Drying Up Democracy? Extreme Weather, Clientelism, and Political Attitudes in Brazil and Mexico

Anthony Calacino*

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Abstract

Climate change is theorized to be increasing the frequency and intensity of weather across the world, and extant work shows natural disasters are important for violent and non-violent politics. In this study, I examine the impact of extreme weather events on public opinion regarding trust in politicians, governments, and democracy. Drawing on two surveys conducted in Brazil and Mexico, the study finds that extreme weather events have heterogeneous effects on communities depending on individual socioeconomic vulnerability and the degree of clientelistic governance. The study argues that extreme weather events lower trust in elections, as the distribution of resources becomes even more crucial in their aftermath. The study further reveals that where clientelism is dominant, extreme weather events cause non-vulnerable individuals to trust local governments less, while more vulnerable individuals come to trust local governments more. The findings suggest that drought is critical in explaining trust in elections and local government. The study's main contribution is its demonstration of the localized nature of extreme weather's effects, with attitudes regarding national political actors and governments being less significantly impacted due to closer linkages created by clientelism with local politicians.

*Ph.D. Candidate, University of Texas at Austin, anthony.calacino@utexas.edu

1 Introduction

Climate change is intensifying weather patterns across the world. Recent weather events like record-breaking floods in Brazil, wildfires in the Western United States, and heatwaves in Siberia are being attributed to a warming planet (Magnan et al. 2021). The rising trend of record-breaking and dangerous weather patterns has led to scholarly interest in the effects of climate change on politics. Extant work has indicated that extreme weather like drought affects conflict (Koubi 2019), but also non-violent politics like voting behavior (Bastos and Miller 2013; Cavalcanti 2018; Cole, Healy, and Werker 2011; Cooperman 2022), support for government investment to protect the environment and/or climate change mitigation spending (Baccini and Leemann 2021; Soni and Mistur 2022), and perhaps beliefs about climate change (Bergquist and Warshaw 2019; Howe et al. 2019; Konisky, Hughes, and Kaylor 2016).

There is increasing interest in the potential consequences of extreme weather on other political attitudes beyond climate opinion. Climate change intensification poses a great risk to political stability and perhaps even regime stability as more of the public come to be affected by extreme weather. While little is known about how intense weather affects public opinion, extant findings on natural disasters suggest there may be a companion crisis of democracy to the climate crisis (Carlin, Love, and Zechmeister 2014; Balcazar and Kennard 2022). Carlin et al. (2014) found that a major earthquake and tsunami in Chile led to lower trust in local governments and higher support for autocratic governance. In addition, in an unpublished study, Balcazar and Kennard (2022) found that extremely high temperatures also lowered support for subnational governments in India and decreased trust in the police. These studies suggest there are important, and as of yet, overlooked threats to political stability due to climate change. These concerns are also bolstered by theoretical working linking climate change to threats to democracy (Latour 2018; Mittiga 2022).

The general dearth of studies on extreme weather's potential consequences on political opinion serves as the motivation for this paper. There is a growing need to clarify the role of extreme weather's effect on general political attitudes. To do this, I also advance a theory about the effects of extreme weather on public opinion in the Global South. I argue that the public evaluate political leaders and governments based on their response to extreme weather, and two factors help explain the heterogeneous effects of extreme weather on public opinion: vulnerability and the degree of clientelistic governance. Vulernability refers to socioeconomic levels and social capital, and clientelistic governacne refers to the degree that local politicians exchange particularistic goods and services for political support (Hicken 2011). Together, vulnerability and clientelism determine the direction and magnitude of effects for important political attitudes after extreme weather. Counter-intuitively, I argue it is the non-vulnerable where clientelist governance dominatnes who have the most negative change in their political attitudes as they lose trust in elections and lose trust in local governments. The vulnerable under clientelistic governance will come to have more trust in local governments. Importantly, clientelism 'localizes' the issue of extreme weather such that are strong effects for local politics, but generally my argument expects the legitimacy about national political figures and national level governments to be less affected.

The persistence of clientelism in the Global South and Latin America (Nichter 2018) is important for considering extreme weather because patterns of clientelism determine how important resources - like water - are distributed. Extreme weather events act as windows of opportunity for governemtns to respond to urgent citizen demands. Clientelism creates less resilient systems of resource distribution such that if extreme weather causes scarcity, the government is less able to meet resource demands. Furthermore, because citizens as 'clients' have come to expect resources in exchange for their political support under clientelisitc exchanges, local governments have urgent needs to satiate the demands of a subset of their community who are politically necessary. The non-vulnerable are unlikely to receive resources during times of extreme weather because they have less need to turn to clientelism. As extreme weather causes demand for resources, even the non-vulnerable may come to solicit clientelist exchanges - however, scarcity and poor governance means governments cannot meet this new demand. As a result, these kinds of governments come to reward their previous 'loyal' clients. In brief, the non-bulnerable are shut out of getting important resources, and are likely to be indirectly and negatively affected by the less efficient response to extreme weather by clientelsitic governments.

In communities with more programmatic governance, the government is usually better able to respond to extreme weather. Furthermore, preexisting patterns of vulnerability tend to be reinforced when it comes to resource distribution. Yet, the vulnerable do not have the expectation of resource provision for political support, meaning their political attitudes are less affected by extreme weather. The result is that citizens (vulnerable or not) are unlikely to lose or gain confidence in political actors en masse, meaning effects on political attitudes in communities with more programmatic politics are likely to be neutral on average.

To test this theory and understand the effects of extreme weather on public opinion, this paper uses extreme rainfall and temperature data on public opinion in Brazil and Mexico. As middle-income countries with different levels of climate vulnerability and state capacity, a systematic analysis of these two countries can tell us much about the effects of extreme weather shocks as a result of climaye change. This paper makes use of two high-quality surveys: AmericasBarometer (2006-2019) and the 2012 Mexico Election Panel Survey which had two waves. The combination of two weather variables, two surveys, and two countries allows for a systematic analysis of the potential causal effects of intense climate events on public opinion. I employ two-way fixed effects models and a Differences-in-Differences (DID) approach in a quasi-experimental design for causal identification. I also employ multiple measures of clientelism for robustness and to avoid post-treatment effects.

Results from the analysis provide strong support for the argument, as extreme weather - especially drought - decreases trust in elections and municipal governments. Data from the AmericasBarometer show that citizens in communities where clietenlism is more dominant (measured by instances of perceived vote-buying) come to trust the municipal government less under extreme weather. I find there is a decrease of 15% in respondents' trust in municipal governments where extreme drought occurs and respondents report a high perception of vote buying. Neither the president, national government, nor democracy seem to lose legitimacy after extreme weather regardless of the degree of clientelism. These results suggests the risks of extreme weather are increased where clientelism is rampant, but at the same time, clientelism might create some action toward accountability by building community expectations of resource provision. These consequences are important for understanding new democracies in the Global South as climate change ratchets up the effects of extreme weather. This paper also makes important contributions to the literature on political accountability, as I show that clientelism may have short-term benefits for clients but short-term harm for non-clients. Yet, long-term outlooks suggest clientelism will lead to lower government capacity to respond to increasing disasters.

The paper is organized as follows. First, what proceeds is background on the relevant literature related to climate shocks and politics. Next, I describe the context of Brazil and Mexico regarding climate vulnerability and public opinion. Following is a presentation of the empirical strategy covering the collected data and chosen model. The subsequent section presents the novel argument in greater detail. I also present the data and results of the main data using AmericasBarometer and also present robustness tests using the 2012 Mexico Election Panel survey. The final section discusses the findings and pathways for future research.

2 Background

A consequence of human-caused climate change and average warming of the planet is the increased likelihood and intensity of extreme weather like floods and droughts, (Herring et al. 2015). Scholars have looked to explore the social consequences of extreme weather, and political scientists have asked if extreme weather affects politics from conflict to elections. The consensus is that extreme weather affects a variety of political outcomes ranging from violent conflict (Koubi 2019; O'Loughlin et al. 2012) to opinions about climate change.

Political scientists have devoted extensive attention to the effect of extreme weather on elections, which as a function of public attitudes is important in understanding potential effects for political attitudes. Nearly every major study has found a negative effect of abnormally dry or wet weather on incumbent vote shares (Achen et al. 2017; Bastos and Miller 2013; Cavalcanti 2018; Cole, Healy, and Werker 2011; Cooperman 2022; Oliver and Reeves 2015; Gasper and Reeves 2011). Scholars have theorized that voters act retrospectively in the wake of extreme weather, even though politicians have no control over what they are being blamed for. Many studies conclude that weather has a direct and causal effect on electoral outcomes. However, research has also discovered that how governments respond to disasters can mediate the impact of natural disasters, which contradicts the 'direct' effect hypothesis. If governments give disaster aid, voters have been found to reward them at the polls (Bechtel and Hainmueller 2011; Cole, Healy, and Werker 2011; Gallego 2018). Bechtel et al. (2011) find that the electoral rewards after disaster aid generally outweigh the negative effects of extreme weather, and this effect is persistent over several electoral cycles. Yet, in some political contexts, disaster aid is used to further political ambitions instead of providing relief to those in need. Gallego (2018) argues that disaster aid is used to buy votes in Colombia and strengthen clientelist linkages to voters. Additionally, Cooperman (2022) shows that in Brazil, disaster aid is sometimes declared where there are no disasters, indicating this aid may be leveraged for political gain. The findings on disaster aid point to various potential effects on voters, especially in policies with legacies of clientelism and higher rates of corruption.

Increasingly more studies are examining public opinion and if weather affects support for environmental policies. For example, policies designed to protect the environment often include costly infrastructure projects or regulations for various industrial sectors. Several studies have found voters are more supportive of burdening the costs of environmental policies in the aftermath of extreme weather events (Baccini and Leemann 2021; Hazlett and Mildenberger 2020; Soni and Mistur 2022). Hazlett and Mildenberger (2020) show that a particularly intense year of wildfires in California increased the propensity for some voters to approve more climate-mitigation spending in the state, however, the effects were only significant for those who identified with the Democratic party.

There is also growing interest in understanding how extreme weather affects climate opinions, which are opinions that are directly related to beliefs about climate change. The theoretical framework is often referred to as realism, which suggests that physical changes in one's environment cause an update in beliefs about weather systems and climate change. In a meta-study that examined over 70 papers on climate opinions, there were conflicting findings and an elusive consensus on whether extreme weather impacts climate opinion (Howe et al. 2019). Others have turned to study the heterogeneous effects of weather on climate opinion (Bergquist and Warshaw 2019; Konisky, Hughes, and Kaylor 2016). The type of disaster, media coverage, partisanship, and contextual factors are identified as vital conditions that determine if and how weather events impact changes in public opinion (Boudet et al. 2020). Indeed, Howe et al. (2019) find that which weather measure is used - specifically if studies operationalized precipitation or temperature - led to different effects on climate opinions.

Even though climate opinion would seem theoretically approximate to extreme weather, the mixture of evidence raises doubts about the so-called 'realist framework' that links climate change's proximate effects to opinion change. At the same time, climate opinion might be unique and resistant to change because it is highly polarized in many countries (Falkenberg et al. 2022). It is thus unclear if climate opinion is a special case of general public opinion that extreme weather may affect, or if all public opinion is subject to strong moderating factors. Analyzing other political attitudes, as this paper aims to do, can help shed light on whether climate opinion is indeed a special case.

Research on non-climate public opinion is still emerging, but extant studies provide evidence of strong effects on political trust and democratic norms. In a working paper that addresses non-climate public opinion, Balcazar and Kennard (2022) found that extremely high temperatures lowered support for subnational governments in India, lowered trust in the police, and increased intra-community cooperation to collect water. Despite the strong panel survey research design, this study does not address many important questions about public opinion and extreme weather. First, the authors only use temperature data and thus these results cannot account for possible precipitation events. Also, the study relies exclusively on one country, meaning there may be limits to external validity. The study also does not address questions related to democratic norms.

Carlin et al. (2014) examined democratic norms in disasters by looking at the 2010 Chile earthquake and accompanying tsunami. While the earthquake was not related to climate change, this type of exogenous event and accompanying tsunami give a good snapshot into the potential effects of extreme exogenous weather events. The authors find that these paired natural disasters led to lower trust in local governments and higher support for autocratic governance, but trust in the president did not seem to change as a function of the earthquake's maximum magnitude near survey respondents. The authors also found more support for political coups, autogolpes, and increased political participation. Additionally, the results showed a decrease in political tolerance. These results indicate exogenous disasters might have a depressive effect on political trust and democratic attitudes. However, these results might be unique to a disaster like an earthquake, which is relatively rare when compared to extreme weather patterns.

The proposed effects on democracy have been the focus of theoretical interest. Mittiga (2022) connects security concerns as a result of climate change to weakened support for democratic institutions and norms. The public are expected to be more concerned about climate change, more affected by it, and more critical of their governments for failing to ensure their safety and security. The scale of the climate crisis is likely to spread government resources thin and weaken state capacity too. The expected result is that increasing existential insecurity after natural disasters will generate more tolerance for limiting individual freedoms and democratic norms to protect physical security. That is, the public will come to accept the infringement of democracy in the pursuit of security.

While this framework provides a good starting point for thinking about the effects of climate change on democracy, several points deserve to be challenged. First, it is not clear why citizens claim democracy is accountable for the threat that climate change poses to their lives and communities. It is also not clear why failing to address climate change would create a legitimacy crisis for democracy. It might make sense that extreme weather decreases satisfaction with democracy, such as economic performance has been shown to do (Christmann 2018). In times of low economic performance, the public may be outraged about democracy's inability to guarantee prosperity, but public sentiment rarely turns against democracy as an ideal. In other words, people may grow dissatisfied with democracy during times of crisis, but the preference of democracy to other systems tends not to be affected all that much.

The effect of extreme weather on pro-authoritarian views might also be active through a crisis effect which can create anger and fear, and lead to a desire for a strong leader (Córdova and Seligson 2009). Other studies have found a relationship between crises and support for populist politics that tend to feature strong exectuvies who care little for institutional checks and balances (Moffitt 2015; Weyland 2020). Populists and pro-authoritarian leaders can use these crises and present restrictions on their powers as hindering solutions. Crises can thus be used to convince the public to increase the political leader's power, which may come to threaten democracy. In other words, extreme weather as a result of the climate crisis may be useful crises that populists can seize upon to increase power. Yet, this type of environmental populism seems far-fetched given the reality that most modern populists are right-wing and tend to shun environmental policies. Indeed, populism is linked to worse environmental performance (Böhmelt 2021).

Others have argued the climate crisis does not affect politics and public opinion in such a direct and 'realist' way, instead advocating for heterogeneous effects and complex social moderators (Latour 2018). In summarizing the emerging debate about the fate of democracy in the climate crisis, there is elusive consensus and limited empirical studies.

The literature covering extreme weather and public opinion is small and emerging, yet important questions arise from the extant discourse. Primarily, it is unclear why only subational governments face threats to their legitimacy after disasters, yet there are indications that the head of government may be spared. It is also unclear if democratic attitudes are shaped by events other than earthquakes, and which attitudes about democracy might be affected. Finally, we do not know if one type of extreme weather (e.g., precipitation or temperature) plays a more important role in shaping public opinion. This papers attempts to address these questions and clarify if there are effects of extreme weather on public opinion. In the next section, I propose a new theory to link extreme weather to certain change sin public opinion with an empahiss on new democracies in the Global South.

3 Theory & Hypotheses

I present a new argument for how extreme weather could impact public opinion relevant to political stability in the Global South. Primarily, I argue that voters do behave retrospectively with extreme weather, and that effects on public opinion are mostly the result of if and how governments respond to disasters. Yet effects are heterogeneous and I argue that two factors are important in mediating the consequences for political attitudes: vulnerability and the extent of clientelistic governance. Briefly, my argument expects that under more clientelistic governance, the vulnerable will have *more* positive views of local politics, and that the *less* vulnerable will have more negative views of both local politics and elections. Under more programmatic governance, public opinion is unlikely to change on average and that the differences in opinion between levels of vulnerability are less profound.

My argument starts by assuming that extreme weather introduces more demand for resources but also decreases local government's capacities to provide these resources. At the same time, extreme weather increases government control of distribution through emergency measures (e.g., legally binding disaster declarations). As extreme weather worsens, governments and politicians will have to decide how important resources are distributed. I assume that governments with more programmatic politics tend more efficiently distribute resources in general. Programmatic politics means politicians compete for votes rather than condition the provision of goods and services for political support (Hicken 2011).

Yet, governments with more programmatic politics will still have to selectively give resources if demand is greater than the supply due to scarcity introduced by extreme weather.

Under such cases, the already vulnerable are less likely to receive resources. Poorer neighborhoods and more rural communities have less infrastructure and less political power, making it more feasible and politically easier to divert services to wealthy neighborhoods. This was the case with a mega drought that struck the city of São Paulo in 2014 (Cohen 2016), where income levels explained who was spared water shutoffs. São Paulo city is considered to have mostly programmatic politics with party competition being quite strong. Investigations into the drought revealed that lackluster infrastructure in lower income neighborhoods was the main factor behind water shut-offs that rarely occurred in wealthier parts of the city. Similar patterns in disaster response have been found in Mexico with flooding (Coates and Nygren 2020), where marginalization was reinforced by extreme weather.

When extreme weather strikes areas with more programmatic governance, residents are likely to have mixed views about government performance. Those who receive assistance or are spared the worse effect of an extreme disaster are likely to have more positive views of their politicians, government, and the quality of the political system. Those who do not receive as much assistance or attention are likely to have negative views; yet, because preexisting patterns of vulnerability and privilege generally explain government response, public opinion is more static. In this way, extreme weather reinforces skepticism of the government in vulnerable communities, but is unlikely to increase skepticism significantly. The resulting effects of this process are that attitudes towards political figures and governments are, across the whole community with more programmatic governance, likely to be near zero or very small where programmatic governance dominates.

Effects are likely to be quite different in communities where clientelistic governance dominates. Clientelism is the exchange of particularistic goods and services for political support (Hicken 2011). Clientelism tends to be a feature of specific towns and cities, such that history matters for which communities experience clientelism (Bustikova and Corduneanu-Huci 2017). In communities where clientelism is dominant, the weather has similar initial effects as in settings with more programmatic politics: increasing resource demands and scarcity, as well as increasing government control of such resources. Unlike programmatic communities, however, it is likely many among the vulnerable have traded political support for the delivery of certain goods and services (e.g., water and electricity). For example, many communities rely on clientelistic exchanges for access to clean drinking water and connection to sewage systems (Herrera 2017). Individuals can offer their votes or public displays of support (Nichter 2018). Other goods leveraged by incumbents for political gain include food, access to some government welfare programs, and inclusion in disaster relief (Cooperman 2022).

These clientelistic exchanges generally mean the overall system of resource distribution is worse off when extreme weather strikes, as clientelism inhibits good governance, and generates disincentives for investing in infrastructure and good crisis management (Herrera 2017; Lo Bue, Sen, and Lindberg 2021). Despite the likely inefficiencies in disaster response as a result of clientelistic governance, political actors - especially mayors - will have urgent needs to use what little resources they have to maintain their bought political base. Political actors will try to divert resources to their citizen clients. Clientelism creates interdependence between clients and politicians that are almost always exploitative to citizens and beneficial to politicians. Yet, extreme weather might impose certain conditions such that citizens have a slight upper-hand in clientelistic exchanges.

This pattern of distribution is a detriment to other citizens in the community. In fact, the non-vulnerable are likely to see this type of government response as a rigging of elections. Such an effect is likely to be strong either because the non-vulnerable are more educated and thus more aware of the pitfalls of buying votes instead of addressing root issues of poor governance during disaster, or because they are not receiving scarce resources. There is also the chance vulnerable individuals who did not engage in clientelistic exchanges come to do so. These individuals are likely to see elections as less fair too, so that clientelism decreases trust between the vulnerable and non-vulnerable. Furthermore, it is unlikely that the vulnerable who are likelier to receive benefits, will come to have more faith in elections - their views on elections (regardless of governance type or extreme weather) are unlikely to change. This leads to the first hypothesis of this paper:

- H1: Extreme drought will decrease trust in elections.

To explore the effect on elections in greater detail, I turn to looking at how distinguishing between the vulnerable and non-vulnerable will reveal other impacts on political trust. The non-vulnerable might be unlikely to receive resources because in extreme cases, politicians will strictly prioritize their electoral base. The result is that the vulnerable might have more positive views of local political actors, whereas the non-vulnerable will have less positive views of political actors and elections. There is an emphasis on the local because clientelism creates tight linkages between communities and their leaders, and when communities feel their clientelistic exchanges cannot be fulfilled, they drop their political support. Such effects are not expected to be strong for more national political figures and government levels, though it is worthwhile to test hypotheses at the national level. This is also in line with some previous findings that the national executive does not face a loss of public trust after extreme natural disasters (Carlin, Love, and Zechmeister 2014).

- H2: Extreme drought will decrease trust in municipal governments when clientelistic governance is more prevalent.
- H3: Extreme drought will decrease trust in the president when clientelistic governance is more prevalent.
- H4: Extreme drought will decrease trust in the national government when clientelistic governance is more prevalent.

Next, I turn to several hypotheses related to democracy. In general, my argument does not make specific expectations about democratic attitudes. This is because of the heterogeneous effects of extreme weather and the dynamics between clientelism and democracy. Also, as discussed in the literature review, it is not clear why climate change is a unique threat to democracy compared to inequality, economic under performance, and low development are not. In short, my argument expects very little effects outside of local politics and election.

Neither attitudes regarding the quality nor ideal of democracy are likely to be affected. Still, I test the following hypotheses:

- H5a: Extreme weather will decrease support for democracy as an ideal among those more affected by clientelism.
- H5b: Extreme weather will decrease satisfaction with democracy among those more affected by clientelism.

Up to now, my argument does not differentiate between extreme weather events. But, there are theoretical reasons to expect that precipitation and temperature may have different effects. I expect that the most important extreme weather event is drought. This is because drought directly causes resource scarcity affecting communities of both programmatic and clientelistic politics. Flooding has the potential to affect communities, and governments will clearly need to distribute some resources, yet there is no direct effect on the supply of resources. Extreme temperatures clearly create indirect effects on resource availability. Extreme temperatures also pose a direct threat to humans and their public opinion about politics, but alone, temperatures are unlikely to constitute events that negatively affect public opinion. This is because, unlike drought, temperature affects an entire community, and governments are usually not in a position to decide who receives help - there is often little governments can do to help whereas in drought, governments can deliver water. Temperatures might reduce electricity provision if demand outstrips supply and the grid crashes. In this case, public opinion might be effected and explained by a similar logic that I have described. Yet, heat waves capable of affecting grid stability on entire cities are still quite rare compared to droughts.

4 Context: Brazil and Mexico

Brazil and Mexico are two middle-income countries with large territories that encompass a variety of different climates and biomes. Both countries are generally considered democratic, though with serious flaws and until the 1980s in the case of Brazil and the 1990s in the case of Mexico, both experienced long periods of authoritarian rule. These two countries share other political similarities, such as corruption and clientelism being present. Clientelism is not a universal political experience in these countries; indeed it is thought to be historically rooted and occurs in certain communities that tend to be rural and generally affect the poor (Bustikova and Corduneanu-Huci 2017; Hidalgo and Nichter 2016). Both Brazil and Mexico have implemented a variety of electoral rules and safeguards to limit traditional vote buying, like strong protections for a secret ballot (Nichter 2018) or programmatic aid like Conditional Cash Transfer programs. Yet, clientelism continues to prosper, as voters can trade other types of political support for services and goods such as public displays of support. In exchange, voters receive particularistic benefits like food or connection to city services like water and electricity. As such, clientelism continues to prosper in isolated communities and areas of large municipalities throughout both countries.

When it comes to climate vulnerability, Brazil and Mexico are found to be in the middle of most countries as neither extremely vulnerable nor having scores of low vulnerability (Edmonds, J. Lovell, and C. Lovell 2020). Vulnerability is more widespread in Global South countries, especially where inequality is high. This is true both from an economic welfare standpoint and also in terms of the threat to welfare caused by climate change (Cruz and Rossi-Hansberg 2023). Cruz and Rossi-Hansberg (2023) find that Latin America and Sub-Saharan Africa face the greatest threats to welfare as climate change intensifies. While there is some disagreement among different indices (Burck et al. 2022; Chen et al. 2015), Mexico seems to be more vulnerable than Brazil across all measures of cliamte vulnerabiligy. In terms of deaths attributed to natural disasters (of all types), since 1960 Brazil's estimated annual deaths were anywhere between a few dozen to over 1000 (Ritchie, Rosado, and Roser 2022). Mexico's range was estimated to be smaller, with a maximum being at about 800 but with comparatively fewer disaster deaths each year than Brazil. The variation in climate vulnerability enables this study to better address the debate about the conditions under which extreme weather may influence public opinion, as well as make this study more generalizable.

Climate vulnerability is moderated by development and state capacity; that is, communities are only so vulnerable if the level of development and state capacity is weak. Brazil and Mexico are complicated cases due to inequality within the countries. Both the Brazilian and Mexican states have the considerable capacity, but this capacity is uneven. Also, depending on the strength of a disaster, even areas with relatively high measures of state capacity might suffer serious effects. However, given the difficulty of calculating subnational state capacity (Harbers 2015), it is difficult to know which areas within these two countries can better withstand extreme weather, receives faster assistance, and can recover more quickly. Yet, as my argument makes clear, the prominence of clientelism is likely to play an important role in moderating vulnerability. Thus, while it is beyond the scope of this paper to test for state capacity, it is well noted that there is considerable within-country variation. Though, inequality tends to mean that regardless of the state's ability to assist the vulnerable, it is the wealthier and more privileged who can take advantage of the state's resources most often.

4.1 Drought in Mexico 2012

The secondary analysis in this paper examines responses to the 2012 Mexico Elections Panel survey, which coincidentally occurred in the middle of one of Mexico's most extreme droughts in recorded history.[1] Along with large parts of the Western and Southwestern U.S., hundreds of cities in central and northern Mexico struggled under intense drought conditions that fluctuated between 2011 and 2013. The drought led to a severe loss of livestock and hit farms especially hard. The Mexican Federal government responded to the disaster with the help of aid organizations and local authorities (Ortega-Gaucin, Pérez, and Cortés 2016). Many municipal governments solicited much disaster aid during the drought, which

[1] Reuters article

strained national resources. Federal and local authorities also organized water and food delivery through trucks sent to various communities. However, there were challenges such as the lack of coordination between emergency services and welfare agencies as well as gaps in who received the disaster response (Ortega-Gaucin, Pérez, and Cortés 2016). Leveraging the 2012 Election Panel Study will help reveal how public opinion changed in response to such extreme drought conditions in the country.

5 Empirical strategy

The empirical strategy in this paper aims to set up a quasi-experimental design to test the causal effects of exogenous weather on public opinion at a granular level in Brazil and Mexico. To do this, I deploy a two-way fixed effects model on 2006-2019 AmericasBarometer data with municipal and month-year fixed effects with standard clustered errors at the municipal level. However, there is recent concern that a two-way fixed effects model can produce biased estimates and that this model does not actually approximate a design-based method of causal inference (De Chaisemartin and d'Haultfoeuille 2022; Imai and Kim 2021). However, proposed solutions to this problem - particularly a multiple periods Differences-in-Differences (DID) design with an estimator for heterogenous treatment effects (Callaway and Sant'Anna 2021) - are not suitable for the data format in this analysis. This is because AmericasBarometer is not a true panel, as observations are from individuals surveyed only once, though municipalities are revisited over survey waves. Furthermore, "treatment" is ambiguous in the case of extreme weather, as it is important to compare the effects of flooding versus drought to normal conditions.

To address causal identification concerns and expand this analysis, I also use a two-period DID model on the Mexico Election Panel of 2012 for robustness. The benefit of the Mexico Panel is that the same individuals are surveyed twice over three and a half months, indicating a true panel. Furthermore, the study is limited to two periods and no extreme floods or freezes occurred between the two waves. Thus, the treatment is less ambiguous: municipalities are treated if they experience extreme drought or experience extremely high temperatures. 36 of the 67 cities in the Mexico Panel experienced extreme drought in one of the two waves. 10 of these cities went from having normal conditions to drought conditions between the waves, while another 26 went from having drought to normal conditions. This design is much closer to an ideal DID approach and can provide better estimates than the AmericasBarometer analysis.

5.1 Models

The main analysis in this paper is based on a two-way fixed effects (FE) model on survey data from the AmericasBarometer. To measure how extreme weather moderates evaluations of government with where clientelism dominates, I also propose an interaction effect. The following model is implemented to estimate the various dependent variables y:

$$y_{i,t,c} = x_{i,t}\beta + \gamma * Precip + \omega * Temp + m_i + k_t + j_c + \epsilon_{i,t}$$

Where $x_{it}\beta$ is the set of coefficients and estimates, and m_i are the unit fixed effects and k_t are the time fixed effects so that $i = 1, ..., N$ and $t = 1, ..., J$. j_c is the country fixed-effect. Additionally, for the moderating model:

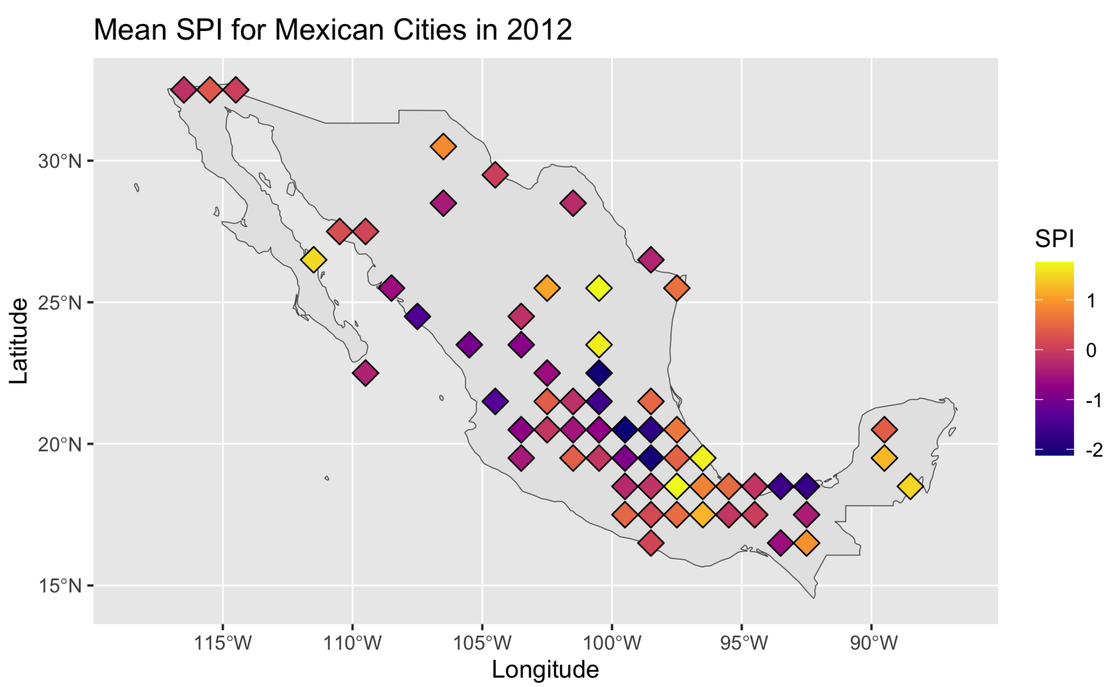
$$\begin{aligned} y_{i,t,c} = x_{i,t}\beta + \gamma * Precip + \omega * Temp + \zeta * Clientelism \\ + \theta * (Precip * Clientelism) + m_i + k_t + j_c + \epsilon_{i,t} \end{aligned}$$

The Mexico Panel differences-in-differences (DID) model is as follows where $x_{i,t}\beta$ refers to the set of control variables, and the term of primary interest is captured by $\zeta * (wave * Precip)$ where $Precip$ is a binary measure of whether a municipality went from having normal conditions in period 1 to drought conditions in period 2.

$$y_{i,t} = x_{i,t}\beta + \theta * wave + \gamma * Precip + \omega * Temp + \zeta * (wave * Precip) + \epsilon_{i,t}$$

5.2 Data

To measure weather, I use the Standardized Precipitation Index (SPI), a product of the Global Precipitation Climatology Centre (**schneider2011**). This data produces local 3, 6, and 12-month precipitation trend measures for each month of the year at a granular level of a 1 by 1 coordinate grid that spans the globe. The measure is adjusted for a local historical average so that an SPI measure in Mexico can be compared to an SPI measure in Brazil. Negative values indicate drought conditions compared to local average, and positive values indicate extreme rainfall and floods. This is very important, as many previous studies of extreme weather fail to adjust for local averages (Howe et al. 2019). SPI is produced for each coordinate pair. To illustrate this measure, means for monthly SPI in Mexico are plotted for the year 2012 below to give a sense of the range of values. Each point corresponds to a city that has respondents from the AmericasBarometer survey in that year.



The 6-month SPI has been used in other political science research and is considered a good blend measure of short and long-term drought (Cooperman 2022). Droughts are compound events, where the longer a region goes without precipitation, the more severe drought is considered. This means that a region can go from normal to dry conditions to having an extreme drought in as little as several months, and the opposite case is true for extreme flooding.

I also deploy temperature anomaly data from National Oceanic and Atmospheric Administration (NOAA) (**jones1999**). Similar to SPI, the temperature anomaly produces a local value based on a historical reference period so that measures can be compared across place and time. However, unlike SPI, the temperature is not based on a previous set of months and is instead current to around the month's measurement, thus in the analysis the temperature measure is lagged. The NOAA temperature anomaly data is available on a 2 by 2 global grid.

Like the SPI, temperature measured are centered around 0, so that more positive values indicate hotter temperatures. Negative values indicate colder temperatures.[2] This type of measure means that a value of 1 or -1 is one degree C away from a local's norm weather. To operationalize both precipitation and temperature, a factor variable was created to indicate extreme drought if precipitation was below -1, and extreme flooding if precipitation was above 1. This is in line with conventions that tend to argue that 'moderate' drought and flooding generally begin at scores of one standard deviation from 0. Extremely high temperatures correspond to those values above 1 and extremely low temperatures correspond to those values below -1.

The public opinion data used in this analysis comes from the AmericasBarometer[3] survey and the 2012 Mexico Elections Panel (Lawson 2013). The AmericasBarometer is ideal because it has a range of questions related to various aspects of politics, like trust in democratic institutions and politicians. The survey has run a wave in Brazil and Mexico every two to three years (accessible data begins with the 2004 wave in the case of Mexico, and 2006 in

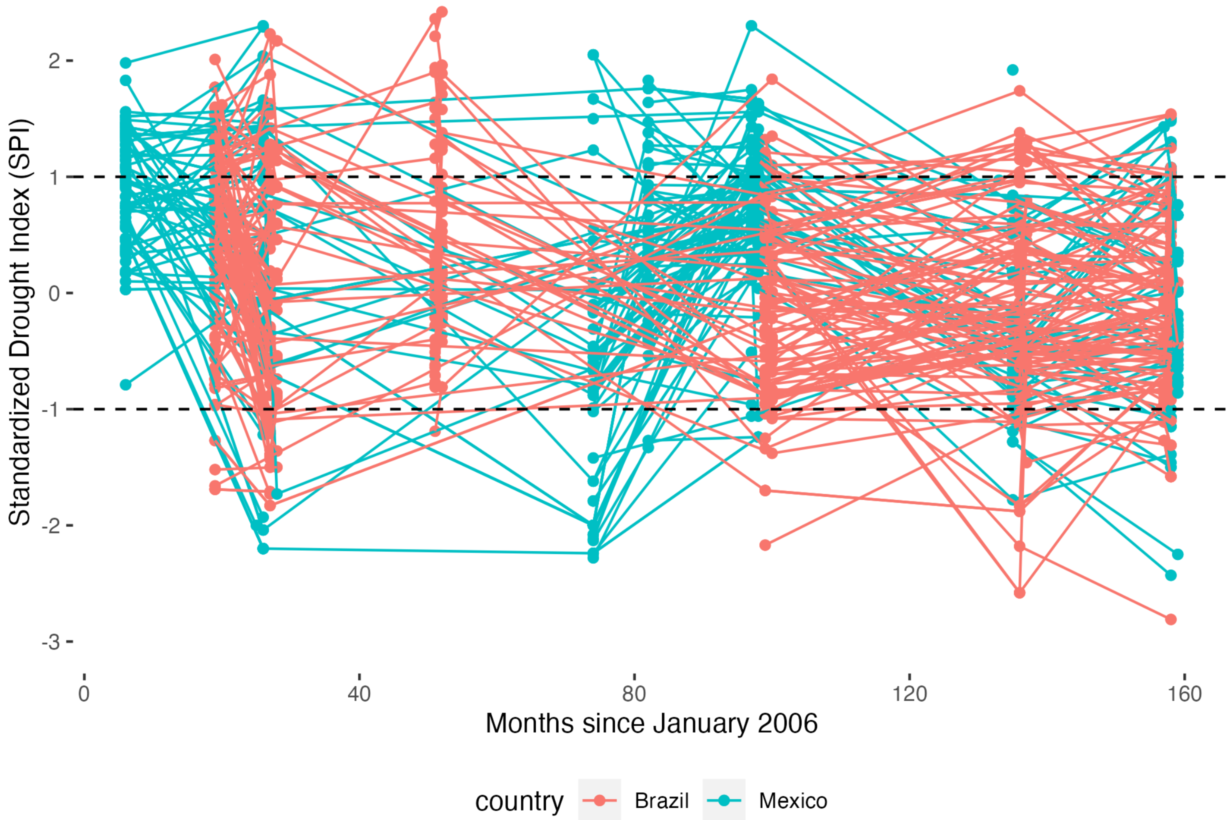
[2]To visualize extreme weather in the Mexican and Brazilian cities surveyed, please see the Appendix.
[3]The AmericasBarometer by the AmericasBarometer Lab, www.vanderbilt.edu/lapop

the case of Brazil). However, there are only some years in which the date of the interview was recorded, so certain waves cannot be used for a month-year analysis that is necessary for weather. A granular time scale is necessary because weather shocks are thought to have effects that diminish quickly over time. It also took a lot of data wrangling to standardize locations of interviews.[4] Also, not all questions are repeated from one wave to the next, and municipalities are not always revisited in subsequent waves.

Cities were geocoded to match to the grid coordinates of weather data.[5] For an overview of the AmericasBarometer data, below I plot each municipality with the exogenous SPI weather value for each month going back to 2006. Lines connect the same municipality if it was included in the survey in subsequent waves. Some waves were conducted in consecutive months (e.g., March and April) meaning there can be weather data variation between close points.

[4] I think Dr. Elizabeth Zachmeister at AmericasBarometer for help with decoding location codes.

[5] A Python script that used the Open Street Map API was used to geocode cities.



To measure clientelism, I take two approaches. The first approach uses a survey question that asks if an individual knows someone who accepted a gift in exchange for a vote in the previous national election. This measure tends to be clustered so that specific communities over time have higher incidences of clientelism. Also, it is unlikely the vulnerable who engage in clientelism respond to this question because of social desirability bias - instead it is likely the less-vulnerable who do not have any need to turn to clientelism respond to this question positively. In short, this is a measure of where clientelism occurs according to the the less-vulnerable. A regression analysis (see appendix) shows that those with higher income, education, and left-leaning political views are more likely to respond positively to this question (income, education, and ideology are significant to $p < 0.05$).

An important issue with this measure of clientelism is that it may introduce post-treatment effects into the analysis. Post-treatment effects are concern for variables who are caused by the treatment and affect the outcome of interest, thus deviating from ideal experimental conditions (Montgomery, Nyhan, and Torres 2018). I conceptualize of clientelism as a moderating variable, but Montgomery, Nyhan, and Torres (2018) are clear that a moderating variable should only be used in the statistical analysis of an experiment (or quasi-experiment) if it is unaffected by the treatment.

Even though the responses clientelism question in the AmericasBarometer should be unaffected by current weather events (the question refers to events four years in the past), I use a second approach to measure clientelism by focusing on Brazil that cannot introduce post-treatment effects. Research on vote buying and Brazilian elections has revealed that extremely high turnout rates are correlated with inflated voter registries and incumbent win reversals (Hidalgo and Nichter 2016). At 80% municipal turnout to population, Brazil's electoral authority (Tribunal Superior Eleitoral, TSE) conducts an automatic audit of local elections, Hidalgo and Nichter (2016) exploit this threshold with a Regression Discontinuity Design and find that the chance of incumbency decreases 18% if an audit is is conducted, and over 1900 votes on average are removed from tallies. This means that electorate rates near 80% of local population are likely indicative of clientelism (especially the kind in which politicians bus in voters from nearby municipalities). I use turnout as a percentage of district population from the last election (two years prior) to proxy the likelihood of clientelism. The appendix includes a graph showing the distribution of this measure such that extremely high turnout occurs over a wide range of populations. Such a distribution indicates irregularities. Furthermore, to better isolate those likely to participate in clientelism and those not, I use an interaction term with years of education. This variable should also not be prone to post-treatment effects, whereas another variable that proxies vulnerability - like income - might be affected by extreme weather. The expectation is that more educated individuals in communities with turnout rates near 80% of the population should be similar to the individuals who respond affirmatively to the AmericasBaromter clientelism question: less-vulnerable individuals in more clientelistic prone communities.

5.3 Survey Balance

Here I address questions about the balance of the quasi-experimental analysis at the center of this paper. Specifically, a concern of natural or quasi-experiments is the lack of control researchers have over randomly administering which units belong to the treatment and control groups. In this study, nature decides which municipalities and when experience extreme precipitation or temperature events. Below, I present a table of the general demographic statistics of those individuals in the AmericasBarometer survey in municipalities which eventually became treated by experiencing extreme drought or experiencing extreme floods. The demographic statistics confirm respondents exposed to extreme weather were virtually identical to those who experienced normal conditions.

	Normal		Drought		Flood	
	Mean	SD	Mean	SD	Mean	SD
age	39.82	16.14	39.86	16.03	40.81	16.48
gender	1.50	0.49	1.50	0.50	1.51	0.49
ideology	5.57	2.57	5.42	2.65	5.61	2.51
urban	0.82	0.37	0.79	0.35	0.83	0.35
respondents	10451		1391		3004	

A similar summary of the panel balance for temperature extremes is below. Besides the “Freeze" measure (which occurs in very few cities), the samples are fairly identical.

	Normal		Freeze		Scorch	
	Mean	SD	Mean	SD	Mean	SD
age	40.31	16.37	40.88	16.99	39.79	16.04
gender	1.50	0.49	1.51	0.50	1.50	0.49
ideology	5.86	2.56	7.64	2.88	5.47	2.57
urban	0.80	0.39	0.80	0.00	0.842	0.36
respondents	6758		54		8993	

6 Main Results

Models 1-3 below present results of the effects of weather shocks on trust in elections in Brazil and Mexico.[6] Drought refers to areas with SPI below -1, Flood refers to areas with SPI above 1, Freeze refers to areas with temperatures below -1, and Scorch refers to areas above 1 degree. For the surveys in which the question about elections was asked, no municipalities experienced extreme temperatures below a -1 anomaly. This means the variable for freezing temperatures could not be included. The results are consistent across all specifications: drought in particular has a negative and significant ($p < 0.05$) effect on trust in elections. The addition of control variables and fixed effects leads to an increase in the size of the estimated direct effect. In general, these results support rejecting the null-hypothesis for H1.

[6]The dependent variable is a combination of AmericasBarometer question B47 (pre-2012) and B47a (post-2012).

Dependent Variable:	Trust in Elections		
Model:	(1)	(2)	(3)
Variables			
Constant	3.682***		
	(0.0260)		
Drought	-0.1752***	-0.2143**	-0.2872**
	(0.0529)	(0.0993)	(0.1120)
Flood	0.2700***	0.0568	0.0636
	(0.0379)	(0.0803)	(0.0880)
Scorch	-0.0348	0.1949**	0.1138
	(0.0312)	(0.0932)	(0.1013)
Controls	No	No	Yes
Fixed-effects			
District		Yes	Yes
Month_year		Yes	Yes
Country		Yes	Yes
Fit statistics			
Observations	16,131	16,131	12,517
R^2	0.00471	0.14222	0.17534
Within R^2		0.00122	0.02390

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Controls include: a continuous measure of ideology, gender, age, education, and whether dwelling of respondent is in an urban or rural setting.

As a robustness check of the results from the AmericasBarometer data, I also conduct a similar analysis on the 2012 Mexico Panel Study (Lawson 2013). This election panel study interviewed close to 3000 individuals several months before and after the 2012 Mexican General Election (wave one occurred in April, and wave two occurred in late July). Respondents in the first wave were subsequently contacted in the second wave. This type of panel study allows for an analysis of how weather shocks changed individual opinion over time without aggregating to the municipal level (as is the case with the AmericasBarometer, which does not revisit the same respondents).

The Mexico Panel study included questions related to various aspects of politics, and importantly for this study, it included questions about elections, the president, and clientelism (vote buying prevalence). The wording of the questions is similar for most questions than the AmericasBarometer. The panel asks respondents to give their degree of agreement with “This year’s elections will be clean".[7] For the DID, the main independent variable is called “drought". The treatment group covers over 10% of the total respondents.

[7] Other question wording: For democracy, the survey asks: “These days, Mexico is a democracy." Unfortunately, the Mexico Panel Survey does not include a question about local political leaders or governments. The question about confidence in the President is as follows: “In general, do you approve or disapprove of the way Felipe Calderón is doing his job as President? (ASK) Strongly or somewhat?" Finally, the question on clientelism used in this study is phrased as follows: "In my community, politicians often try to buy votes with gifts, favors, or access to services." Responses to questions are reversed so that higher scores indicate more agreement or more intensity.

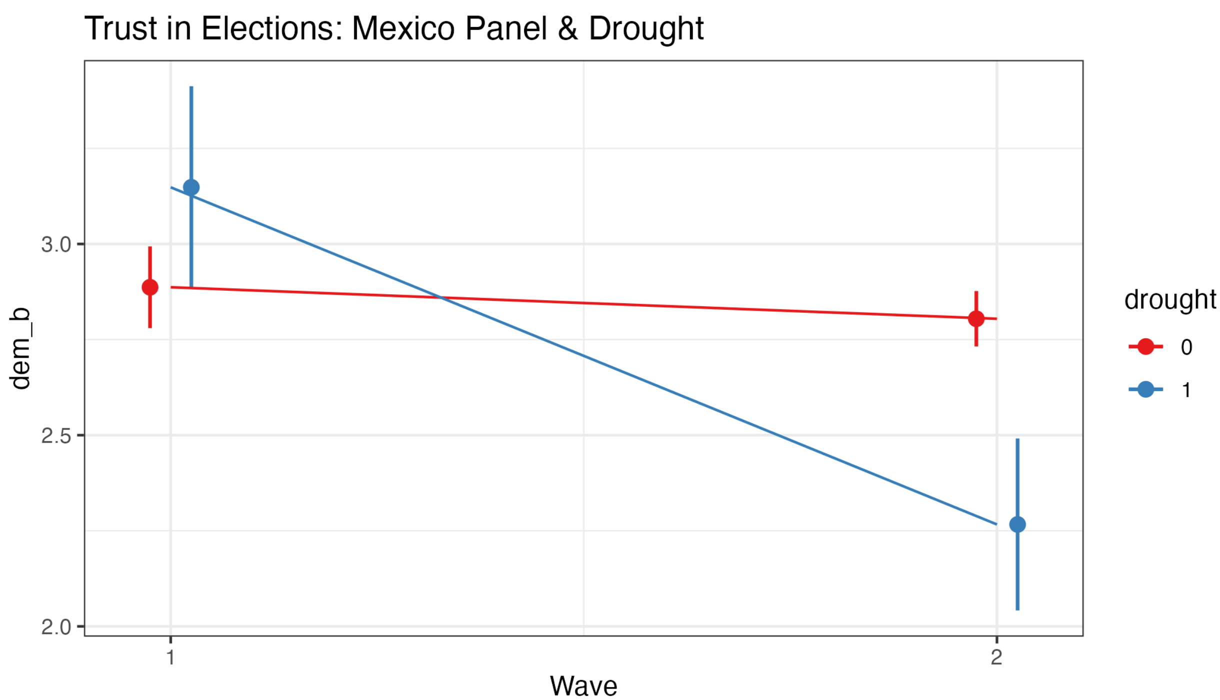
Dependent Variable:	Elections are Clean	
Model:	(1)	(2)
Variables		
Constant	2.900***	3.274***
	(0.0544)	(0.1839)
Wave_2	-0.0975	-0.0824
	(0.0658)	(0.0659)
Drought	0.2719**	0.2614**
	(0.1319)	(0.1322)
Scorch	-0.2820***	-0.2530***
	(0.0789)	(0.0792)
Wave_2 × Drought	-0.7940***	-0.7993***
	(0.1786)	(0.1783)
Controls	No	Yes
Fit statistics		
Observations	2,054	2,054
R^2	0.01674	0.02311
Adjusted R^2	0.01482	0.01880

IID standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Models include controls for age, gender, education, ideology, and whether the respondent is in an urban setting. In the 2012 context, there were no extreme floods or freeze events in the surveyed cities.

The results from the Mexico panel agree with the results from the analysis of the AmericasBarometer data, as the coefficient of interest 'Wave_2 x Drought' is negative and significant ($p < 0.01$). Perceptions about the fairness of elections significantly decrease in communities that experienced extreme drought shocks between the first and second waves of the panel.

Also like the previous analysis, I did not find significant effects of extreme weather on perceptions of the president nor on beliefs that Mexico is a democracy. Thus, I cannot reject H5a or H5b.



Two concerns might arise from the results of the Mexico Panel. The first is that the survey occurred around a national election, which may introduce patterns in survey respondents that obfuscate the estimates of extreme weather. The most obvious issue might be that after an election, individuals might be less likely to see it as "fair" in all municipalities due to reports of irregularities. This point is rather weak given that municipalities experience drought randomly. Still, we can also say the 2012 Mexico Election was not pegged with widespread reports of irregularities (Domínguez et al. 2015). In fact, after the contested 2006 elections, new electoral campaign rules were put in place so that the 2012 election "was one of the most tightly regulated campaign environments in history" (Domínguez et al., 2015, p. 21). Furthermore, the model includes controls for an individual's ideology and hence candidate preference, meaning defeated partisans are unlikely to be driving the result observed in Models 1 and 2.

The second concern with the Mexico Panel, as will all DID designs, is the parallel trends assumption that assumes that all units would have had similar trajectories without some being treated. However, we do not have prior responses from the individuals in the 2012 Mexico Panel. Yet, we can be more confident in the parallel trends assumption because weather shocks are exogenous. Also, as the graphic above illustrates, both drought affected and non-drought affected individuals have fairly similar responses to survey questions in wave 1 given the confidence intervals. Issues with parallel trends would be more concerning if the starting position of respondents between the treatment (drought) and control (normal) were significantly different.

7 Heterogeneous Effects with Vulnerability and Clientelism

The evidence presented thus far provides significant support for the argument that extreme weather - and in particular drought - has a negative effect on trust in elections. Next, I turn to exploring the possible factors underlying this general effect and how extreme weather in combination with vulnerability and clientelistic governance shape political attitudes. The next table presents regression analysis on the various dependent variables of interest such as trust in: the municipal government, the president, and the national government. I also include dependent variables related to beliefs on the quality of democracy and the preference for democracy.

Model 1 is the level of trust individuals have in their municipal governments. Both the independent effect of drought and the interaction effect when individuals report more vote buying in their community are negative and significant at $p < 0.05$. Among all other political attitudes, this is the most robust result, meaning I have sufficient evidence to reject the null-hypothesis for H2. Model 2-3 test the effect of extreme weather on trust in the president and trust in the national government. The effects do not reach the consensus for statistical significance below $p < 0.05$, meaning I cannot reject the null-hypotheses for H3 and H4. Models 4-5 test the effect of extreme weather on attitudes of the quality of democracy and the ideal of democracy (respectively). Effects do not seem to be significant, meaning I also cannot reject the null-hypotheses for H5a and H5b. Robustness checks were also performed by dropping month-year, country fixed-effects, and controls. Only trust in municipal governments remained significant and the sign of the effects remained consistent. However, when state FE are substituted for municipal FE, the independent effect of drought is no longer statistically significant, though the interaction effect remains at $p < 0.05$. In short, the effect on municipal governments is robust to nearly every specification. This gives significant weight to rejecting the null-hypothesis that extreme weather negatively affects trust in local governments where clientelism is more prominent. [8]

[8] See appendix for robustness models.

Dependent Variables:	Municipal Gov.	President	National Gov.	Qual of Dem.	Prefer Dem.
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
Drought	-0.5987***	-0.1123	0.4511*	-0.1596*	0.2639
	(0.1811)	(0.2543)	(0.2374)	(0.0839)	(0.1661)
Flood	0.1099	-0.0936	-0.1192	0.0884	-0.2852**
	(0.1459)	(0.1646)	(0.1776)	(0.0577)	(0.1370)
Vote buying	-0.3177***	-0.1925*	-0.1827**	-0.1632***	-0.0394
	(0.0796)	(0.1006)	(0.0847)	(0.0338)	(0.0371)
Freeze	-0.5302	-0.8491**	0.2173	-0.1970	0.7785***
	(0.3623)	(0.3366)	(0.3699)	(0.3295)	(0.2432)
Scorch	0.1740	-0.1759	-0.4507	-0.1285*	-0.2065**
	(0.1336)	(0.2023)	(0.2987)	(0.0695)	(0.0837)
Drought × Vote buying	-0.4477**	-0.6388*	-0.3233	0.1274	0.0028
	(0.2258)	(0.3326)	(0.2342)	(0.0933)	(0.1264)
Flood × Vote buying	0.1625	0.0563	0.0100	-0.0681	-0.0005
	(0.1433)	(0.1804)	(0.1610)	(0.0648)	(0.0759)
Fixed-effects					
District	Yes	Yes	Yes	Yes	Yes
Month_Year	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	3,778	3,768	3,692	3,699	2,280
Month_Years:	7	7	7	7	4
Municipalities:	218	218	218	218	215
R^2	0.23316	0.26896	0.23493	0.14109	0.16303
Within R^2	0.06431	0.06405	0.05009	0.03395	0.01268

Clustered (muni_code) standard-errors in parentheses

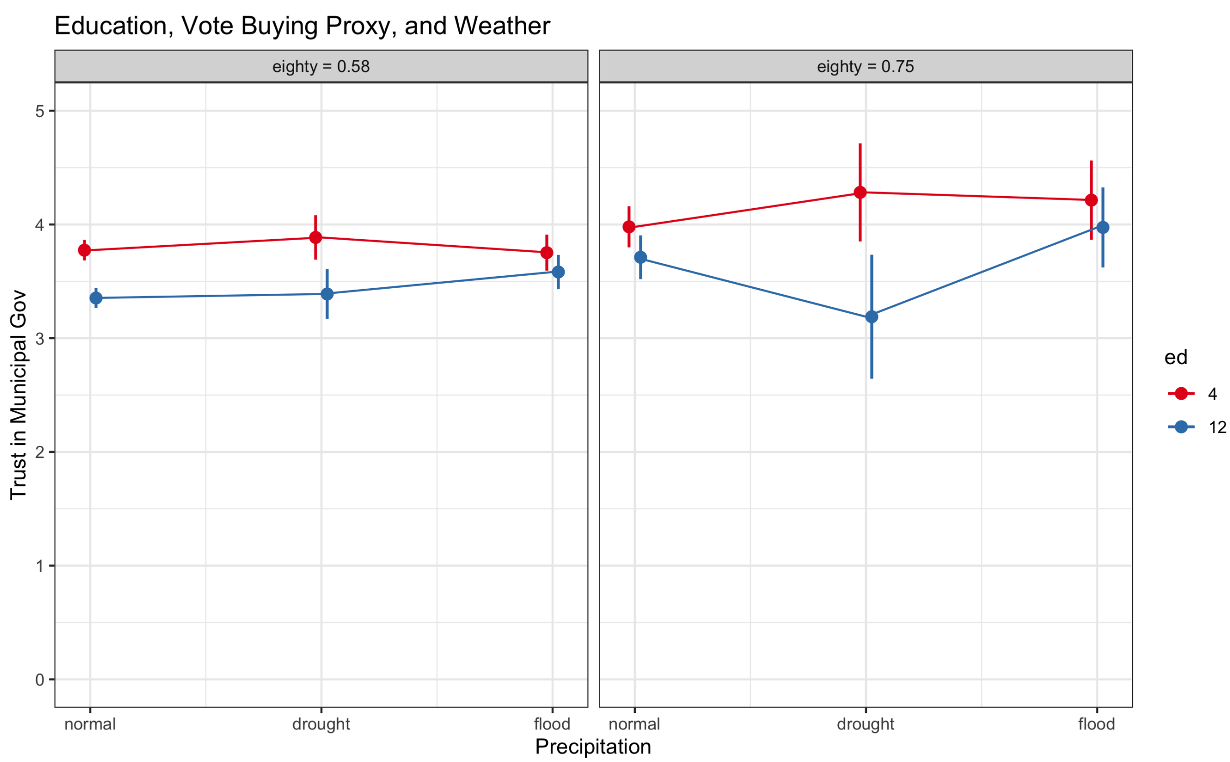
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

An issue with including moderators in experimental analysis (or quasi-experimental) is the possibility of post-treatment effects. As I discussed in the data section, extremely high turnout ($\tilde{7}5\%$ and above) as a percentage of the local population is likely a good indicator of clientelism. Together with years of education in a triple interaction regression, I can better assess the effect of extreme weather on municipal governments while accounting for vulnerability and clientelism, and avoiding post-treatment effects. Below is a shortened regression table that includes the variable of interest: a triple interaction term with drought, turnout share, and years of education (the full model is available in the appendix). Across all specifications, the three-way interaction term is negative and significant ($p < 0.05$). This lends greater support to the argument that there are heterogeneous effects influenced by vulnerability and and clientelism.

Dependent Variable:	Trust in Municipal Government		
Model:	(1)	(2)	(3)
Variables			
Drought × Turnout_share × Ed	-0.5733**	-0.6445***	-0.6106***
	(0.2409)	(0.2363)	(0.1824)
Controls	No	No	Yes
Fixed-effects			
District		Yes	Yes
Month_year		Yes	Yes
Fit statistics			
Observations	7,981	7,981	6,685
R^2	0.02459	0.13732	0.14880
Within R^2		0.00889	0.02616

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

The graphic below illustrates the marginal effects from the model. In communities with average turnout (which for this sample is 58%) extreme weather has little effect on opinions of municipal governments. However, at 75% turnout as a percentage of population, there are divergent effects among those with only some elementary schooling (four years) and those who completed secondary schooling (twelve years). Specifically, when drought strikes in more clientelistic communities, the more educated report lower trust in the municipal government, whereas the less educated report slightly more trust. For both normal and flood conditions (SPI above a value of one), there is little divergence based on education. I also found no significant effect on other measures such as evaluations of the president, the national government, nor democracy. This further suggests that there is not enough evidence to weigh in on the null-hypotheses related to national political actors. This analysis aligns with the measure of clientelism from the AmericasBarometer, since more educated and wealthier individuals in higher turnout to population areas are likelier to report vote buying.[9] Clientelism and vulnerability appear to shape divergent evaluations of municipal governments.



[9] In assessing the covariance of turnout to the AmericasBarometer clientelism measure in Brazil, and I ran regressions analyzing both the interaction effect of turnout and education or income on responses to clientelism. Using education, I find find a positive 0.010 coefficient ($p < 0.1$) in clientelism reported among more educated individuals in areas with greater than the 75th percentile turnout as a percentage of population. Using income instead of education, the interaction term is positive at 0.013 and significant ($p < 0.05$).

8 Discussion and Conclusion

This paper set out to determine if extreme weather has consequences for political stability in the Global South by examining public opinion. I provided a systematic analysis of weather shocks on political attitudes by using two measures of extreme weather (precipitation and temperature), as well as opinion data from two countries: Brazil and Mexico. I advanced a novel theory that stipulated individuals primarily update their political attitudes based on how governments respond to extreme weather and there is likely to be a negative effects on trust in elections. Also, I argued that there are heterogeneous effects on trust in municipal elections conditional on vulnerability and the dominance of clientelistic politics. The results are supportive of this argument, and span Brazil and Mexico and in different years, giving credibility to the findings.

The effect on municipal governments seems to extend from a logic that does not affect national governments or the president. This is likely because, as argued, patterns of vulnerability in the Global South are highly impacted by the presence of clientelism. Under extreme weather, there are changes to demand for resources and how these resources are distributed. In communities with programmatic politics, resource distribution is mapped to preexisting vulnerability such that changes to political attitudes are limited or average to zero.

Where clientelistic politics dominates, politicians have incentives to divert their limited resources to citizens who have tradtitionally been their clients, perhaps at the expense of the non-vulnerable and the community at large. This result provides a different picture of clientelism than usually imagined, one that may actually *increase* the willingness of individuals to hold politicians accountable - but only those who are unlikely to need the benefits provided through clientelisitc linkages. Yet, communities who endure clientelism are likely to have negative long-term effects as there is less incentive for proper disaster governance. It is concerning to those concerned about democracy that drought drought may boost clientelistic linkages, as the vulnerable come to reward local governments in the short-term. These conclusion stress the importance of undermining clientelistic practices in new democracies, a project made more important by the effect of extreme weather.

The results from this paper also speak to the growing debate about the legitimacy of democracy in the climate crisis. The results indicate there is little evidence of a legitimacy crisis in the wake of extreme weather. While there might be some effect, it does not approach conventions for statistical significance. The lack of positive results for theories like those advanced by Mittiga (2022) is likely because, as previously discussed, the appears to be a missing link that carries extreme weather to questioning the legitimacy of crisis. Extreme weather, like economic crises, is short-run events that have temporary though often significant impacts. Despite many economic downturns in Brazil and Mexico, the vast majority of the population are still seriously in favor of democracy. There does not appear to be a clear reason why extreme weather would do lead to a legitimacy crisis whereas rampant corruption, inequality, and poor economic performance have not. Some might point out that the climate crisis poses issues on a scale that economic recessions do not approach, and that it may only be a matter of time before democracy suffers a legitimacy crisis. But this modification to the democracy argument risks becoming anti-scientific as the crisis for democracy may always be located at some point in the future.

Also, as a variety of scholars have shown empirically, democracies seem to have better environmental performance. Several studies find that democracy is associated with less climate change causing CO2 emissions (Clulow 2019), though some argue this relationship holds only in some contexts where corruption is low (Povitkina 2018). Yet, as my argument makes clear in high corruption contexts, patterns of within-country vulnerability are likely to reinforce democratic attitudes rather than the amount to a crisis of legitimacy. Still, reducing emissions does not help communities adapt to intensifying extreme weather - meaning it remains a question if democracy will face a crisis of legitimacy as intense weather demands evermore resources for disaster response and there is increased risk to public safety. And as I show in this article, more focus should be placed on examining how democracies - especially those in the Global South - respond to extreme weather in ways that intersect with vulnerability.

Future research should seek to create more fine-grained measures of weather shocks and climate vulnerability. There is also great need for surveys tailored to understanding how political opinions are shaped in the face of extreme weather that go beyond climate opinions. Further research on drought and resource distribution in the Global South is needed, and fieldwork studies could be well suited to this task.

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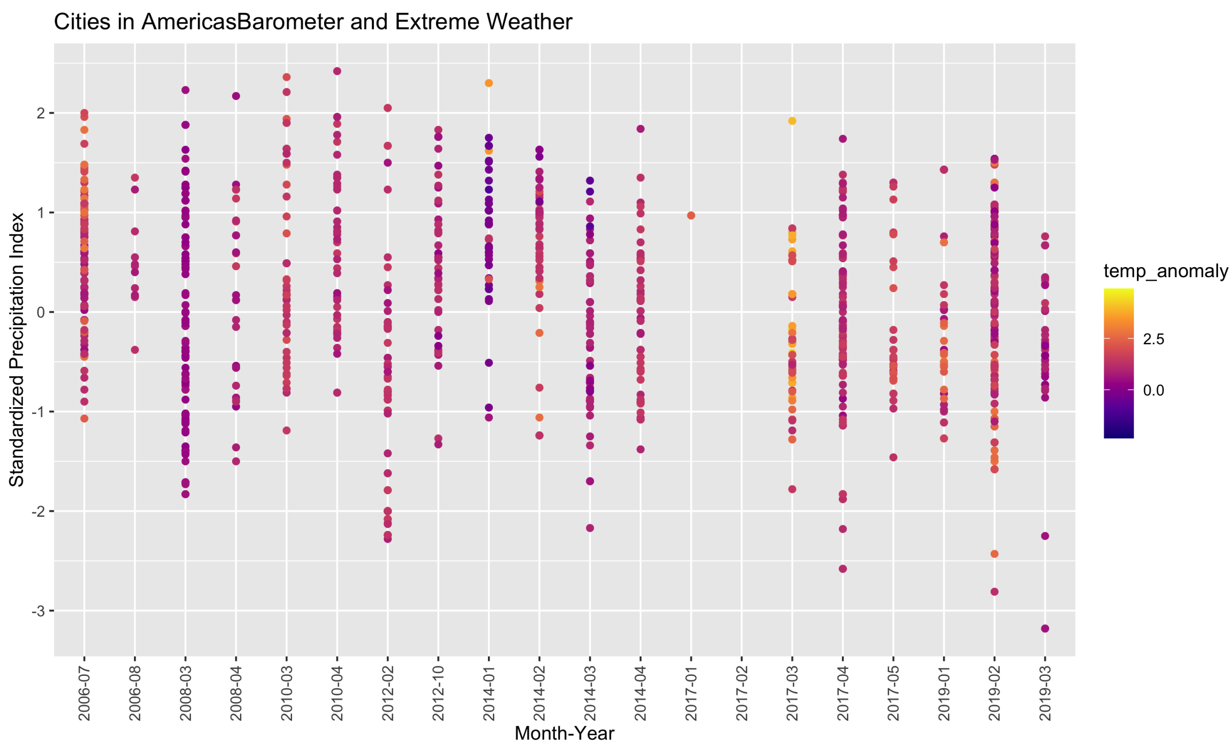
Appendix

Extreme Weather

Extreme weather in cities included in the AmericasBarometer for Brazil and Mexico is summarized in the graphic below. Some key points are that extreme precipitation and extreme temperatures do not have a clear joint pattern.



8.1 Survey Questions

Survey questions are pulled from the AmericasBarometer 2006-2019 Brazil and Mexico questionnaires. Not all questions listed below are included in every wave for both countries. Except for question B47 on elections, the questions are surveyed in both Brazil and Mexico.

- B21A. To what extent do you trust the President?
- B47. To what extent do you trust elections?
- CLIEN1n: Thinking about the last national elections, a candidate or party offered a favor, present, or other benefit to someone you know for their support or vote?
- B32. To what extent do you trust the local, municipal or metro government?
- B14. To what extent do you trust the national government?
- PN4. In general, would you say that you are very satisfied, satisfied, dissatisfied or very dissatisfied with the form of democracy in the United States?
- DEM2 With which of the following statements do you agree with the most: (1) For people like me, it doesn't matter whether a regime is democratic or non-democratic. (2) Democracy is preferable to any other form of government (3) Under some circumstances an authoritarian government may be preferable to a democratic one. (8) DK/DR
- A4. In your opinion, what is the most pressing problem this country is facing? 13: Corruption (converted to value of 1 if corruption was the response, 0 if another valid response was given, NA for all other cases).

Who reports clientelism?

This regression tests the liklihood of positive responses to whether someone knows someone who accepted a gift for their vote in the last national election (CLIEN1n). The findings indicate wealtherier, left-leaning, more educated individuals are likelier to report clientelism.

Dependent Variable:	clien_new
Model:	(1)
Variables	
standard_income	0.0180**
	(0.0078)
as.numeric(l1)	-0.0075**
	(0.0033)
as.numeric(q1)	0.0052
	(0.0143)
as.numeric(q2)	-0.0019***
	(0.0005)
as.numeric(ed)	0.0043**
	(0.0021)
urban	0.0306
	(0.0373)
Fixed-effects	
muni_code	Yes
month_year	Yes
as.factor(pais)	Yes
Fit statistics	
Observations	3,381
R^2	0.12429
Within R^2	0.01539

Clustered (muni_code) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Robustness Tests

To test the robustness of results from the regression analysis of the AmericasBarometer data, below we present the results using a model that only takes into account municipal fixed effects. By dropping time and country fixed effects we can better assess if results in the two-way fixed effects are robust. The general results suggest that aside from the main finding, that extreme drought decreases the perceptions of fair elections, extreme weather's effects are not strong or highly sensitive to model specifications.

AmericasBarometer: Removing Time and Country FE

Dependent Variables:	b32	as.numeric(b21a)	as.numeric(b13)	pn4_inverse	dem2_inverse
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
precip_extdrought	-0.6103***	-0.1657	0.3997	-0.1654*	0.1811
	(0.1834)	(0.3395)	(0.2801)	(0.0891)	(0.1722)
precip_extflood	0.0111	-0.1608	-0.1790	0.0576	-0.1237
	(0.1380)	(0.2519)	(0.1872)	(0.0633)	(0.0929)
clien_new	-0.3089***	-0.1626	-0.1711**	-0.1565***	-0.0377
	(0.0795)	(0.1034)	(0.0845)	(0.0337)	(0.0368)
temp_extfreeze	-0.3734	-1.707***	-0.1035	-0.2989	0.9427***
	(0.3159)	(0.3232)	(0.2812)	(0.3173)	(0.2182)
temp_extscorch	0.2088***	1.375***	0.3255***	0.1194***	-0.2041**
	(0.0786)	(0.1271)	(0.0852)	(0.0363)	(0.0945)
as.numeric(l1)	0.1039***	0.1014***	0.0944***	0.0227***	-0.0044
	(0.0122)	(0.0145)	(0.0130)	(0.0058)	(0.0057)
q1	-0.0761	0.0029	4.79×10^{-5}	-0.0295	0.0096
	(0.0552)	(0.0669)	(0.0547)	(0.0204)	(0.0243)
as.numeric(q2)	0.0040**	0.0169***	0.0058***	0.0009	-0.0010
	(0.0018)	(0.0025)	(0.0020)	(0.0008)	(0.0008)
ed	-0.0520***	-0.0309***	-0.0394***	-0.0119***	-0.0053
	(0.0079)	(0.0092)	(0.0082)	(0.0033)	(0.0032)
urban	-0.1903	-0.3089	-0.3537	-0.1036	0.0408
	(0.2772)	(0.2324)	(0.2154)	(0.1088)	(0.1692)
precip_extdrought × clien_new	-0.4480**	-0.6815**	-0.3437	0.1195	0.0022
	(0.2259)	(0.3340)	(0.2326)	(0.0936)	(0.1263)
precip_extflood × clien_new	0.1523	0.1417	0.0241	-0.0648	-0.0039
	(0.1431)	(0.1974)	(0.1665)	(0.0646)	(0.0750)
Fixed-effects					
muni_code	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	3,778	3,768	3,692	3,699	2,280
R^2	0.23180	0.22794	0.22497	0.13276	0.16206
Within R^2	0.06350	0.11808	0.05023	0.03313	0.01397

Clustered (muni_code) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

AmericasBarometer: No Controls

Dependent Variables:	b32	as.numeric(b21a)	as.numeric(b13)	pn4_inverse	dem2_inverse
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
precip_extdrought	-0.4235**	0.0228	0.2943	-0.1070	0.2420
	(0.2027)	(0.2769)	(0.2878)	(0.0766)	(0.2120)
precip_extflood	0.0665	-0.0191	-0.0944	0.1229**	-0.2945**
	(0.1346)	(0.1641)	(0.1756)	(0.0601)	(0.1264)
clien_new	-0.3805***	-0.2945***	-0.2663***	-0.1785***	-0.0459
	(0.0793)	(0.0924)	(0.0852)	(0.0321)	(0.0356)
temp_extfreeze	-0.2941	-0.5901**	-0.0485	-0.2094	0.6961***
	(0.3153)	(0.2983)	(0.2576)	(0.3110)	(0.2454)
temp_extscorch	0.1975	-0.1052	0.3769***	-0.1277**	-0.0861
	(0.1648)	(0.2259)	(0.0812)	(0.0635)	(0.0790)
precip_extdrought × clien_new	-0.4144**	-0.6615**	-0.2970	0.0594	-0.0212
	(0.2093)	(0.2976)	(0.2211)	(0.0790)	(0.1233)
precip_extflood × clien_new	0.1112	-0.0361	0.0296	-0.0804	0.0087
	(0.1368)	(0.1601)	(0.1538)	(0.0589)	(0.0760)
Fixed-effects					
muni_code	Yes	Yes	Yes	Yes	Yes
month_year	Yes	Yes	Yes	Yes	Yes
country	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	4,461	4,449	4,288	4,313	2,749
R^2	0.18824	0.22694	0.18947	0.12594	0.16106
Within R^2	0.01219	0.00821	0.01280	0.01798	0.00819

Clustered (muni_code) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

AmericasBarometer: State FE

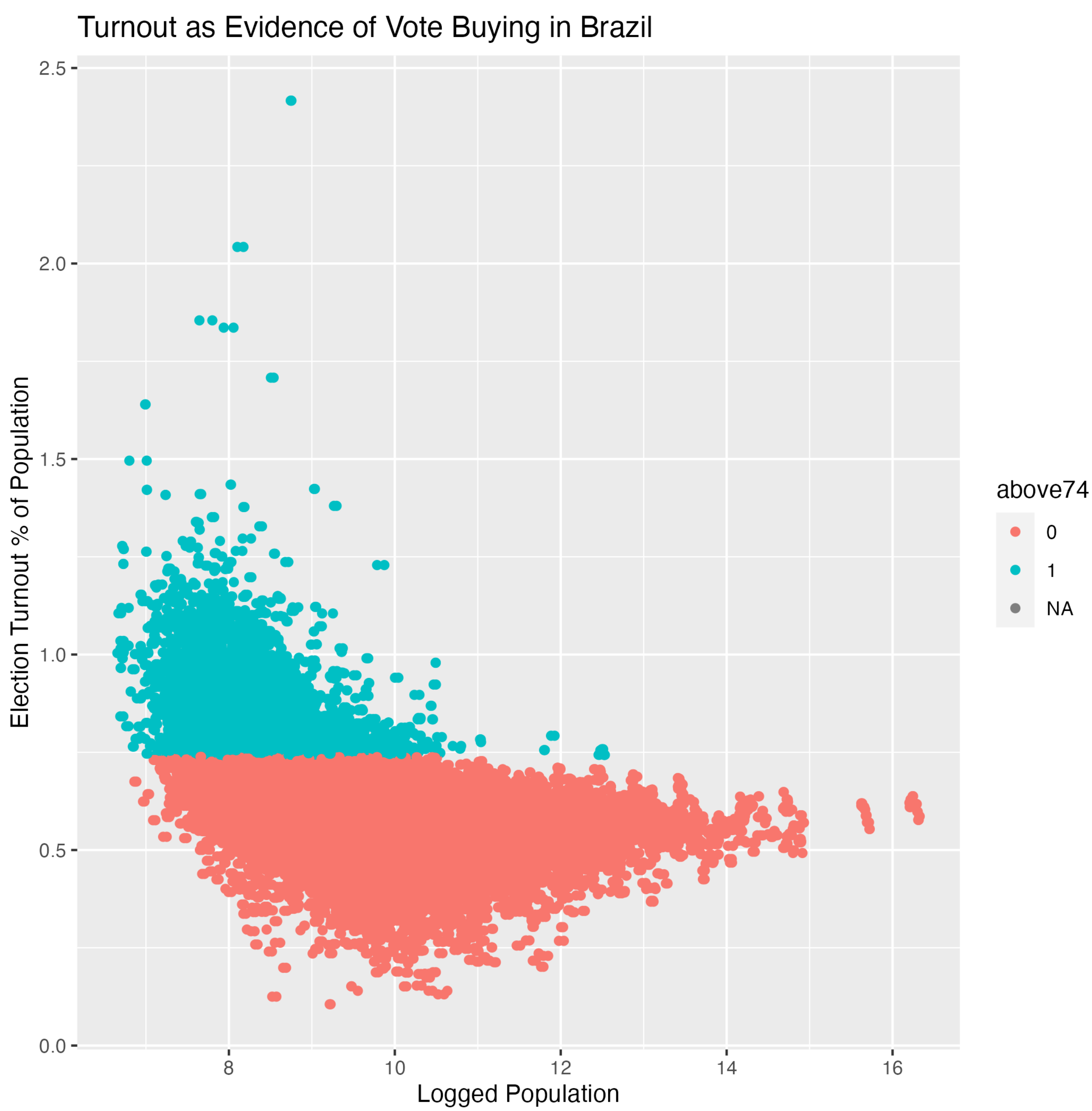
Dependent Variables:	b32	as.numeric(b21a)	as.numeric(b13)	pn4_inverse	dem2_inverse
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
precip_extdrought	-0.0186	0.1969	0.4162***	-0.0787	0.0564
	(0.1708)	(0.1952)	(0.1321)	(0.0533)	(0.0932)
precip_extflood	0.1212	-0.0502	0.0067	0.0204	-0.1069**
	(0.0913)	(0.1243)	(0.1481)	(0.0486)	(0.0464)
clien_new	-0.2500**	-0.1258	-0.1670*	-0.1609***	-0.0610**
	(0.0966)	(0.0987)	(0.0905)	(0.0277)	(0.0301)
temp_extfreeze	-0.2253	-0.4585*	0.2758	-0.0164	0.4915***
	(0.2489)	(0.2349)	(0.2548)	(0.1420)	(0.1363)
temp_extscorch	0.0971	-0.2742	-0.4984*	-0.0935	0.0534
	(0.1210)	(0.1652)	(0.2499)	(0.0751)	(0.0981)
as.numeric(l1)	0.1137***	0.1144***	0.1059***	0.0265***	-0.0063
	(0.0127)	(0.0140)	(0.0124)	(0.0058)	(0.0051)
q1	-0.0806	-0.0497	-0.0130	-0.0417**	0.0179
	(0.0543)	(0.0600)	(0.0660)	(0.0182)	(0.0217)
as.numeric(q2)	0.0047**	0.0147***	0.0050**	0.0006	-0.0009
	(0.0018)	(0.0025)	(0.0021)	(0.0007)	(0.0007)
ed	-0.0502***	-0.0385***	-0.0442***	-0.0136***	-0.0044
	(0.0071)	(0.0091)	(0.0075)	(0.0029)	(0.0039)
urban	-0.4894***	-0.6310***	-0.4298***	-0.1587***	-0.0195
	(0.1128)	(0.0796)	(0.0914)	(0.0380)	(0.0353)
precip_extdrought × clien_new	-0.4899**	-0.7149**	-0.2866	0.1212	-0.0201
	(0.2323)	(0.2978)	(0.2019)	(0.0732)	(0.1093)
precip_extflood × clien_new	0.0690	-0.0152	-0.0186	-0.0523	0.0616
	(0.1051)	(0.1509)	(0.1292)	(0.0506)	(0.0696)
Fixed-effects					
state_unit	Yes	Yes	Yes	Yes	Yes
month_year	Yes	Yes	Yes	Yes	Yes
country	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	3,778	3,768	3,692	3,699	2,280
R^2	0.16121	0.22619	0.18603	0.08673	0.07805
Within R^2	0.07437	0.07854	0.06567	0.04198	0.01126

Clustered (state_unit) standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Avoiding Post-Treatment Effects: Full Model

Here I plot the election turnout as a percentage of population to population in Brazil. Because clientelism is expected to be more prevalent at turnout near 80%, I mark those municipalities that have rates about 74%. This graphic makes clear that across a wide range of populations, turnout rates can exceed this 74% marker.



Extended Models Using Turnout to Measure Clientelism

Dependent Variables:	b32			election		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Constant	4.935***			3.054***		
	(0.4638)			(0.2598)		
precip_extdrought	-1.891	-3.656***	-3.297**	2.268***	1.185*	0.3590
	(1.160)	(1.331)	(1.343)	(0.6135)	(0.6393)	(0.7783)
precip_extflood	-1.334	-0.8315	-1.120	0.3328	0.0512	1.205
	(1.043)	(1.306)	(1.478)	(0.5859)	(0.8807)	(1.417)
eighty	0.0635	4.388***	4.035**	0.9746***	1.018*	1.506
	(0.7395)	(1.664)	(1.829)	(0.3767)	(0.4785)	(1.613)
ed	-0.1140**	-0.0769*	-0.0576	0.0054	0.0155*	0.0168**
	(0.0491)	(0.0451)	(0.0499)	(0.0067)	(0.0079)	(0.0065)
temp_extscorch	0.0463	0.1000	0.0137	0.1087**	-0.2344***	0.0219
	(0.0450)	(0.1201)	(0.1201)	(0.0502)	(0.0543)	(0.1234)
log(population+1)	-0.0877***	3.026**	2.557*			
	(0.0109)	(1.444)	(1.500)			
precip_extdrought × eighty	3.452*	5.692**	5.190**	-4.129***	-2.326*	-1.052
	(1.991)	(2.219)	(2.255)	(1.057)	(1.124)	(1.286)
precip_extflood × eighty	2.249	1.047	1.471	0.1822	-0.0854	-2.231
	(1.743)	(2.134)	(2.395)	(0.9819)	(1.506)	(2.370)
precip_extdrought × ed	0.3226**	0.3892***	0.3683***			
	(0.1390)	(0.1422)	(0.1116)			
precip_extflood × ed	0.1362	0.0630	0.1514			
	(0.1194)	(0.1281)	(0.1584)			
eighty × ed	0.1196	0.0680	0.0524			
	(0.0842)	(0.0763)	(0.0857)			
precip_extdrought × eighty × ed	-0.5733**	-0.6445***	-0.6106***			
	(0.2409)	(0.2363)	(0.1824)			
precip_extflood × eighty × ed	-0.1905	-0.0769	-0.2135			
	(0.1988)	(0.2071)	(0.2600)			
as.numeric(l1)			0.0891***	0.1036***	0.0862***	0.0848***
			(0.0097)	(0.0094)	(0.0124)	(0.0098)
as.numeric(q1)			-0.0350	-0.2902***	-0.3004***	-0.2914***
			(0.0441)	(0.0482)	(0.0498)	(0.0508)
as.numeric(q2)			0.0048***	0.0008	0.0017	0.0014
			(0.0018)	(0.0016)	(0.0013)	(0.0016)
urban			-0.0602	-0.4389***	-0.3611**	-0.1106
			(0.1620)	(0.0704)	(0.1157)	(0.2269)
Fixed-effects						
muni_code		Yes	Yes			Yes
month_year		Yes	Yes		Yes	Yes
Fit statistics						
Observations	7,981	7,981	6,685	6,678	6,678	6,678
R^2	0.02459	0.13732	0.14880	0.04078	0.10192	0.16801
Within R^2		0.00889	0.02616		0.02817	0.02133

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

8.2 Robustness Tests: Probit Models

For additional robustness tests, I use a probit (ordered logistic) model that accounts for ordered dependent variables like those from the AmericasBarometer and 2012 Mexico Panel Survey. The model can be described as the following:

$$logitP(Y <= k|x) = \zeta_{it}\theta_{it} - \epsilon_{it}$$

The first table presents estimates of exogenous weather shocks on responses to trust in elections in Brazil before 2012. The results show that even under a Generalized Linear Model (GLM) the effect of drought being negative on trust in elections holds. The results suggest that under this specification, drought may have the opposite effect. Though earlier findings suggest there is no confidence in this effect as it may be sensitive to model specification. Model includes fixed effects for municipalities. The second table is the same specification but for the perceived cleanliness of elections with the 2012 Mexico Panel Survey.

Probit: AmericasBarometer

	Est	Std. Error	t value	p value
Drought	-0.2675	0.1161	-2.3027	0.0212
Flood	1.3372	0.0735	18.1815	0.0000
Temp Anomaly (lag)	-0.5529	0.0475	-11.637	0.0000

Residual Deviance: 24688.78

AIC: 25408.78

Probit: 2012 Mexico Panel Survey

	Est	Std. Error	t value	p value
Drought	-0.6023	0.1215	-4.9559	0.0000
Scorch	0.1803	0.1701	1.0600	0.2891

Residual Deviance: 5931.057

AIC: 6075.057