Who electorally rents from an economic downturn? Evidence from Brazil's cocoa region

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Resumo

O artigo avalia as consequências eleitorais do declínio econômico da região cacaueira mais produtiva do Brasil após a infecção pela doença da vassoura-de-bruxa. Propõe-se a utilização do volume médio de chuvas na região como a variável instrumental. Encontro indícios de que os eleitores da área afetada puniram no curto prazo o candidato à presidência ligado ao incumbente da época, aumentando a votação para o Partido dos Treabladores. No que diz respeito à eleição para governador, os resultados sugerem o movimento contrário: os eleitores recompensaram o partido do governador incumbente de forma persistente ao longo de todo o período analisado, dando maior parcela de votos ao Partido da Frente Liberal. Os eleitores são mais reativos entre os municípios com maior PIB per capita, maior produção de cacau e maior população rural. A análise do mecanismo revela que o fenômeno elevou a taxa de desemprego, a pobreza e a desigualdade.

Palavras-chave: Economia Política; Desenvolvimento Econômico; Variável Instrumental.

Abstract

The paper assesses the electoral consequences of the economic decline of Brazil's most productive cocoa region after infection with the witches' broom disease. I propose to use the mean rainfall in the region as the instrumental variable. I find evidence that the voters in the affected area punished the incumbent's presidential candidate in the short-run, by increasing the Workers' Party vote share. With respect to the gubernatorial election, the results suggest the same movement: the voters punished the incumbent's party persistently throughout the entire period analysed by giving a higher share of votes to the Liberal Front Party. Voters are more responsive among the municipalities with the highest GDP per capita, highest cocoa production, and highest rural population. The mechanism analysis reveal that the phenomenon raised the unemployment rate, the poverty, and the inequality.

Keywords: Political Economy; Development Economics; Instrumental Variable.

ÁREA DE SUBMISSÃO: 17 - Desenvolvimento rural e local.
JEL codes: P48, O13, C26.

1 Introduction

An economic decline can have a number of socio-economic consequences for the affected region, such as increased poverty, violence, educational problems, and slumization. The economic shock extends to voters' perception which tends to change their outlook and preferences. Extreme historical events demonstrates profound shifts such as the ascension of the National Socialist German Workers' Party (Gasiorowski, 1995). Ordinary political changes are commonplace to materialize the less disruptive evolution of voters' perspectives. For instance, the public sector strengthening in the economy, the Welfare state after the Second World War, the deregulation and the privatization shove in the late 1970s in several countries (Gourevitch, 1986).

Considering that voters are responsive to economic shocks, what political party or candidate benefit the most? I exploit a quasi-experimental design to examine the electoral impact of the witches' broom disease outbreak in Brazil's most productive cocoa region on the presidential and gubernatorial election. I use six presidential elections between 1989 and 2010 to estimate the effect on the Workers' Party's (PT) vote share, for they ran for presidency in all elections since the Brazilian redemocratization in 1980s. With respect to the election of the state governor, the investigation uses the share of votes for the Liberal Front Party (PFL) between 1990 and 2010. The PFL has also ran for all the state elections in Bahia. In 2007, the party is reestablished as Democrats.

The paper applies instrumental variable research design. It uses the rainfall as instrument and assert that it is one of the key factors that explain the cocoa productivity and it is not correlated with the dependent variables except through the witches' broom disease. The treatment group is the municipalities located at the cocoa microregion, where the outbreak spread begins in 1989. The control group is comprised of all producing cocoa municipalities out of the cocoa microregion. Then, the estimates from 1998 onward are properly interpreted as being a sub-estimated effect, as discussed later. The Kleibergen-Paap version of F-statistics for the first stage relevance assumption is higher than 10 (Stock and Yogo, 2002).

The results suggest that the witches' broom increases, in the national elections, the PT's vote share by 3.5 percentage points (p.p.) in only the 1994 election with no long-term impact. The evidences indicate that, in the state elections, the impact on the PFL's vote share in sustained throughout the entire period. In 1994, 1998, 2002, 2006, and 2010 elections, the witches' broom causes an increase of 15 p.p., 21 p.p., 27 p.p., 22 p.p., and 23 p.p. respectively. From those results, it is possible to infer that the voters respond to the fungus outbreak by electorally punishing the incumbent parties at the moment. The estimates present that the impact is larger in the poorest municipalities, the effect is weaker in the least productive municipalities, and oscillates among the most urban municipalities. The analysis of the mechanism underlines that the fungus leads to a reduction in cocoa production and a worsening of socioeconomic indicators.

The paper provides some contributions to the literature concerned about the economic effects on the elections. I explore a sudden and unexpected event involving a regional sample in Brazil. Then, I find that the voter reacts immediately to the economic impact in the 1994 election, even before the socioeconomic consequences begin to raise in the estimates. From there, it implies that the voters punish the current incumbent immediately. The reason why the effect is enduring at the governor level is an issue for further investigation.

The literature on economic voting has a long tradition of examining the relationship between economic outcome and voter behaviour. A seminal theoretical result comes from the Downsian model in which the voter is inclined to vote for the candidate that whose policies

may provide her a higher level of utility. The incumbent gets the vote when the economy thrives, but loses it when the economy struggles, as summarized by the reward–punishment economic voting theory (Lewis-Beck and Stegmaier, 2018).

Nannestad and Paldam (1994) speak of three different waves on the empirical economic voting.[1] From the late 1960s trough the mid 1970s, the first wave empirically focuses on the macroeconomic impact on voting, popularity, and others. For instance, Kramer (1971) notes that the macroeconomic variables have a significant influence on the incumbent's party electoral performance. Moreover, this literature also finds that the voters appraise the government's responsibility for economic development and their myopic outlook.

The second wave develops both the new theoretical models, in response to the Lucas' Critique, and the empirical estimates (Frey and Schneider, 1979; Hibbs Jr et al., 1982). The microfoundation evokes a deeper investigation regarding the voter's motivations in going to vote, for instance whether the voter is retrospective or prospective in her decision and the egotropic or sociotropic hypothesis. The first is to determine whether the voter is evaluating the incumbent's performance or taking into account the future. The latter hypothesis examines whether the voter is concerned about her own experience (pocketbook) or about the macroeconomic variables. Regarding the third wave, the authors briefly argues that it is more fragmented and explores other phenomena, such as the incumbent's increase of popularity due to wars, and a refinement of the empirical assessment.

According to Lewis-Beck and Paldam (2000), there are nine stylised facts in the literature on economic voting. For instance: economic variation responds to about one-third of a shift in the vote and is a significant prognostication of the government support; the macroeconomic variables that voters concerns the most are unemployment, growth, and inflation; voters are myopic; slightly more retrospective; and mostly sociotropic with exceptions. Recent studies confirm the convergence of these findings and indicate that economic changes in voting are balanced by the perception of government responsibility (Lewis-Beck and Stegmaier, 2018).

Moreover, Duch and Stevenson (2008) suggest that more open economies have less economic votes than less open countries. Voters react differently to economic shocks during local or national elections (Fernandes and Fernandes, 2017). Elinder (2010) reports that lower unemployment rates at the regional level have a greater impact in national elections than at the municipal level. Martins and Veiga (2014) discuss the impact of economic variables on Portuguese municipal and state elections. The results show that the increase of unemployment rate has a higher impact on the local election than on the national level, especially if the mayor is politically close to the president's party, whereas the inflation rate has the opposite effect. According to Veiga and Veiga (2010), the country's economic conditions explain the economic vote more than the local conditions.

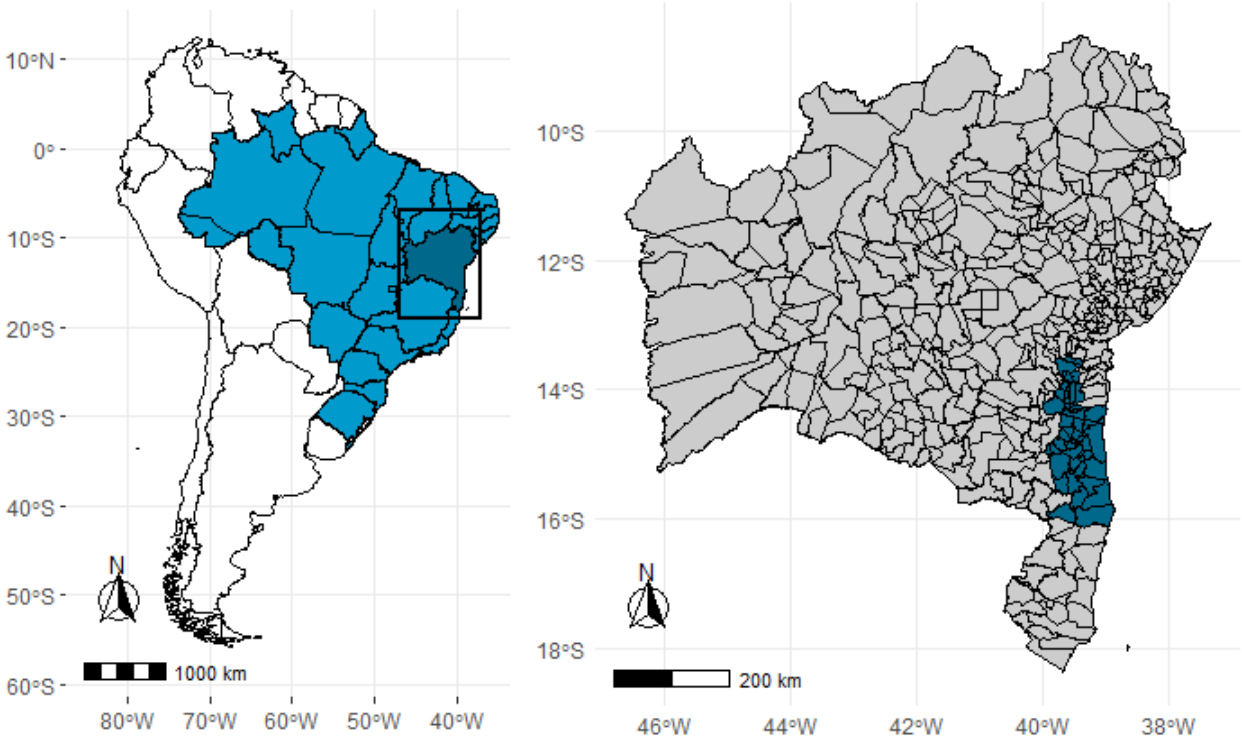
The Great Recession of 2008 fosters the investigations regarding the economic recession impact on voting. Campbell (2010) argues that the economic downturn contributed to the presidential election of Barack Obama. Lewis-Beck and Whitten (2013) point out that the studies identify the reward-punishment theory worldwide and Lindvall et al. (2013) find evidence that lower economic groups are more electoral responsive to economic recessions. Rattinger and Steinbrecher (2011) find evidence that, due to the 2008 crisis, the German voters' intention for the incumbent reduces, if the voters hold the incumbent more accountable for the poor economic performance then they are less likely to vote for a party of the government coalition. The authors suggest that the incumbent's party triumph in the 2009 elections is partly due to the effective economic actions of the political coalition to reduce the economic

[1] The literature is also named as the VP function, which V stands for the economic and political variable assessment that potentially explain the vote, and P is for the popularity polls.

crisis. Karyotis and Rüdig (2015) examine the election outcome of the incumbent in charge of the Greek austerity plan in 2009. The results suggest that the incumbent party is perceived as implementing an unfair economic recovery plan rather than an economic failure based on the reward-punishment model. Fraile and Lewis-Beck (2014) find that the economic vote is even stronger after the 2008 economic crisis in Spain.

The remainder of the paper is organized as follows. In section 2, I present the historical background of the cocoa production in Bahia and the potential origins of the witches' broom disease outbreak in the region. Section 3 summarizes the dataset and the rainfall measure. Section 4 introduces the empirical strategy for appraising the phenomenon. Section 5 presents the baseline estimations, the heterogeneous effect, the mechanism investigation, and the robustness checks. Finally, section 6 concludes.

Figure 1: Cocoa region in the state of Bahia



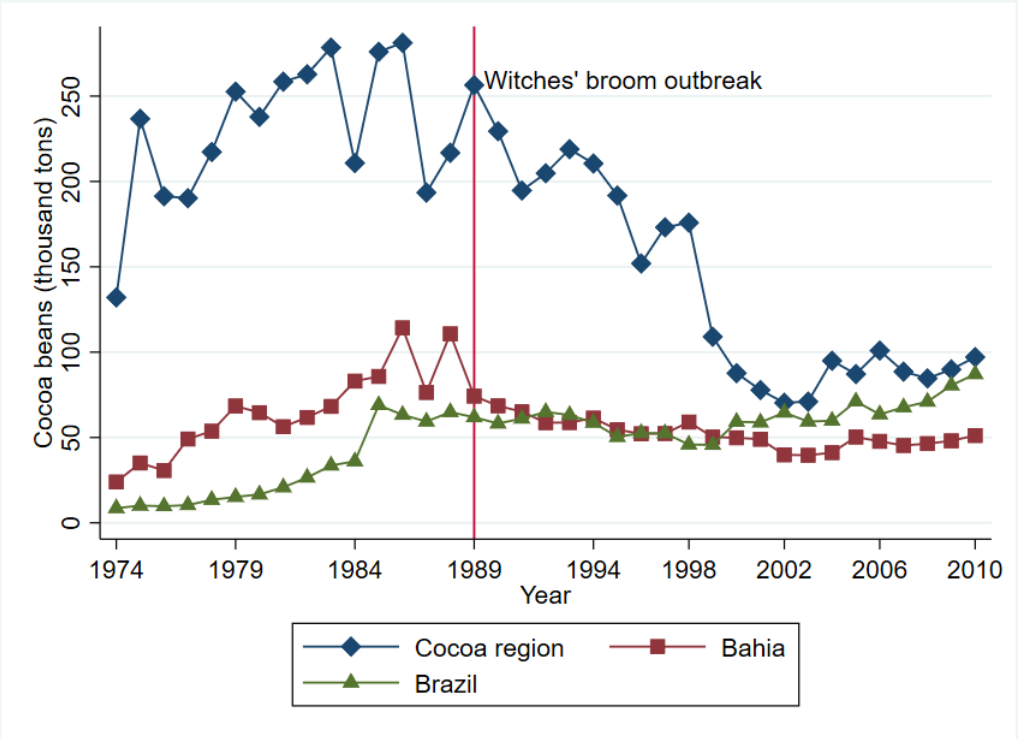
2 Cocoa in Bahia

Cocoa beans are the key ingredient in chocolate and are grown from cocoa trees, which is native from the American rainforest. In Brazil, the cocoa tree is originally from the Amazon region, but it is in the state of Bahia where cocoa cultivation grew the most, turning the location into one of the leading cocoa producers in the world (Rocha, 2008). It was introduced in this region in 1746, in the municipal area of Ilhéus, when the French Louis Fréderic Varneaux brings the cocoa seeds from the state of Pará. The crop spread throughout the region, but it was only in the late 1800s that the region makes high investments in it. In 1835, it produces 75 tons of cocoa beans and, in 1935, the production reaches over 108,000 tons. In the 1930s, the country becomes the leading cocoa producer, but is progressively surpassed by other countries, including those in West Africa (Rocha, 2008; Bastide et al., 2007).

The cocoa tree is best adapted to tropical climates, high air humidity, soil moisture, and

regular rainfall throughout the seasons. Due to its sensitivity to sunlight, it requires cultivation under shade trees to protect cocoa plants from intense heat (Rocha, 2008). South Bahia has several features that make it suitable for growing cocoa: climate, rainfall, humidity, and the Atlantic Rainforest. Figure 1 where the Cocoa region is located, which is the most productive cocoa area in Brazil. Since the introduction of cacao seeds in Bahia, the culture gradually expands to nearby communities. Five other Brazilian states produce cocoa beans, with Bahia being the largest producer.

Figure 2: Cocoa production in Cocoa region, Bahia, and Brazil



The crop in the Cocoa region has a degree of volatility explained by the rainfall regime, the presence of other pests such as black pod of the *Phytophthora* species, since the 1920s, due to sporadic outbreaks related to increased humidity (Oliveira and Luz, 2005; Bowers et al., 2001). Some internal and external factors may also contribute to it, such as macroeconomic uncertainties, low modernization of production, occasional drought and international price fluctuations (Mascarenhas, 2004).

Over the centuries, the cacao farming in the south of Bahia embeds the culture of the local population. The harvest enables many families to emerge from poverty and enrich themselves. Novels and poetry are written, soap operas are recorded, registering the daily life of the locals. For instance, the author Jorge Amado writes several novels inspired by everyday life in the cocoa region where he was born and raised. The region is commonly portrayed as having a profound income and political inequality, the big cocoa landlords are named as “colonels", for they are usually part of economic and political elite ruling the region (Rocha, 2008).

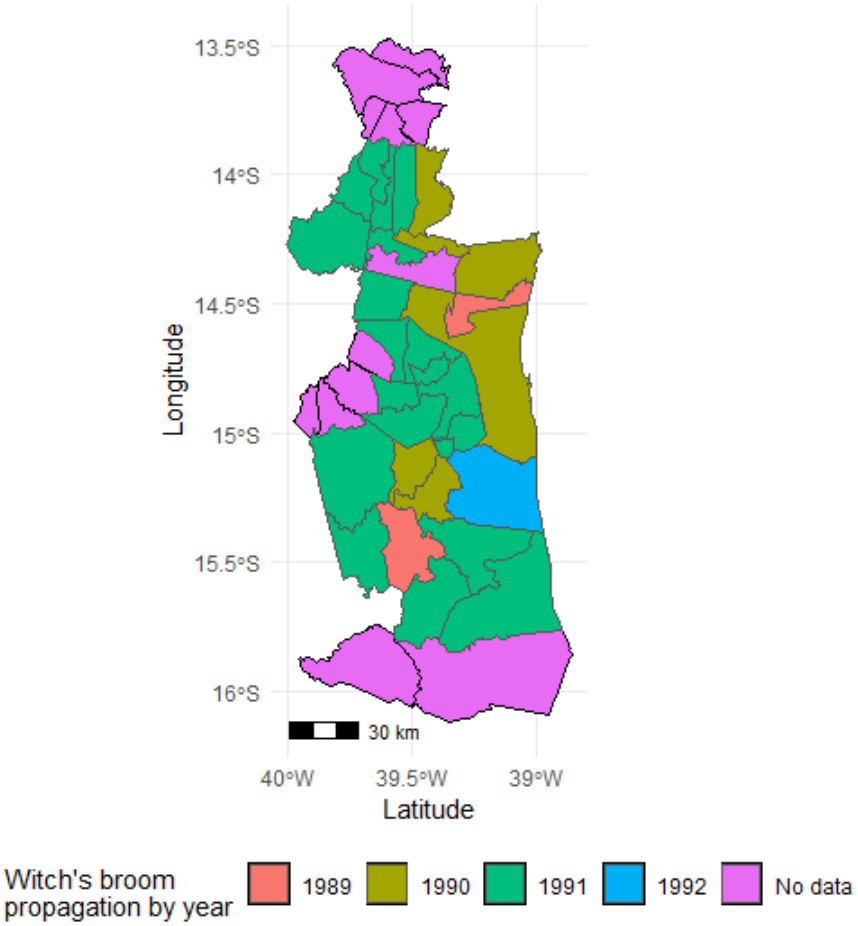
The state of Bahia consists of 417 municipalities, 100 of which produce cocoa. The cocoa region is a microregion classified by the Brazilian Institute of Geography and Statistics (IBGE), known as Ilhéus-Itabuna microregion[2]. The microregion is composed of 41 highly

[2]I will henceforth use the name Cocoa region as a synonym for Ilhéus-Itabuna microregion

productive cocoa municipalities located in the Mesoregion of South Bahia. Figure 2 shows the cocoa beans crop from the Cocoa region, from the other municipalities in the state of Bahia, and from Brazil (excluding Bahia's production). Between 1985 and 1989, the cocoa region accounted for 73% of total production in Bahia and 38% of Brazil's total production.

The witches' broom disease is long known by the Brazilian authorities, it was first reported in Suriname in 1895 (Calle et al., 1982). The disease is caused by the fungus Crinipellis perniciosa and is native to the Amazon region, which occurs in several countries on the American Continent. Bahia's crop remained free from this disease until 1989, its distance of over 2000 kilometers to the Amazon region, combined with the efforts of the authorities efforts, may explain it. In the 1960s, the Executive Committee of the Cacao Crop Plan (CEPLAC) established the first quarantine of plants to hinder the potential contaminants from reaching the Southern Bahia (Rocha, 2008). During the 1980s, thousands of plant materials were apprehended along the way to the area (Pereira et al., 1996).

Figure 3: Outbreak timeline in Cocoa region



Between May and October 1989, the witches' broom pathogen is suddenly discovered in two farms more than 100 kilometers apart. First in Uruçuca and second in Camacã further south. Since then, the Cocoa crop falls by over 70% in 2002, when it returned to a steady growth. At its peak, the region employed 400,000 workers, after 1989 the data suggest a massive rural-urban migration due to higher unemployment and poverty (Aguiar et al., 2014). The slumazation process is reinforced, especially in Ilhéus and Itabuna, the two largest

municipalities in the region (Rocha, 2008). Pereira et al. (1996) report that the disease rapidly spreads throughout the southern Bahia, as shown Figure 3. In 2001, the disease of the witches' broom is detected in the state of Espírito Santo, over 500 kilometers south of Camacã (Lima et al., 2018).

The exact cause of the plague outbreak is controversial. According to the 2006 Federal Police's investigation, they conclude that the evidences lead to a deliberate human act, and cannot be attributed to natural agents (Rangel and Tonella, 2013). The literature raises three hypotheses, according to Caldas and Perz (2013), namely: (i) sabotage from international competitors, (ii) contaminated plant material unintentionally transported from the Amazon region to the Cocoa region, and (iii) the politically motivated sabotage.

The third conjecture gains more attention when, in 2006, a man claiming to be the saboteur gives an interview to Veja, a mass-circulation magazine (Junior, 2006). He confirms the political intentions with the witches' broom contamination to weaken the political power of local colonels and replace them with the left-wing parties. According to him, the first fungus outbreaks occurred in the cocoa farm belonged to the president of the Democratic Rural Union, a right-wing supporter. In 1992, PT's mayoral candidate is elected in Itabuna. In 1993, the same municipality helps to elect a PT's congressman. In 1996, three of the most productive cocoa municipalities, Uruçuca, Ilhéus, and Camacã, elect left-wing mayors Caldas and Perz (2013).

Two major institutions historically support the Cocoa region's production, namely the Bahia Cacao Institute (ICP) and the Executive Committee for the Cacao Crop Plan (CEPLAC). The first is a Bahia state agency established in 1936 and closed in 1992, the latter is a federal agency established since 1957. From the the witches' broom outbreak, CEPLAC's assistance to farmers operated to control the fungus in a number of unsuccessful strategies. Their first attempt to resolve it is drastic measures based on the eradication of the contaminated cocoa tree in conjunction with phytosanitation and chemicals, and gradually move to a damage containment strategy as the propagation becomes inevitable (Pereira et al., 1996). In 1998, CEPLAC starts with grafting the cocoa trees with resistant clones, and inaugurates the Cocoa Genetic Improvement Program to develop a diversity of genetically enhanced clones (Rocha, 2008).

3 Data source

The investigation uses Brazilian municipalities located in the state of Bahia to assess the electoral consequences of the witches' broom disease. The state is composed of 417 municipalities and the affected cocoa area has 41 municipalities. The presidential data correspond to six election cycles: 1989, 1994, 1998, 2002, 2006, and 2010, while the state data starts from 1990 and then follow the same presidential election periodicity.

Data on elections in Brazil are available in the official statistics of the Superior Electoral Court (TSE) from 1994 onward. Information on the 1989 elections comes from Ipeadata and Atlas das Eleições Presidenciais no Brasil. I measure the president variable as the Workers' Party (PT) vote share in the first round of the elections, because PT has run for president in all elections since the end of the Brazilian military regime. Between 1989 and 2006, Lula runs for election, having won in 2002 and 2006. In 2010, PT wins the election once more with Dilma Rousseff. The state governor variable is the PFL's vote share, since the party participates in every election for governor in the state of Bahia since 1990. The initial year of both elections are different, it is so due to the different mandate lengths. The president mandates are of five years until 1998, when the Parliament changes it to four years and give permission to the

current president to run for the reelection. The governor mandates are always of four years.

With respect to the cocoa production, the database is obtained from the Brazilian Institute of Geography and Statistics (IBGE). Details of the spread of the disease in the Cocoa Region area reported by Pereira et al. (1996).

Figure 4: Rainfall station locations

I use Rainfall as the instrumental variable obtained from the Terrestrial Precipitation: 1900-2010 Gridded Monthly Time Series (Version 3.01). The data are compiled and organized by Kenji Matsuura and Cort J. Willmott (Delaware University) from multiple station data sources. Figure 4 presents the station locations in the state of Bahia used to calculate the weighted average precipitation in millimiters, they are interpolated to a 0.5 by 0.5 degree grid and available on a monthly basis. The dataset provides a monthly estimate of mean rainfall between 1900 and 2010. I follow Arvate et al. (2015) who compiled and estimated this rainfall dataset per municipality weighting it by the inverse Euclidean distance from the municipal center to the four closest stations. That is, the closer it is to a station location, the more weight it has. Based on that, I calculate the average rainfall for the president election period: 1900-1989, 1900-1994, 1900-1998, 1900-2002, 1900-2006, and 1900-2010. The state governor election period is the same, except for the first period which is 1900-1990.

The descriptive statistics are in Table 1, where I separate the variables in the 1989 electoral period, at the start of witches' broom disease in the area, and the 1994-2010 electoral periods, from which I compute the aggregate statistics. I use the PT's vote share as the measure of the president election. The mean PT's vote share during 1989 electoral period among the treated and control group are, respectively, 16.46% and 21.12%; with respect to the mean period 1994-2010, 45.12% and 47.60% respectively. Highlighting the mean differences, I notice that the PT's vote share in the treatment group rise more rapidly than the control group.

In 1989, among the treated and control group, respectively, the mean cocoa production are 6023t and 1544t, as in the period 1994-2010, they are 3169t and 789t. Both groups experience a declining trend of approximately 50% throughout the whole period. I also note that comparison of the mean cocoa production in both groups follows a downward trend, in

Table 1: Descriptive statistics

	1989		1994-2010	
	Treated	Control	Treated	Control
Name of variables	Cocoa region	Rest of Cocoa	Cocoa region	Rest of Cocoa
PT's vote share	16.46[8.7]	21.12[10.9]	45.12[17.4]	47.60[20.6]
	40 60	204	326	
PFL's vote share	51.44[11.5]	50.81[12.9]	53.56[22.4]	50.14[22.7]
	41	66	205	327
Cocoa production	6022.85[6738.6]	1543.75[2662.2]	327.72[640.3]	788.98[1023.0]
	41	60	205	326
Rainfall	118.58[14.2]	100.67[21.0]	117.81[14.4]	103.45[22.2]
	41	60	205	326
Inequality	10.61[2.3]	10.77[2.3]	6.17[2.2]	9.90[2.4]
	41	60	205	196
Poverty	84.42[7.1]	78.47[9.0]	54.42[20.5]	50.84[20.3]
	41	60	205	326
Unemployment	6.79[3.6]	5.94[3.8]	13.26[6.6]	11.66[7.0]
	41	60	205	326
Suicide rate	1.11[1.3]	0.68[1.1]	2.14[2.2]	2.08[2.2]
	41	60	205	326
School discrepancy	64.81[4.5]	61.68[5.0]	32.70[8.7]	50.89[10.9]
	41	60	205	196
School dropout	53.22[8.4]	51.11[13.2]	20.85[14.4]	33.74[16.5]
	41	60	205	196
Rural population	0.49[0.2]	0.49[0.2]	0.29[0.2]	0.35[0.2]
	41	60	205	326
GDP	142.57[168.1]	394.68[874.5]	327.56[191.1]	545.09[758.1]
	40	60	205	326
Density	67.30[69.6]	55.44[64.0]	64.18[71.6]	58.39[73.7]
	41	60	205	326
Share of women	0.49[0.01]	0.50[0.01]	0.49[0.01]	0.49[0.01]
	41	60	205	326

Notes: The table reports the mean, the standard error in brackets, and the number of observations on the line below. Rest of Cocoa refers to the all the cocoa producing municipalities in Bahia excluding those located in the cocoa region. The 1989 PFL's vote share refers to 1990.

which the control group falls slightly more. Therefore, I cannot conclude whether the witches' broom is a key component for this trend.

The following data are from Ipeadata: income inequality measured as the income share of the bottom 40% of population, school discrepancy measured as at least one year school gap for students ranging from 7 and 14 years old, and school dropout is the rate of students that drop out of school raging from 15 to 17. From Datasus: suicide rate is measured as per 100,000 inhabitants, and poverty rates as the share of the population earning less than 25% of the minimum wage. From the IBGE's population census of 1991, 2000 and 2010: unemployment rate and the share of rural population. The population size is estimated by the General Accounting Office and made available by IBGE for the years of 1991 to 2018. Regarding the 1989 population size, I use the 1991 estimation, while the remainder electoral periods are the average within each period. The population density is calculated from the population over the municipality's area. I use electricity consumption per capita from Bahia's superintendence of economic and social studies (SEI) as the proxy variable of GDP per capita,

since it is available from 2002 onward.

4 Empirical Strategy

This paper examines the electoral impact of the witches' broom disease contamination in Brazil's most productive cocoa region. It uses the the instrumental variable (IV) research design for this purpose. I propose to use the fixed effects two-stage least square estimator as presented in equations (1) and (2). I estimate the local average treatment effect (LATE)[3] by considering the following pair of electoral periods: 1989 and 1994; 1989 and 1998; 1989 and 2002; 1989 and 2006; 1989 and 2010. The goal with it is to capture the treatment effect by demeaning the variables before and after the witches' broom disease spread.

First stage:

$$D_{it} = \beta_0 + \beta Rainfall_{it} + \psi X_{it} + \beta_i + \beta_t + \epsilon_{it} \tag{1}$$

Second stage:

$$PT_{it} = \gamma_0 + \gamma D_{it} + \eta X_{it} + \gamma_i + \gamma_t + \varepsilon_{it} \tag{2}$$

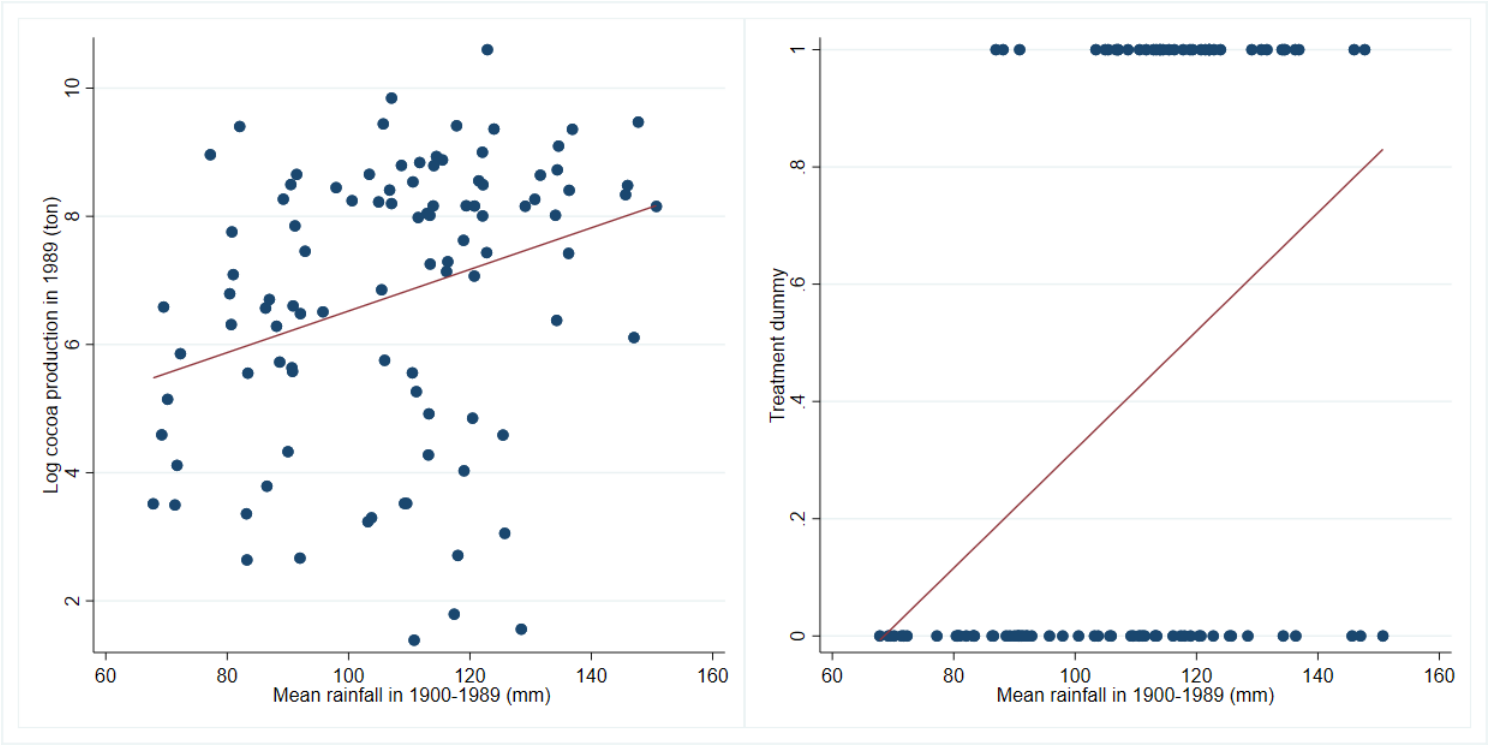
where β is the instrumental variable coefficient, and γ estimates the local average treatment effect.

In the previous section, I present some evidence of how witches' broom disease infected the cocoa plantation in Bahia. Because it is handmade, it can be argued that the outbreak is most likely to infect the most productive area of cocoa in the first place. Cocoa planting involves many geographical factors to its productivity, such as soil quality, humidity, temperature and rainfall. I assert that the rainfall is a potentially well-suited instrument for fulfilling the two main requirements, namely: (i) the relevance condition (rainfall is a good predictor of the municipalities belonged to the treatment group of the cocoa region) and (ii) the exclusion restriction (rainfall affects elections only indirectly through the treatment dummy). The intuition for using $Rainfall$ as the instrumental variable is the high correlation with the cocoa production and with the municipalities located in the Cocoa Region in Bahia as depicted in Figure 5. Rainfall is positive correlated with cocoa production and the treatment dummy, which is all the municipalities located in the cocoa region, when I restrain the sample to the cocoa producing municipalities. With respect to the exclusion restriction, I argue that rainfall is an exogenous variable when restricting the analysis to the subsample containing only the cocoa producing municipalities, hence it is not correlated to any municipal characteristic, as I present in the later section.

Since I restrict this estimation to the subsample containing only cocoa producing municipalities, few considerations about the interpretation about what γ captures in equation (2) are worth to mention. Regarding the electoral period 1989 and 1994, the witches' broom is still restricted to the Cocoa region, then γ measures both the effect of the disease presence on the people's subjective perception and the potential economic downfall especially the cocoa production. With regard to the 1989 and 1998 election cycles, the plague gradually spread to other adjacent cocoa plantations in municipalities beyond the Cocoa region. Hence, γ measures the effect of the disease presence on the people's subjective perception of the Cocoa

[3] More on the interpretation of the instrumental variable as LATE, see Becker 2016.

Figure 5: Rainfall, cocoa production, and treated area



region relative to the people's subjective perception from other regions and also the potential economic downfall in the Cocoa region relative to the economic downfall in other regions. Therefore, from 1998 onward, the estimates of the witches' broom impact can be considered as being sub-estimating the real effect.

5 Result

In this section, I present the impact of the witches' broom disease on the elections of the president and state governor of the state of Bahia. First, I show the results of IV estimates, from which I conclude that the voters punished the current incumbents at the federal and state levels differently. Secondly, I conduct the heterogeneous analysis and explore the potential mechanisms to better understand the phenomenon. Eventually, I run the robustness checks on the research designs, and indirectly test the exclusion restriction of the IV.

5.1 Baseline estimation

In Table 2, I estimate the effect of the witches' broom on the presidential election using the Fixed effects and the Two-stage least squares fixed effect estimators. Panels A and B report the president's election estimates. I select the subsamples by column as follows: column (1) 1989 and 1994 electoral period, column (2) 1989 and 1998, column (3) 1989 and 2002, column (4) 1989 and 2006, and column (5) 1989 and 2010[4]. In panel A, the FE estimates show that the witches' broom increases by 4.6 p.p. the PT's vote share only in the 1998 elections according to column (2). Panel B displays the results for FE2SLS. I find evidence that the disease is

[4]The gubernatorial election cycles are 1990-1994, 1990-1998, 1990-2002, 1990-2006, 1990-2006, 1990-2010.

responsible for 3.5 p.p. increase in the PT's vote share in the 1994 election explaining 14% (3.5/24.25) of the share of PT votes.

Table 2: IV estimation on the presidential election

	1994	1998	2002	2006	2010
	(1)	(2)	(3)	(4)	(5)
Dependent var.: President		Panel A: FE			
Witches' broom	2.006	4.583**	-2.945	0.923	0.440
	(1.576)	(2.230)	(2.349)	(2.649)	(2.400)
		Panel B: FE2SLS			
Cocoa region	3.540*	-0.577	-4.998	5.696	-0.433
	(2.160)	(4.264)	(4.165)	(6.427)	(4.547)
	[0.088]	[0.827]	[0.244]	[0.378]	[0.941]
First Stage Instrument					
Rain	-0.952***	-0.393***	-0.277***	-0.202***	-0.191***
Standard error	0.085	0.053	0.041	0.030	0.024
F statistic for IV in first stage	126.450	54.348	44.510	44.257	63.738
Anderson-Rubin test	0.100	0.892	0.240	0.356	0.925
N	190	190	182	184	184
Mean Dependent Variable	24.248	23.848	33.741	43.880	41.954
Std. Dev. Dependent Variable	10.956	12.423	17.808	25.637	23.942

Notes: Control variables are: Share of women in population, Share of Rural population, GDP per capita, and Electoral year fixed effects. Robust standard errors in parenthesis. Bootstrap's p-value in brackets. Kleibergen-Paap rk Wald statistic is used for the F statistics. * p ≤ 0.10, ** p≤0.05, *** p≤0.01.

The robust standard error results in a p-value slightly greater than 10% threshold. A way to improve the inference is by using the bootstrap method. I then run the wild bootstrap[5] to obtain the p-value of 0.088. The remaining columns have no statistically significant effects. The first stage estimations reveal that the instrument is strongly correlated with the dummy treatment. The F-statistic is above 10, which reduces the probability of weak instrumental variable (Stock and Yogo, 2002). As regards the instrumental variable coefficient, rainfall coefficient has a negative impact on the dummy treatment. The reason for this is that the rainfall is obtained by demeaning the data, by coincidence the rainfall indicates a deeper decline in its measures in the cocoa region after the 1989 election cycle.

Table 3 presents the state governor election using both the PFL's vote share as the dependent variable. I find no evidence that there is any significant correlation between the fungus outbreak and the governor elections employing the fixed effect estimator in panel A. By performing the Fixed-effect 2-stage least square in panel B, the figures show a persistent impact on the election of the state governor and statistically significant. In the first column (1990-1994), the impact is approximately by 15 p.p.. In column (2), the impact goes to 20 p.p. and to 27 p.p. in column (3). Columns (4) and (5) display an effect by 22 p.p. and by 23 p.p. respectively. The F-statistics exceed 10 in all the subsamples. In both cases, the results are significant across all the subsamples, making the fungus effect persistent.

The FE2SLS indicates a short-term impact of the witches' broom disease on the cocoa region, an increasing on the PT's vote share in the presidential election, only in the next election cycle. That is, in the long run, the FE2SLS estimates present no statistical significance

[5] I use the wild bootstrap with Wald test, wild restricted efficient bootstrap, Rademacher weights, null imposed, and with 999 repetitions according to Roodman et al., 2019.

Table 3: IV estimation on the state governor election

	1994	1998	2002	2006	2010
	(1)	(2)	(3)	(4)	(5)
			Panel A: FE		
Witches' broom	2.444	-1.492	4.964	4.434	0.534
	(3.240)	(2.697)	(3.043)	(3.291)	(3.621)
			Panel B: FE2SLS		
Cocoa region	14.851**	20.572***	27.063***	21.565***	22.748***
	(5.673)	(7.643)	(8.116)	(7.575)	(7.374)
First Stage Instrument					
Rain	-0.896***	-0.320***	-0.231***	-0.175***	-0.155***
Standard error	0.121	0.057	0.039	0.029	0.023
F statistic for IV in first stage	55.057	32.149	34.898	37.430	43.734
Anderson-Rubin test	0.006	0.001	0.0001	0.002	0.001
N	202	202	194	196	196
Mean Dependent Variable	53.134	64.430	56.189	48.676	33.815
Std. Dev. Dependent Variable	11.587	16.581	12.996	12.802	20.274

Notes: Control variables are: Share of women in population, Share of Rural population, GDP per capita, and Electoral year fixed effects. Robust standard errors in parenthesis. Bootstrap's p-value in brackets. Kleibergen-Paap rk Wald statistic is used for the F statistics. * p ≤ 0.10, ** p≤0.05, *** p≤0.01.

of the witches' broom on PT's vote share. With respect to the gubernatorial elections, the estimates points to a persistent effect in all cycles from 1994 onward.

Those results suggest that the voters potentially punish the president that was ruling when the fungus outbreak occured. At the national level, the 1994 election took place between two candidates in the second round: Fernando Henrique Cardoso, representing the Brazilian Social Democracy Party (PSDB), who had some connection with the president at that time, Itamar Franco[6], and Luiz Inácio Lula da Silva, from the PT. Regarding the gubernatorial elections in the state of Bahia, the estimates suggest that the voters of the cocoa region reinforced their persistent preference against the incumbent's candidate at that time. In 1990 election, Nilo Peçanha[7], from the PMDB, failed to make his successor from the PMDB, the candidate Roberto Santos, winning Antônio Carlos Magalhães, a traditional politician of the state.

5.2 Heterogeneous effects and Mechanism

In this section, I analyse the heterogeneous effect of the witches' broom disease on both the president and the state governor by excluding the municipalities with the 10% highest percentiles regarding the energy consumption per capita (which is the proxy of GDP), the cocoa production, and the share of rural population. Later, I investigate the economic and social mechanisms that are likely to clarify the phenomenon. I evaluate the following variables: unemployment, poverty, inequality as the economic mechanism; share of rural population, school drop-out rate, and school discrepancy as the social mechanisms.

[6]Itamar Franco was the vice president of the impeached President Fernando Collor de Mello elected in 1989.

[7]In 1989, the governor of Bahia, Waldir Pires from the Brazilian Democratic Movement Party (PMDB), resigned to become the vice president of the presidential candidate Ulysses Guimarães. Nilo Peçanha was Waldir Pires' vice governor.

In Table 4, I present the heterogeneous effect of the cocoa-producing region affected by the witches' broom disease at the national and state level elections. In panel A, I estimate the effect by excluding the last decile corresponding to the municipalities with the highest per capita energy use. In column (1), the FE2SLS indicates that the municipalities with lower GDP per capita are more responsive to the disease by increasing the PT's vote share. The remaining columns show evidence of this long-term sensitivity, I highlight the FE2SLS coefficient in column (4) becomes much higher than the one in column (1) and statistically significant regarding the baseline estimation. At the state level, the municipalities are less sensitive to the fungus outbreak compared to the baseline estimate.

Table 4: Heterogenous effect

	1994	1998	2002	2006	2010
	(1)	(2)	(3)	(4)	(5)
	Panel A: Below 90% Energy consumption				
$FE2SLS_{president}$	3.933*	5.733	-1.221	14.432**	3.240
	(2.447)	(4.729)	(5.536)	(8.075)	(6.697)
	[0.100]	[0.216]	[0.857]	[0.036]	[0.633]
N	180	178	170	172	172
$FE2SLS_{governor}$	12.544**	17.293*	23.480**	17.374**	22.083**
	(5.908)	(8.840)	(9.772)	(8.658)	(9.410)
N	188	186	178	180	180
	Panel B: Below 90% Cocoa production				
$FE2SLS_{president}$	3.563*	-2.232	-5.342	8.840	1.632
	(2.345)	(5.150)	(4.700)	(6.521)	(5.289)
	[0.100]	[0.639]	[0.274]	[0.170]	[0.775]
N	174	174	166	168	168
$FE2SLS_{governor}$	12.620**	17.496**	25.892***	17.364**	16.937**
	(5.631)	(7.422)	(8.138)	(7.481)	(6.967)
	Panel C: Below 90% Share of rural population				
$FE2SLS_{president}$	3.989*	-1.205	-4.387	7.186	1.306
	(2.233)	(4.150)	(4.084)	(6.452)	(4.522)
N	170	170	162	164	164
$FE2SLS_{governor}$	17.791***	23.164***	34.386***	29.254***	28.217***
	(5.624)	(7.671)	(7.903)	(7.660)	(7.792)
N	184	184	176	178	178

Notes: $FE2SLS_{president}$ consider the PT's vote share as the dependent variable. $FE2SLS_{governor}$ estimates the PFL's vote share. Control variables are: Share of women in population, Share of Rural population, GDP per capita, and Electoral year fixed effects. F-statistics for the first stage of the FE2SLS estimations are above 10. Robust standard errors in parenthesis. In brackets, the bootstrap's p-value. Kleibergen-Paap rk Wald statistic is used for the F statistics. * p ≤ 0.10, ** p≤0.05, *** p≤0.01.

In panel B, I assess municipalities excluding the decile for the municipalities with the highest cocoa production. In column (1), the FE2SLS indicates the increase of the PT vote share compared to the baseline estimation. As for the state governor, estimates indicate that the subsample is less responsive to the witches' broom than the baseline.

Finally, panel C presents the estimates by excluding the decile of the municipalities with the highest share of the rural population. In both the presidential and gubernatorial estimates, I find in column (1) that the FE2SLS exhibits a higher magnitude than the baseline estimation, while the latter presents a 14.9 p.p. increasing on PT's vote share, the former exhibits a sizeable effect of 17.8 p.p.. The other columns follows the same pattern of in the rise of the coefficient compared to the baseline estimates.

To gain a deeper understanding about the phenomenon, I examine the direct effect

Table 5: Effect of witches' broom on cocoa production and GDP

	1994	1998	2002	2006	2010
			Panel A: Cocoa production		
FE2SLS	146.7	-1459.5	-3936.5*	-3481.2*	-3644.2**
	(866.111)	(1584.999)	(2193.477)	(1864.108)	(1575.312)
N	192	192	184	186	186
			Panel B: Effect on GDP		
FE2SLS	4.779	-8.868	-5.537	-3.176	1.442
	(4.263)	(7.870)	(8.848)	(13.659)	(10.168)
N	192	192	184	186	186

Notes: GDP is measured by the per capita energy use. Control variables are: Share of women in population, Share of Rural population, GDP per capita, and Electoral year fixed effects. FE2SLS stands for Fixed effects two stage least squares. Robust standard errors in parenthesis. F-statistics for the first stage of the FE2SLS estimations are above 10. In brackets, the bootstrap's p-value. Kleibergen-Paap rk Wald statistic is used for the F statistics. * p ≤ 0.10, ** p≤0.05, *** p≤0.01.

of the plague on the cocoa production and on multiple socioeconomic variables that are potential transmission mechanisms for the electoral estimations. I discuss the following outcome variables: unemployment, poverty, inequality, rural population, school drop-out, and school discrepancy.

The first step for this goal is to evaluate the magnitude of the contamination on the cocoa production following Table 5. According to panel A, the FE2SLS estimator points to a decrease by 3,937 tons, 3,481 tons, and 3,644 tons from 2002 onward. I emphasize that those sizeable estimated impacts are related to the causal effect of the fungus. Other variables can positively affect the increase of the cocoa production, which is why the cocoa region still produces throughout the whole period. In panel B, I look at the fungus outbreak on the GDP per capita. I measure it with the per capita energy use, since the data is not directly available at that time. The FE2SLS does not capture the same movement, the estimates are not statistically significant.

In Table 6, I split the IV estimations into two: $FE2SLS_{President}$, which takes into consideration the election base in 1989, and $FE2SLS_{Governor}$ whose base election year is 1990. $FE2SLS_{Governor}$ estimates suggest that the witches' broom is responsible for a 2.7 p.p. increase in the unemployment rate in 2006. With respect to the poverty rate, I find evidence of a long-term decrease between 11-14 p.p. in 2006 and 9-13 p.p. in 2010, 1.2 p.p. and 2.8 p.p. in column (3). Considering the results on the inequality rate, the data are restricted to the short-term effect in 1998 and 2002. $FE2SLS_{President}$ estimator shows an increase of 2.7 p.p and 2.8 p.p., and in the $FE2SLS_{Governor}$ estimator of 3.3 p.p. in both periods.

I also assess the mechanism transmission on the social variables: the share of the rural population, the school dropout, and the school discrepancy. Considering the share of rural population, the estimates suggest a short-term reduction effect by 0.08 p.p and 0.13 in 1998 considering the presidential and gubernatorial time span respectively. In panel B, the point estimates are negative but not significant. Considering the school discrepancy, I also find no evidence statistically significant that the fungus caused any change on it.

The economic mechanism analysis reports a worsening on the following years after the witches' broom disease shows up in the cocoa region. The same occurs for the reduction of the rural population. That is, a rapid decrease of the share of rural population may be

Table 6: Economic mechanism

	1994 (1)	1998 (2)	2002 (3)	2006 (4)	2010 (5)
			Panel A: Unemployment		
$FE2SLS_{President}$		0.556	0.924	2.725*	2.163
		(2.133)	(2.331)	(1.575)	(1.410)
$FE2SLS_{Governor}$		-0.218	0.547	2.569	2.010
		(3.004)	(2.914)	(1.924)	(1.793)
			Panel B: Poverty		
$FE2SLS_{President}$		0.977	1.091	-10.990***	-9.253***
		(2.537)	(2.699)	(3.874)	(3.158)
$FE2SLS_{Governor}$		-0.840	-1.049	-14.013***	-12.590***
		(3.064)	(3.074)	(4.457)	(4.092)
			Panel C: Inequality		
$FE2SLS_{president}$		2.696***	2.793***		
		(0.945)	(1.013)		
$FE2SLS_{Governor}$		3.286***	3.347***		
		(1.157)	(1.147)		
N_{FE2SLS}		192	184	186	186

Notes: $FE2SLS_{Prsident}$ uses 1989 as the base year, and $FE2SLS_{Prsident}$ uses 1990. Control variables are: Share of women in population, Share of Rural population, GDP per capita, and Electoral year fixed effects. FE2SLS stands for Fixed effects two stage least squares. Robust standard errors in parenthesis. F-statistics for the first stage of the FE2SLS estimations are above 10. In brackets, the bootstrap's p-value. Kleibergen-Paap rk Wald statistic is used for the F statistics. * p ≤ 0.10, ** p≤0.05, *** p≤0.01

accompanied by collateral social factors deterioration such as the emergence of slums, the increase of violence rate, and drug consumption. It potentially explains why the local voters started voting more to PT. There are two feasible reasons for this electoral effect: (i) voters seeking an alternative to their own policy demands, and (ii) a protest vote.

5.3 Robustness checks

The robustness checks for the two-stage fixed effect least squares estimator are presented. The instrumental variable requires two hypotheses to capture the causal effect, namely, (i) the relevance hypothesis and (ii) the exclusion restriction. The first is directly testable by measuring the first stage, while the second can be indirectly evaluated by placebo tests. I run the reduced form on the PT's vote share and several socioeconomic variables in the 1989 electoral period, when the witches' broom affected only two municipalities in the cocoa region, and the 2SLS in 1989 to assess whether there is an evidence of a pre-treatment effect.

In Table 8, the reduced form in column (1) indicates that the instrument does not directly influence the dependent variable. In column (2), I run the structural equation in the pre-treatment period and find evidence that the treated group is systematically different than the control group, showing the necessity of an instrument as good as randomly assigned. In column (3) and (4), I run the placebo test by estimating the 2SLS in the pre-treatment period and imply that the interest variable, witches' broom, loses its effect. It indicates that

Table 7: Social effects

	1994 (1)	1998 (2)	2002 (3)	2006 (4)	2010 (5)
			Panel A: Rural population		
$FE2SLS_{President}$		-0.084**	-0.060	-0.077	-0.078
		(0.035)	(0.040)	(0.081)	(0.073)
$FE2SLS_{Governor}$		-0.128**	-0.082	-0.088	-0.098
		(0.053)	(0.052)	(0.088)	(0.081)
			Panel B: School dropout		
$FE2SLS_{President}$		-1.423	-2.077		
		(4.188)	(4.805)		
$FE2SLS_{Governor}$		-2.283	-2.578		
		(6.025)	(5.864)		
			Panel C: School discrepancy		
$FE2SLS_{President}$		0.153	1.120		
		(1.830)	(1.762)		
$FE2SLS_{Governor}$		-0.466	1.251		
		(2.485)	(2.275)		
N_{2SLS}	192	192	184	186	186

Notes: $FE2SLS_{Prsident}$ uses 1989 as the base year, and $FE2SLS_{Prsident}$ uses 1990. Control variables are: Share of women in population, Share of Rural population, GDP per capita, and Electoral year fixed effects. FE2SLS stands for Fixed effects two stage least squares. Robust standard errors in parenthesis. F-statistics for the first stage of the FE2SLS estimations are above 10. In brackets, the bootstrap's p-value. Kleibergen-Paap rk Wald statistic is used for the F statistics. * p ≤ 0.10, ** p≤0.05, *** p≤0.01.

the rainfall instrumental variable is as good as randomly assigned. Then, I include the control variables in Column (4), that is my preferred specification, for instance since it cleans any potential correlation between the rainfall and the GDP per capita, whose proxy is the electric consumption per capita.

I also verify the correlation between the instrument and the socioeconomic variables. In Table 9, I run the reduced form of several socioeconomic variables before the massive witches' broom spread, namely, income inequality, share of rural population, poverty, population density, suicide rate, school dropout, and school gap. All estimates have no statistical effect of rainfall on the list of variables.

6 Concluding remarks

This paper proposes to investigate the political impact of the witches' broom outbreak in Brazil's most productive cocoa region. I perform a quasi-experiment using both the difference-in-difference estimator and the instrumental variable from 1989 to 2010. The results suggest that the witches' broom contributes to the local cocoa production and it changes the voter behavior, according to the reward–punishment economic voting theory. Voters punished the president at that time by transferring the votes to the Workers' Party in a short-term movement. With respect to the governor's election, the results suggest the same movement:

Table 8: Placebo - Witches' broom on PT's vote share

Dependent variable	**PT's vote share**			
	OLS		2SLS	
	(1)	(2)	(3)	(4)
Rainfall	-0.003			
	(0.038)			
Witches' broom		-4.760**	-0.343	-2.958
		(1.983)	(3.779)	(4.907)
Control	No	No	No	Yes
First Stage Instrument				
Rainfall			0.010***	0.008***
Standard error			0.002	0.002
F statistic for IV in first stage			24.324	10.645
Anderson-Rubin test			0.93	0.56
N	98	98	98	98
Mean Dependent Variable	19.272	19.272	19.272	19.272
Std. Dev. Dependent Variable	10.285	10.285	10.285	10.285

Notes: Control variables are: Share of women in population, Share of Rural population, GDP per capita, and Electoral year fixed effects. Robust standard errors in parenthesis. Kleibergen-Paap rk Wald statistic is used for the F statistics. * p ≤ 0.10, ** p≤0.05, *** p≤0.01.

Table 9: Placebo test - Reduced form

	Inequality	Rural population	Poverty	Density	Suicide	Dropout	School gap
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rainfall	-0.015	0.001	-0.040	0.376	0.003	0.079	0.013
	(0.011)	(0.001)	(0.037)	(0.250)	(0.005)	(0.058)	(0.023)
N	99	99	99	99	99	99	99
Mean of dependent variable	10.66	0.49	0.49	59.23	0.87	51.82	62.82

Notes: Robust standard errors in parenthesis. * p ≤ 0.10, ** p ≤ 0.05, *** p ≤ 0.01.

the voters punished the incumbent's party persistently throughout the entire period analysed by giving a higher share of votes to the Liberal Front Party.

I find evidence that the voter behavior is more responsive among the municipalities with the highest GDP per capita, the most productive cocoa municipalities, and the municipalities with the highest rural population. I then examine in more detail the mechanism that can explain this behavior of electors. The findings indicate that the witches' broom has increased the unemployment rate, the poverty, the inequality, and the reduction of the rural population. The robustness checks suggest that the DID is not an appropriate estimator for studying the phenomenon.

References

Aguiar, P. C., Bruno-Lima, N., Moreau-Souza-dos Santos, A. M., and Fontes-de Oliveira, E. (2014). Evolução da ocupação e na configuraçao territorial do município de canavieiras, bahia, brasil. *Revista Geográfica de América Central*, 2(53):189–216.

Arvate, P. R., Mattos, E., and Rocha, F. (2015). Intergovernmental transfers and public spending in brazilian municipalities.

Bastide, P. M., Perret, C., and Bossard, L. (2007). Cocoa. *Atlas on Regional Integration in West Africa: economy series*, September:1–16.

Becker, S. O. (2016). Using instrumental variables to establish causality. *IZA World of Labor*, (250).

Bowers, J. H., Bailey, B. A., Hebbar, P. K., Sanogo, S., and Lumsden, R. D. (2001). The impact of plant diseases on world chocolate production. *Plant Health Progress*, 2(1):12.

Caldas, M. M. and Perz, S. (2013). Agro-terrorism? the causes and consequences of the appearance of witch's broom disease in cocoa plantations of southern bahia, brazil. *Geoforum*, 47:147–157.

Calle, H., Cook, A., and Fernando, S. (1982). Histology of witches' broom caused in cacao by crinipellis perniciosa. *Phytopathology*, 72(1479):81.

Campbell, J. E. (2010). The exceptional election of 2008: Performance, values, and crisis. *Presidential Studies Quarterly*, 40(2):225–246.

Duch, R. M. and Stevenson, R. T. (2008). *The economic vote: How political and economic institutions condition election results*. Cambridge University Press.

Elinder, M. (2010). Local economies and general elections: The influence of municipal and regional economic conditions on voting in sweden 1985–2002. *European Journal of Political Economy*, 26(2):279–292.

Fernandes, I. F. d. A. L. and Fernandes, G. A. d. A. L. (2017). A importância do crescimento econômico local na escolha do chefe do executivo no brasil. *Revista de Administração Pública*, 51:653–688.

Fraile, M. and Lewis-Beck, M. S. (2014). Economic vote instability: Endogeneity or restricted variance? spanish panel evidence from 2008 and 2011. *European Journal of Political Research*, 53(1):160–179.

Frey, B. S. and Schneider, F. (1979). An econometric model with an endogenous government sector. *Public choice*, pages 29–43.

Gasiorowski, M. J. (1995). Economic crisis and political regime change: An event history analysis. *American political science review*, 89(4):882–897.

Gourevitch, P. (1986). *Politics in hard times: Comparative responses to international economic crises*. Cornell University Press.

Hibbs Jr, D. A., Rivers, R. D., and Vasilatos, N. (1982). On the demand for economic outcomes: Macroeconomic performance and mass political support in the united states, great britain, and germany. *The Journal of Politics*, 44(2):426–462.

Junior, P. (2006). Agroterrorismo - petistas acusados de propagar praga do cacau.

Karyotis, G. and Rüdig, W. (2015). Blame and punishment? the electoral politics of extreme austerity in g reece. *Political Studies*, 63(1):2–24.

Kramer, G. H. (1971). Short-term fluctuations in us voting behavior, 1896–1964. *American political science review*, 65(1):131–143.

Lewis-Beck, M. S. and Paldam, M. (2000). Economic voting: an introduction. *Electoral studies*, 19(2-3):113–121.

Lewis-Beck, M. S. and Stegmaier, M. (2018). Economic voting. *The Oxford handbook of public choice*, 1:247.

Lewis-Beck, M. S. and Whitten, G. D. (2013). Economics and elections: Effects deep and wide.

Lima, S., Spaggiari, C., Patrocínio, N., Silva, R., Santos, R., and Gramacho, K. (2018). Favorabilidade, distribuição e prevalência da vassoura-de-bruxa do cacaueiro no estado do espírito santo. *Brasil. Agrotrópica*, 30:5–14.

Lindvall, J., Martinsson, J., and Oscarsson, H. (2013). Party choice in hard times: Group-specific responses to economic downturns in sweden. *Electoral Studies*, 32(3):529–535.

Martins, R. and Veiga, F. J. (2014). Does voter turnout affect the votes for the incumbent government? *European Journal of Political Economy*, 36:274–286.

Mascarenhas, G. C. C. (2004). A atual conjuntura socioeconômica e ambiental da região sul da bahia e a agricultura sustentável como uma alternativa concreta. In Uzêda, M. C., editor, *.). ODesafio da Agricultura Sustentável: alternativas viáveis para o Sul da Bahia*, chapter 1, pages 13–32. Editus, Ilhéus.

Nannestad, P. and Paldam, M. (1994). The vp-function: A survey of the literature on vote and popularity functions after 25 years. *Public Choice*, 79(3):213–245.

Oliveira, M. L. and Luz, E. D. M. N. (2005). *Identificação e Manejo das Principais Doenças do Cacaueiro no Brasil*. CEPLAC/CEPEC/SEFIT.

Pereira, J., De Almeida, L., and Santos, S. (1996). Witches' broom disease of cocoa in bahia: Attempts at eradication and containment. *Crop Protection*, 15(8):743–752.

Rangel, M. C. and Tonella, C. (2013). A crise da região cacaueira do sul da bahia/brasil e a reconstrução da identidade dos cacauicultores em contexto de adversidades. *Geoingá: Revista do Programa de Pós-Graduação em Geografia (PGE/UEM)*, 5(1):77–101.

Rattinger, H. and Steinbrecher, M. (2011). Economic voting in times of economic crisis. *German Politics*, 20(1):128–145.

Rocha, L. B. (2008). *A região cacaueira da Bahia – dos coronéis à vassoura-de-bruxa: saga, percepção, representação*. Editus.

Roodman, D., Nielsen, M. Ø., MacKinnon, J. G., and Webb, M. D. (2019). Fast and wild: Bootstrap inference in stata using boottest. *The Stata Journal*, 19(1):4–60.

Stock, J. H. and Yogo, M. (2002). Testing for weak instruments in linear iv regression. *NBER Working Paper*, (284).

Veiga, F. J. and Veiga, L. G. (2010). The impact of local and national economic conditions on legislative election results. *Applied Economics*, 42(13):1727–1734.