Rainfall, Drought Declaration, and Reelection: A replication of Cooperman (2021)

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Abstract

In a recent study, Cooperman (2021) finds that among mayors in northeastern Brazil, the declaration of a drought is associated with an increased likelihood of being reelected and that periods of below average rainfall are associated with an increased likelihood of incumbents running for and winning reelection. In our analysis of the paper's findings, we were able to replicate all results. We extended the analysis through graphically depicting the relationship between term-limits and drought declaration, exploring whether changing the time period of analysis impacts the relationship between rainfall and drought declaration, and finally through observing the effects of replacing a binary variable for rainfall with a continuous scale. While we found minor differences in results depending on how variables are interpreted and whether binary or continuous variables are used for rainfall, nothing we found refutes the paper's findings.

Keywords: Disaster, Drought, Reelection

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†Replication data can be accessed HERE

1 Introduction

Understanding how politicians respond to upcoming elections can offer profound insight into the political decision-making process and incentive structure. For one, it shows how politicians interact with their constituents in an election year compared to non-election years. It also highlights how elected officials think about budgets, government funding, and natural disasters, and what might incentivize them to make greater investments in public services and resources. Through comparing politicians' decisions in election years to non-election years, Cooperman (2021) concurs with the existing body of literature (Alesina 1989, Finan & Ferraz 2005, Martinez 2009) that politicians respond to reelection incentives and will distribute public resources in the hopes of serving longer in office.

It's important to understand the political landscape of Brazil to fully interpret the results of the paper. Mayors in Brazil are eligible for two consecutive terms of four years each decided through a majority vote. It is important to note that the Brazilian party system is very fragmented and that social context and family ties often matter more than party affiliation. There are many different parties, and some mayors even switch parties between elections (Novaes 2018) — this creates a political landscape where politicians care less about party re-election after serving two terms[1] meaning that actions taken by term-limited politicians likely are not motivated by the desire for a co-partisan to be elected (Franzese Jr 2002, Clark et al. 1998). For further context, northeast Brazil is one of the poorest regions in the country with significant inequality both in state capacity and poverty (Tendler et al. 1997, Finan & Nelson 2009, Ottonelli & Mariano 2014).

Disaster relief is funded by the state government and is either all or nothing. To begin the drought related aid process, mayors must declare a state of emergency and apply for approval from the governor. This requires reporting of information on the extent of the drought, its impact on residents, and how the relief money will be spent. Cooperman (2021) did extensive research and field interviews to fully understand the complexities of the Brazilian political scheme and process for applying for drought funding.

Cooperman (2021) explores the relationship between municipal drought declarations and mayoral reelections in northeast Brazil, the country's predominantly agricultural re-

[1] This is different than other country contexts like the U.S., where party lines are often much more solid

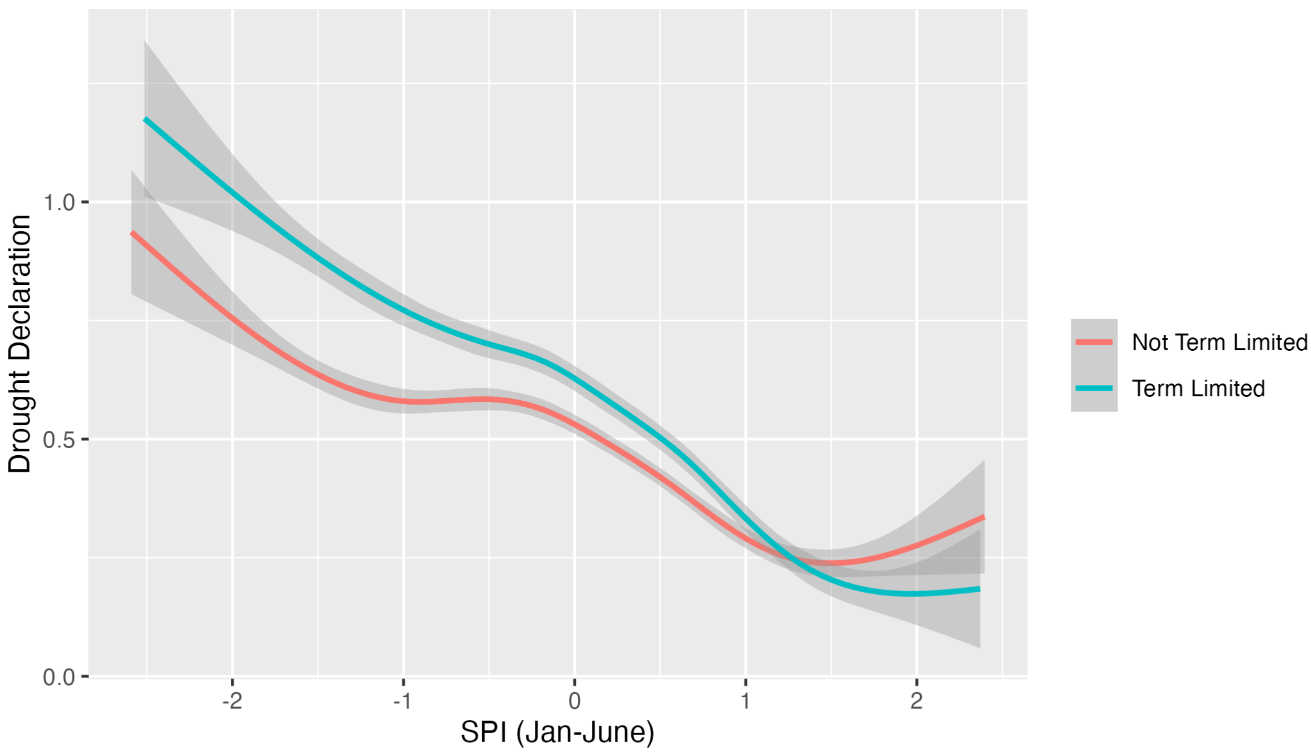
gion. Droughts are not uncommon in Brazil and often disproportionately affect poor subsistence farmers. When an emergency or drought is declared and approved by the national government, resources are deployed to the affected communities. Cooperman (2021) argues that these aid resources can be used to garner support for incumbent politicians as a form of clientelism or distributive politics, incentivizing politicians to declare droughts in election years. Using both rainfall and electoral data, Cooperman (2021) finds evidence that mayors in election years are more likely to declare droughts, even in times of above average rainfall, and that incumbent mayors are more likely to win reelection when they declare droughts. Interestingly, Cooperman (2021) also finds that second-term mayors, mayors that are term limited and cannot run for reelection, declare droughts at higher rates, potentially contradicting the argument that this may be an attempt by politicians to buy votes. Importantly, Cooperman (2021) contextualizes this analysis with interviews with both Brazilian farmers and political figures, providing a more detailed picture of what is happening beyond the data.

2 Understanding the Impact of Term Limits

In our replication of Cooperman (2021), we were able to successfully reproduce the paper's results and tables[2]. As mentioned earlier, we were interested in looking more closely at term-limited politicians and their drought declaring behaviors, specifically why term-limited mayors declare droughts more frequently than not term-limited mayors. Cooperman (2021) posits that mayors become more experienced over time and that this experience makes them better able to go through the relatively lengthy and burdensome administrative processes that declaring drought emergencies require.

[2]To observe the original tables and figures, please visit the Appendix

Figure 1: Drought Declaration and Term Limits



To better observe the variation between mayors who are term limited and those who are not, we create a graphical representation of Table 2 from Cooperman (2021). Instead of using the categorical variables of "below average", "above average" and "very high" to represent rainfall, we use the continuous SPI scale provided in the replication data which represents the rainfall between January and June of that year as it relates to the average rainfall from 1981-2012 during that six-month period.[3]

Figure 1 shows the relationship between rainfall and drought declarations for both term limited and non-term limited mayors. We chose to display this relationship using smoothed conditional means due to the binary nature of the dependent variable. Figure 1 shows that for rainfall amounts that fall beneath 1, meaning they are above average, incumbent mayors are significantly more likely to declare droughts than their non-term limited counterparts.

[3]SPI ranges from -3 to 3 with numbers between 0 and -0.79 indicating an abnormally dry period; numbers between -0.8 and -1.29 indicating moderate drought; -1.3 to 1.59 indicating severe drought; -1.6 to -1.99 indicating extreme drought; and less than -2 indicating exceptional drought. The same gradations can be viewed in the positive direction but for above average rainfall (De Nys et al. 2016).

Observing the graph, there seems to be a switch that happens after 1 but given the large confidence intervals at that point, this switch is not statistically significant and thus nothing should be inferred from it. Although perhaps counter intuitive, as mentioned above, Cooperman (2021) credits this relationship to the burdensome paperwork and legislative processes associated with asking for drought relief, making experienced politicians more likely to take on this burden.

Interestingly, in our replication of Table 2 of the original paper, we find a nebulously labeled variable that could interfere with the interpretation of results from both our paper and Cooperman (2021). The variable Cooperman (2021) used to represent second term or term limited politicians is labelled "lame duck" in the provided replication dataset. Being term limited and being a lame duck are not the same — a lame duck is classified as an official in the final period of office, after the election of a successor and is not necessarily a term limited or second term politician (Jenkins & Nokken 2008). Although it may seem subtle, this change in wording could have profound implications on the actual meaning of the paper's results; the replication code and data available did not include a code book for the dataset, so we are unsure if the lame duck variable is indeed about lame ducks or simply term limited politicians. If the former is true then the analysis in our paper and Cooperman (2021) needs revising.

To further explore the true definition of the lame duck variable, we found the original dataset issued by the Brazilian *Tribunal Superior Eleitoral*. Despite finding this, the dataset was in Portuguese, so we were unable to competently interpret it. However, we were able to find a code book from Hollyer et al. (2021), which also used data from *Tribunal Superior Eleitoral*, the same political source as Cooperman (2021). This codebook includes a lame duck variable but defines it as indicating incumbency. This finding further adds to our confusion about the true meaning of this variable. Both lame duck definitions from Cooperman (2021) and Hollyer et al. (2021) are quite different from the true meaning of the term "lame duck". Given that Hollyer et al. (2021) and Cooperman (2021) likely sourced their data from the same website, we have reason to believe that there may have been some sort of loss in translation or mis-definition causing this confusion. As a result, the findings displayed in Table 2 of the original paper may not actually represent what Cooperman

(2021) argues they do.

3 Rainfall Period and Drought Declaration

Cooperman (2021) explores the relationship between rainfall, whether it is an election year, and the declaration of droughts amongst mayors in municipalities. As we replicated the paper's code, we discovered that Cooperman (2021) used rainfall over the six-month period between January and June as the reference for whether or not there was a drought and how rainfall compared to the average rainfall during that time. Cooperman (2021) justifies this choice explaining that this six-month period is the typical "rainy season" when farmers typically plant crops, suggesting that a drought during this period would be more consequential than during other times. Cooperman (2021) does briefly engage with the other two measures of rainfall — the three month measure from April to June and the nine month measure from January to September — in her supplementary materials but only insofar as to observe the relationship between rainfall during these times and whether a drought is declared. The paper does not observe the implications of having below average rainfall in these periods on drought declaration like was done in Table 1 of Cooperman (2021) using the six-month period data.

Additionally, because elections are held in October and voters may be subject to recency bias, we became particularly interested in how rainfall in the three months leading up to the election (July - September) fits into this relationship. Because there was no specific indicator for these three months provided in the dataset, we extrapolated lower than average rainfall in July - September through finding instances in which the nine month rainfall was below average but the six month rainfall was not. Ideal data would allow for us to explore this as a gross variable, but the data regarding rainfall in Cooperman (2021) only shows rainfall relative to the average for periods of time outside of the January-June period. As a result, we were not able to find the exact amount of rain from July to September. Despite this, our binary variable indicates whether rainfall was significantly below average in the period leading up to the election. While politicians cannot control the weather, hardship due to below-average rainfall in the months immediately before the October election could potentially impact outcomes.

Table 1: Rainfall and Incumbent Outcomes

	Dependent variable:			
	Drought Emergency Declared			
	(1)	(2)	(3)	(4)
Below Average Rainfall (Jan-June)	0.288***			
	(0.052)			
Below Average Rainfall (Apr-June)		0.194***		
		(0.047)		
Below Average Rainfall (Jan-Sept)			0.253***	
			(0.055)	
Below Average Rainfall (June-Sept)				−0.015
				(0.039)
Mayor Election Year	0.043	−0.002	0.030	0.004
	(0.067)	(0.071)	(0.068)	(0.075)
State/Fed Election Year	0.006	0.011	−0.004	−0.032
	(0.080)	(0.076)	(0.080)	(0.079)
Observations	14,054	14,054	14,054	14,054
R^2	0.267	0.243	0.257	0.214
Adjusted R^2	0.208	0.182	0.197	0.151
Residual Std. Error (df = 13013)	0.445	0.452	0.448	0.461
Note:	*p<0.1; **p<0.05; ***p<0.01			

To explore the relationship between rainfall and drought declarations, as was done in Table 1 from the original paper, we repeat the analysis for Model 1 but replace the six-month rainfall statistics with the three-month (Model 2), nine-month (Model 3), and last three months leading up to the election (Model 4). Our results are in line with the findings from the six-month period: below average rainfall over the periods from January-September and April-June are similarly positively correlated with drought declarations. Interestingly, below-average rainfall in the period immediately before the election (July-September) is not significantly correlated with an increase in drought declarations. This may be because this variable is binary and the sample size is much smaller than for the other measures. It also could potentially indicate that below-average rainfall in those three months is not consequential for constituents or that because of the lag between when a drought is declared and when aid is distributed, politicians do not declare droughts during this time because they do not stand to benefit politically from doing so. Thirdly, it could be the case that politicians don't feel the need to declare a drought during this time because it is no longer peak farming season, so the consequences of a drought on farmers will be less severe. To draw any conclusions about these potential explanations, more research and data are needed. Our findings suggest that Cooperman (2021) chose an appropriate time period to analyze droughts. Even without including the qualitative data that explains the importance of the rainy period, it seems that having below average rainfall between January and June better explains the variation in the data than the other measures as it has the highest R-squared value.

4 Rainfall Period and Reelection

The above table and analysis suggest that the time of year in which rainfall is observed as being "below average" does not significantly affect whether a drought is declared. Because of this, we are interested in directly observing the relationship between rainfall amount and both whether an incumbent runs again, and if so, whether they win. The analysis displayed in Table 3 of Cooperman (2021) focuses on the binary variable "below average rainfall" and its effect on whether an incumbent runs again and wins. While the dataset used includes a continuous variable for rainfall relative to the average, the analysis in the

Table 2: Rainfall Amount and Drought Declaration

	Dependent variable:			
	Incumbent Runs		Incumbent Wins	
	(1)	(2)	(3)	(4)
Rainfall Compared to Average (effect of more rainfall)	0.014		−0.016	
	(0.027)		(0.024)	
Below Average Rainfall		−0.064***		−0.037*
		(0.021)		(0.022)
Mayor's Vote Share in Previous Election	−0.029	−0.029	0.336***	0.334***
	(0.087)	(0.086)	(0.094)	(0.094)
Copartisan President	0.061*	0.060*	0.038	0.040
	(0.036)	(0.036)	(0.033)	(0.034)
Copartisan Governor	0.004	0.004	0.007	0.006
	(0.025)	(0.025)	(0.024)	(0.024)
Observations	2,927	2,927	2,927	2,927
R^2	0.016	0.018	0.030	0.030
Adjusted R^2	0.010	0.011	0.023	0.024
Residual Std. Error	0.448	0.448	0.494	0.494

Note: *p<0.1; **p<0.05; ***p<0.01

paper does not. We extend the analysis of Cooperman (2021) by observing rainfall relative to other years as a continuous variable to see whether the relationship seen between an incumbent having "below-average rainfall" and running and winning also holds when we observe rainfall as a continuous variable, and specifically, whether politicians are rewarded for weather-related prosperity that happens within their terms.

Interpreting Table 2, we do not find significant differences between relative rainfall and whether or not an incumbent runs, nor between rainfall and whether an incumbent wins. This could be for a number of reasons including "below average rainfall" affecting communities more than "above average rainfall" or perhaps that the categorical "below average rainfall" variable matters but not rainfall variation more generally.

5 Conclusion

Through our exploration of differential measures of rainfall, we conclude that Cooperman (2021) both made the optimal and logical choice in choosing the six-month rainy period as the main period of rainfall observation. The results do not differ significantly from the three and nine month periods. Additionally, we find that measuring rainfall using a continuous variable rather than a binary "below average" variable eliminates the significant effects of rainfall on incumbents running for and winning reelection. This contradicts the findings of Cooperman (2021) but does not necessarily undermine the results and could potentially be dismissed because of droughts being more relevant than periods of increased rainfall.

Despite our confusion about the nebulous nature of the "lame duck" variable and the possibility that this interfered with both our analysis and the analysis of Cooperman (2021), we believe that regardless of whether the variable indicates a true lame duck or simply a term-limited politician, that there are interesting conclusions to be drawn about the behaviors of politicians who do not experience a reelection incentive.

Replication papers like this one are crucial for ensuring the validity and the significance of academic findings. Sometimes, even if results are replicable, additional robustness checks, changes in modeling, or unique approaches can change the significance of results, or even the results themselves. With political science topics having great significance for policy making around the world, it is essential that we get these questions right or at least right as we possibly could. Replication and peer review strengthen the academic literature and the legitimacy of political science as a field. Even when, like in this paper, there are minimal faults found with the original piece, replication serves as an important step for ensuring validity of results.

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Appendix

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Note: This Appendix includes all tables and figures from the original paper, Cooperman (2021). Exhibits are labelled as they appear in the original paper. Tables are made using the exact code from Cooperman (2021). Figures use the same data but are presented slightly differently.

Figure 2

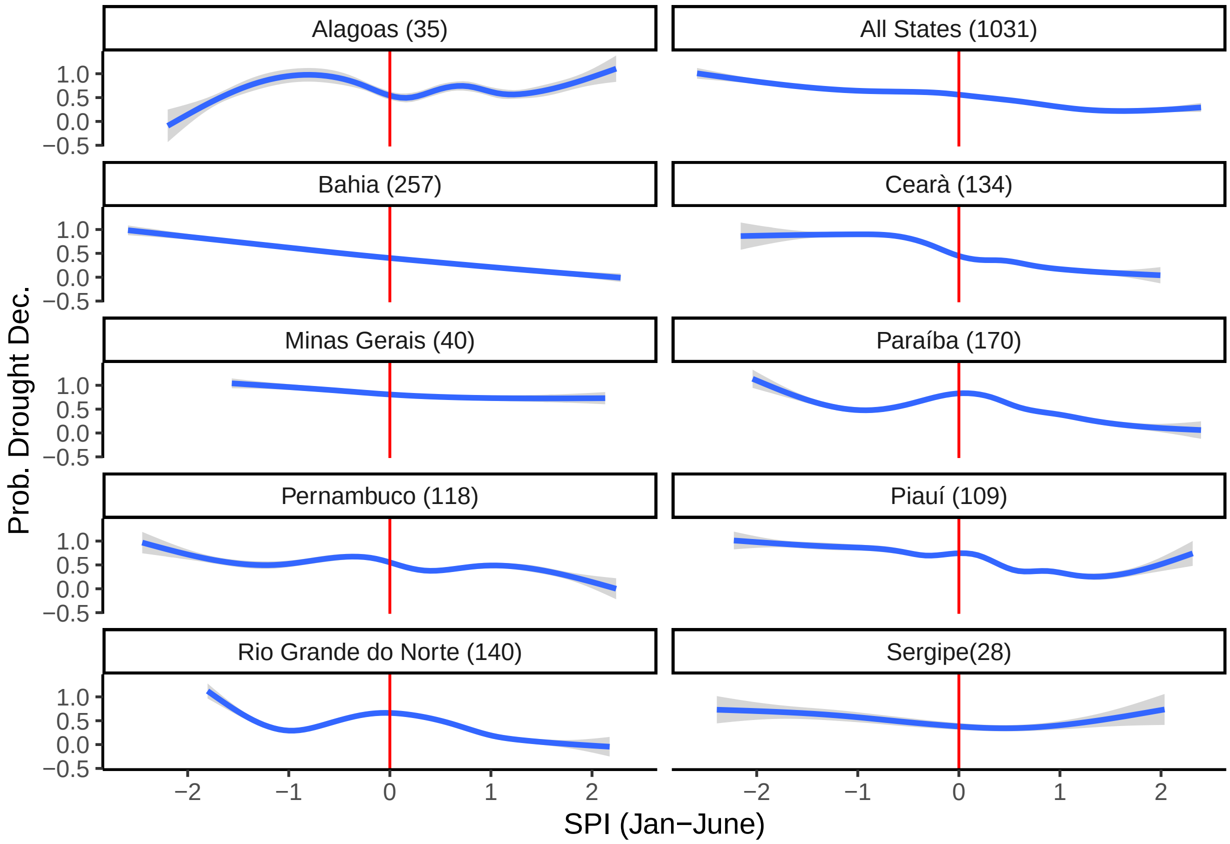
Alagoas (35)
All States (1031)
Bahia (257)
Cearà (134)
Minas Gerais (40)
Paraíba (170)
Pernambuco (118)
Piauí (109)
Rio Grande do Norte (140)
Sergipe(28)
Prob. Drought Dec.
1.0
0.5
0.0
−0.5
−2
−1
0
1
2
SPI (Jan−June)

Figure 3

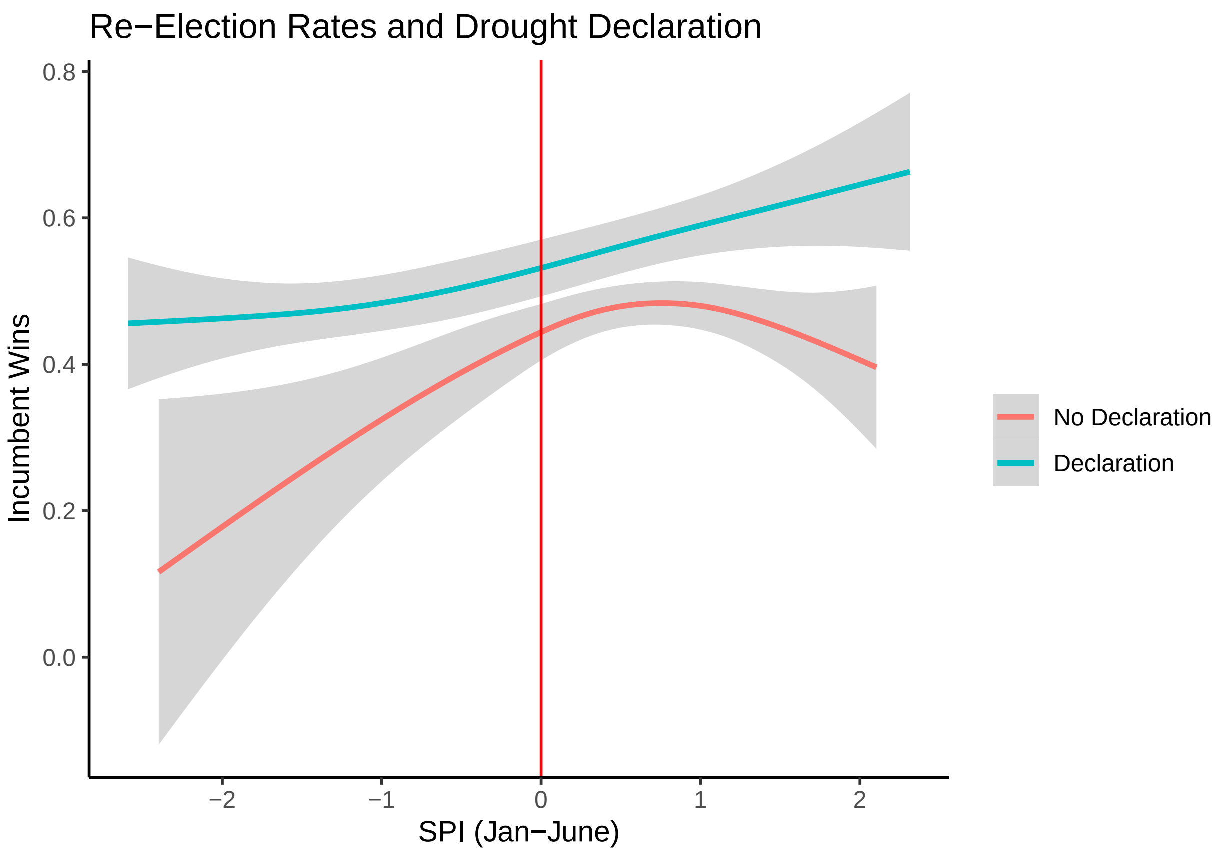
Re−Election Rates and Drought Declaration
0.8
0.6
0.4
0.2
0.0
Incumbent Wins
−2
−1
0
1
2
SPI (Jan−June)
No Declaration
Declaration

Table 1

	Dependent variable:		
	Drought Emergency Declared		
	(1)	(2)	(3)
Below Average Rainfall	0.288***	0.165***	0.198***
	(0.052)	(0.050)	(0.062)
Mayor Election Year	0.043	−0.128**	−0.113
	(0.067)	(0.059)	(0.070)
State/Fed Election Year	0.006		0.028
	(0.080)		(0.084)
Mayor Election * Below Ave. Rainfall		0.577***	0.528***
		(0.147)	(0.163)
State/Fed Election * Below Ave. Rainfall			−0.108
			(0.113)
Observations	14,054	14,054	14,054
R^2	0.267	0.307	0.308
Adjusted R^2	0.208	0.252	0.253
Residual Std. Error	0.445 (df = 13013)	0.432 (df = 13013)	0.432 (df = 13011)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 2

	Dependent variable:					
	Drought Emergency Declared					
	Below Ave.	Below Ave.	Above Ave.	Above Ave.	Very High	Very High
	(1)	(2)	(3)	(4)	(5)	(6)
2nd Term Mayor	0.114***	0.099**	−0.0001	0.013	−0.046	0.084**
	(0.036)	(0.042)	(0.025)	(0.021)	(0.029)	(0.043)
Mayor Election Year	0.295**	0.275*	−0.162**	−0.148**	−0.001	0.091
	(0.149)	(0.153)	(0.065)	(0.067)	(0.080)	(0.079)
Mayor Election * 2nd Term Mayor		0.070		−0.045		−0.250***
		(0.090)		(0.044)		(0.068)
Observations	5,528	5,528	8,526	8,526	2,436	2,436
R^2	0.316	0.317	0.354	0.354	0.551	0.561
Adjusted R^2	0.158	0.158	0.265	0.265	0.229	0.246
Residual Std. Error	0.439	0.438	0.417	0.417	0.380	0.375
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 3

	Dependent variable:					
	Incumbent Runs			Incumbent Wins		
	(1)	(2)	(3)	(4)	(5)	(6)
Below Average Rainfall	-0.064^{***}			-0.037^{*}		
	(0.021)			(0.022)		
Drought Declaration in Mayor Election Year		0.057^{**}			0.143^{***}	
		(0.025)			(0.033)	
Drought Declaration in Last Two Years			0.045^{**}			0.060^{**}
			(0.022)			(0.025)
Mayor's Vote Share in Previous Election	-0.029	-0.016	-0.012	0.334^{***}	0.346^{***}	0.351^{***}
	(0.086)	(0.090)	(0.091)	(0.094)	(0.096)	(0.098)
Copartisan President	0.060^{*}	0.057^{*}	0.058^{*}	0.040	0.034	0.037
	(0.036)	(0.034)	(0.035)	(0.034)	(0.033)	(0.034)
Copartisan Governor	0.004	0.005	0.004	0.006	0.005	0.005
	(0.025)	(0.024)	(0.024)	(0.024)	(0.022)	(0.023)
Observations	2,927	2,927	2,927	2,927	2,927	2,927
R^2	0.018	0.015	0.014	0.030	0.039	0.029
Adjusted R^2	0.011	0.009	0.008	0.024	0.033	0.023
Residual Std. Error	0.448	0.449	0.449	0.494	0.492	0.494

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 4

	Dependent variable:			
	Drought Emergency Declared			
	(1)	(2)	(3)	(4)
Mayor Election Year	−0.111	0.069	0.038	0.022
	(0.082)	(0.053)	(0.054)	(0.053)
PT	−0.001			
	(0.052)			
Copartisan Mayor President		0.111***		
		(0.033)		
Copartisan Mayor Governor			−0.0001	
			(0.025)	
Copartisan Mayor President Coalition				0.038*
				(0.021)
Mayor Elec. * PT	0.396***			
	(0.094)			
Mayor Elec. * Co. Mayor Pres.		−0.109		
		(0.068)		
Mayor Elect. * Co. Mayor Gov.			−0.053	
			(0.040)	
Mayor Elec. * Co. Mayor Pres. Coal.				0.007
				(0.036)
Number of Municipalities	101	315	687	1014
Observations	1,383	4,318	9,386	13,818
R^2	0.340	0.336	0.305	0.306
Adjusted R^2	0.283	0.282	0.250	0.251
Note:	*p<0.1; **p<0.05; ***p<0.01			