Difference	
	(1)	(2)
D_i	-8.15	-4.83
	(10.3)	(9.23)
Bandwidth	IKBW	IKBW
	[0.14]	[0.131]
Observations	487	487
Effective Observations	286	273
Specification	Quadratic	Quadratic
Kernel	Triangular	Triangular
Term Fixed Effects	No	Yes
State Fixed Effects	No	Yes
Controls	No	Yes

Notes: Robust standard errors are in parenthesis. RDD bandwidths are in brackets. Dependent variable is in real per capita terms. Control variables include per capita income, Human Development Index, Gini index and % of urban population in 2010 and area and local resident population.
*p<0.1;**p<0.05; ***p<0.01

Table C.2: Alternative Specification Using Different Bandwidths

	Dependent variable:			
	Difference			
	(1)	(2)	(3)	(4)
D_i	-16.31	-15.27*	-4.42	0.34
	(12.61)	(9.29)	(8.61)	(7.29)
Bandwidth	Fixed	Fixed	Fixed	Fixed
	[0.05]	[0.05]	[0.1]	[0.1]
Observations	487	487	487	487
Effective Observations	112	112	213	213
Specification	Linear	Linear	Linear	Linear
Kernel	Triangular	Triangular	Triangular	Triangular
Term Fixed Effects	No	Yes	No	Yes
State Fixed Effects	No	Yes	No	Yes
Controls	No	Yes	No	Yes

Notes: Robust standard errors are in parenthesis. RDD bandwidths are in brackets. Dependent variable is in real per capita terms. Control variables include per capita income, Human Development Index, Gini index and % of urban population in 2010 and area and local resident population.
*p<0.1;**p<0.05; ***p<0.01

Table C.3: Alternative Specification Using Uniform Kernel

	Dependent variable:	
	Difference	
	(1)	(2)
D_i	-2.25	2.9
	(8.41)	(6.98)
Bandwidth	IKBW	IKBW
	[0.12]	[0.107]
Observations	487	487
Effective Observations	247	223
Specification	Linear	Linear
Kernel	Uniform	Uniform
Term Fixed Effects	No	Yes
State Fixed Effects	No	Yes
Controls	No	Yes

Notes: Robust standard errors are in parenthesis. RDD bandwidths are in brackets. Dependent variable is in real per capita terms. Control variables include per capita income, Human Development Index, Gini index and % of urban population in 2010 and area and local resident population.
*p<0.1;**p<0.05; ***p<0.01

D
Manipulation Test on the Running Variable

Figure D.1: Manipulation Test on the Margin of Victory of Miner Mayors