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# Drought-Reliefs and Partisanship

FEDERICO BOFFA,†,‡ FRANCISCO CAVALCANTI,§
CHRISTIAN FONS-ROSEN¶,# and AMEDEO PIOLATTO††,‡‡,§§

*†Free University of Bozen/Bolzano, Bolzano, Italy (e-mail: Federico.Boffa@unibz.it)*
*‡Collegio Carlo Alberto, Turin, Italy*
*§Department of Economics, Pontifícia Universidade Católica do Rio de Janeiro PUC-Rio, Rio de Janeiro, Brazil (e-mail: francisco.lima.cavalcanti@gmail.com)*
*¶University of California at Merced, California, Merced, USA (e-mail: cfons-rosen@ucmerced.edu)*
*#CEPR, MPI Munich, Munich, Spain*
*††Autonomous University of Barcelona (UAB), Barcelona, Spain (e-mail: amedeo.piolatto@uab.es)*
*‡‡Barcelona School of Economics (BSE), Barcelona, Spain*
*§§Barcelona Institute of Economics (IEB), Barcelona, Spain*

## Abstract

We combine a model of symmetric information with selfish and office-motivated politicians and a Regression Discontinuity Design analysis based on close municipal elections to study partisan bias in the allocation of drought aid relief in Brazil. We identify a novel pattern of distributive politics whereby partisan bias materialises only before municipal elections, while it disappears before presidential elections. Furthermore, before mayoral elections, it fades for extreme (high or low) aridity levels while persisting for moderate levels. Our empirical results show that in this case alignment increases the probability of receiving aid relief by a factor of two (equivalent to 18.1 percentage points).

## I. Introduction

Politicians often act based on political considerations that have little to do with welfare (Ferraz and Finan, 2011; Curto-Grau and Zudenkova, 2018; Tarquinio, 2020; Bonilla-Mejía and Morales, 2021; Finan and Mazzocco, 2021; Lauletta, Rossi, and

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Ruzzier, 2022). Particularly, in federal countries, the upper level of government disproportionally allocates funds to co-partisan local officers (Khemani, 2007; Arulampalam *et al.*, 2009; Brollo and Nannicini, 2012; Bracco *et al.*, 2015; Curto-Grau, Solé-Ollé, and Sorribas-Navarro, 2018).

Our analysis provides a fresh perspective on the role of alignment in shaping distributive politics by recognising that the optimal targeting strategy depends on which level of government is up for re-election next (local vs. national). We thus identify a novel pattern of distributive politics in countries with multiple tiers of government. Furthermore, our data allow us to benchmark the actual allocation to one that is based on objective criteria, hence, we identify some conditions that strengthen or mitigate the partisan bias.

We study drought-relief discretionary transfers to municipalities in Brazil between 1997 and 2016. We look at the pattern of the transfers before both Presidential and municipal elections, which alternate every 2 years. We adopt a Regression Discontinuity Design (RDD) based on close municipal elections. We measure the severity of droughts using data on both precipitations and evapotranspiration (Vicente-Serrano, Beguería, and López-Moreno, 2010).

A look at the raw data shows that, intuitively, the actual severity of droughts is an important determinant of the probability of receiving aid relief. Before mayoral elections,[1] it increases, respectively, by 6.7 percentage points (p.p.) and 1.6 p.p. when transitioning from low to moderate aridity or from moderate to severe. Similarly, before presidential elections, the average probability increments are respectively 13.4 p.p. (from low to moderate) and 6.8 p.p. (from moderate to severe).

However, aridity alone is not enough to explain the transfers: politics matters as well. Before mayoral elections, we find that aligned districts enjoy a 6.3 p.p. higher probability of receiving a transfer, which is in line with most of the literature.[2] However, the novel finding is that the effect is fully and only driven by municipalities that suffered a drought of moderate intensity.[3] In this case, aligned municipalities have 18 p.p. higher probability of receiving aid relief. Instead, there is no alignment bias when aridity is either low or severe. We also show that the alignment bias completely disappears before federal elections.

Our theory model rationalises these patterns. Before local elections, despite being purely office-motivated, the president attaches a weight both to voters' needs and to the development of forward-looking relations with mayors. We show that, as a result, the president displays partisan bias only in marginal cases, i.e. when aridity is moderate. Instead, in municipalities with low or severe aridity, the model predicts no differences based on alignment.

We present the model in Section II and the empirical analysis in Section III. Section IV contains our final remarks. Proofs are relegated to Appendix A. Additional material is available in the Appendix S1 (available at https://doi.org/10.13140/RG.2.2.29618.07364). The data replication package is available at https://doi.org/10.3886/E188961.

[1]The words 'municipal' and 'mayoral' will be used interchangeably.

[2]There, the partisan bias is attributed to altruistic preference by the central politician (Bracco *et al.*, 2015) or to an intrinsic interest in maximising the party local achievements (Brollo and Nannicini, 2012; Curto-Grau *et al.*, 2018). Tarquinio (2020) finds a negative alignment effect in India, motivated by the fact that the return on transfers is smaller in aligned municipalities.

[3]Tarquinio (2020) and Schneider and Kunze (2023) observe similar patterns in India and in the USA.

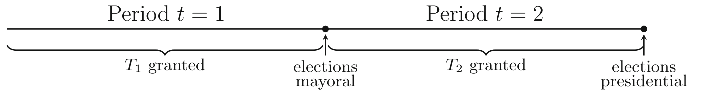


Figure 1. Timing

## II. The model

We consider a two-tier country, with a central government and $i = 1, \ldots, N$ municipalities (or districts). Henceforth, 'president' and 'mayor' will refer, respectively, to the head of the central and local (municipal) government.

Two parties compete both at the central and local level: a municipality is *aligned* if the mayor and the president belong to the same party and *non-aligned* otherwise. We consider a two-period game. In each period $t = \{1, 2\}$, municipality $i$ suffers a drought of intensity $D_t^i \in \left[\underline{D}, \overline{D}\right]$. The president grants a discretionary transfer $\overline{T}$ to an arbitrary subset of municipalities so that $T_t^i = \{0, \overline{T}\}$ is the transfer received by municipality $i$ at period $t$. All municipal elections take place at the end of period one, while the president is elected at the end of period two (Figure 1).

In each district $i$, the representative voter derives utility from consumption (of private and public goods) that depends on $T_t^i - D_t^i$. The utility is increasing and concave in transfers, and decreasing and convex in damage from droughts. For simplicity, we assume $u_t^i = c(T_t^i - D_t^i)$, with $c' > 0$, $c'' < 0$ and $u(c(-\underline{D})) \geq 0$.

Politicians are concerned about their re-election only.[4] Voters in each jurisdiction only care about their current level of utility. They support the re-appointment of the incumbent if their current-period utility is above a threshold that depends at most on the three factors listed below. While factors 1 and 2 matter for both presidential and municipal elections, factor 3 only matters for presidential elections.

1 A popularity shock $\epsilon_i \sim U\left[-\frac{1}{2\phi}, \frac{1}{2\phi}\right]$. For expositional convenience, $\epsilon_i$ represents a negative shock for the incumbent, that is, the incumbent politician gains votes when $\epsilon_i < 0$, while the challenger gains votes when $\epsilon_i > 0$.
2 A lower-bound utility $\underline{u}$. This could represent the utility voters expect to enjoy if the challenger is elected. We assume $\underline{u} < u(c(-\underline{D})) + \frac{1}{2\phi}$, hence, the incumbent politician always has a positive probability (albeit minimal) of being voted. Indeed, the condition implies that the incumbent is re-elected even in municipalities that suffered the most severe drought and received no transfers, as long as the popularity shock is maximal ($\epsilon_i = -\frac{1}{2\phi}$).
3 The mayor's external support to the president's campaign. Transfers assigned by the president before local elections increase the incumbent's re-election probability. We assume that mayors who received the transfer will return the favour, when the time comes, by endorsing the incumbent president or by providing some informal support (possibly in the form of not endorsing the opponent candidate). Depending on the specific context, this 'do ut des' mechanism may be interpreted differently (e.g. gratitude, patronage, clientelism). For the sake of conciseness, we will refer to

[4]Either they enjoy some ego-rent, or they extract rents from sources unrelated to the assignment of transfers.

such 'external campaigning support' as *gratitude* ($g_i$), although slightly imprecise. Importantly, gratitude is unidirectional. Only the president assigns the transfer, so gratitude ($g_i$) flows from the mayor to the president but not vice versa.

We solve the model backwards, starting with the presidential elections and then moving to the president's optimal strategy before the mayoral elections.

**Presidential elections**

The incumbent president is re-appointed if they receive more votes than the challenger, irrespective of the distribution of votes across municipalities.

In each municipality, the president is supported if $u(c_i) > \epsilon_i + \underline{u} - g_i$. Gratitude $g_i$ is defined as:

$$g_i = \begin{cases} \gamma B_i^T & \text{if a transfer was granted in } t = 1 \text{ \& mayor was re-appointed} \\ 0 & \text{otherwise} \end{cases}, \tag{1}$$

where $B_i^T$, formally defined in equation (3), is the electoral *benefit* that the incumbent mayor in $i$ enjoyed at $t = 1$ (while running for reelection) thanks to transfer $T$. In discussing our results, we will focus on positive values of the exogenous parameter $\gamma$. We allow it to vary conditional on partisanship, taking value $\gamma_a$ for aligned municipalities and $\gamma_m$ for their non-aligned counterpart. We assume $\gamma_a > \gamma_m$ because aligned mayors can openly endorse the incumbent president while non-aligned mayors are bound to support their party's candidate (i.e. the challenger). They can, at best, be more lenient toward the incumbent president, resulting in a milder impact.[5]

The ex-ante probability of being voted in municipality $i$ is:[6]

$$Pr(\epsilon_i < u(c_i) - \underline{u} + g_i) = \frac{1}{2} + \phi(u(c_i) - \underline{u} + g_i). \tag{2}$$

When district $i$ is granted a transfer, the electoral benefit enjoyed by the incumbent is

$$B_i^T \equiv \phi\left(u(c(\overline{T} - D_i)) - u(c(-D_i))\right). \tag{3}$$

At $t = 2$ the president must decide which municipalities to grant the transfer to. We exclude the trivial case in which the president can grant a transfer to all municipalities. At the time of the decision, $g_i$ is exogenously fixed (it depends on decisions that are taken at $t = 1$) and is heterogeneous across districts. The popularity shock $\epsilon$ is also heterogeneous, while lower-bound utility $\underline{u}$ is the same across municipalities.

*Proposition 1.* Before central elections, the president's vote-maximising rule is to assign grants to municipalities that suffered the most severe drought.

[5]Our assumption is consistent with the empirical analysis in Kriner and Reeves (2012).

[6]The probability can be interpreted either as the chance that the representative agent in the district votes for the incumbent president, or it can equivalently be interpreted as the intensive margin of political support in the district.

*Corollary 1.* The allocation of transfers before presidential elections is maximising voters' welfare.

*Proof*. See Appendix A. □

The president is not specifically interested in winning one single constituency, but rather, in line with the single-district Brazilian electoral system, they want to maximise the total expected support at the federal level. It is optimal for the president to grant transfers where returns, in terms of votes, are larger. The concavity of the utility function ensures that the marginal utility of transfers is larger in places that suffered more heavily from aridity. Proposition 1 concludes that the president allocates transfers to municipalities that need them the most, implying that interests are aligned between career-concerned politicians and a hypothetical welfare-maximising planner.

The scheme to allocate funds before presidential elections depends entirely on the transfers' marginal impact on the probability of election, as defined by equation (3). The election probability obviously depends on gratitude $g_i$. However, gratitude depends only on transfers in $t = 1$, hence, the president can manipulate the re-election probability in $t = 2$ via gratitude only through the allocation of funds before mayoral elections.

**Mayoral/municipal elections**

If the president grants a transfer in period 1 to municipality $i$, they expect the period 2 electoral gain $E(g_i)$ to be equal to gratitude gains $g_i$ weighted by the probability that the incumbent mayor is re-appointed.[7] Hence:

$$E(g_i) = Pr(\epsilon_i < u(c_i) - \underline{u})g_i. \tag{4}$$

The president allocates transfers in $t = 1$ so as to maximise the sum of the expected electoral gains in $t = 2$. Transfers can be assigned only to a subset of municipalities because of an exogenous constraint on the maximum amount of transfers. Hence, the president selects the subset of municipalities that yields the largest gains.

Municipalities differ in the two previously mentioned respects: (i) they are aligned or non-aligned, (ii) they suffer droughts of heterogeneous severity. Lemma 1 and Proposition 2 study how transfers are allocated, depending on alignment and aridity.

*Lemma 1.* Given alignment, the president's benefit of allocating a transfer to a municipality in period 1 is increasing in the level of aridity if and only if $\frac{u'(c(-D_i))}{u'(c(\overline{T}-D_i))} > \Psi \in (1,2)$, with $\Psi \equiv 1 + \frac{\phi(u(c(\overline{T}-D_i)) - u(c(-D_i))}{1/2 + \phi(u(c(\overline{T}-D_i)) - \underline{u})}$.

*Proof*. See Appendix A. □

Lemma 1 introduces a condition on the slope of the utility function with and without the transfer. It holds when a transfer allocation reduces the marginal utility of consumption enough. This depends on the combination of the curvature of the utility function, the size

[7]By construction, as explained above, $g_i$ doesn't appear in the probability of the mayor of being re-elected, for $g_i$ accounts for the electoral support provided by the mayor to the president's campaign, as a sign of gratitude (*do ut des*) for the transfer received.

of the transfer and the variance of the popularity shock. More specifically, the condition is more likely to be satisfied when the utility function is very concave and both the transfer and the variance of the popularity shock are large. In the upcoming Proposition 2 we assume the condition to hold.

*Proposition 2.* Before mayoral elections, the president allocates transfers to all aligned districts as long as $D_i \geq D_a$ and to all non-aligned districts as long as $D_i \geq D_m$, where $D_a$ and $D_m$ represent lower bounds on the level of aridity. The bound is lower for aligned municipalities ($D_a < D_m$) under our maintained assumption that $\gamma_a > \gamma_m$.

*Corollary 2.* The president's preferred allocation of transfers is not welfare maximising.

*Proof*. See Appendix A. □

Proposition 2 conveys a simple yet powerful message. Before mayoral elections, the allocation of discretionary drought-relief transfers depends not only on the level of aridity but also on party alignment, despite the symmetric information setting. This is not desirable from a welfare perspective.

This result hinges on two crucial assumptions. First, transfers matter enough for citizens $(u'(c(-D_i))/u'\left(c\left(\overline{T}-D_i\right)\right) > \Psi)$. Second, the president benefits, in electoral terms, from the allocation of transfers ($g_i > 0$). Importantly, absent this condition, the president would have no incentives to allocate transfers before local elections.

According to our model, if a mayor receives a transfer in $t = 1$, they will make an extra effort to support the incumbent-president campaign in $t = 2$. Our condition $\gamma_a > \gamma_m$ states that the *marginal* gratitude following a transfer is larger for aligned than for non-aligned mayors. The preferential treatment that aligned municipalities enjoy hinges precisely on gratitude having a larger marginal impact on the re-election probability if expressed by aligned mayors. This condition is not equivalent to an alignment effect.[8]

Interestingly, comparing Propositions 1 and 2 we notice an asymmetry. Alignment does not matter before presidential elections, while it does before mayoral elections. The empirical analysis confirms this intuition.

## III. Empirical analysis

We test our model predictions using Brazilian data. We combine three sets of data: on elections, on municipalities that received a drought-emergency-transfer and on aridity.[9]

### Political and administrative aspects

Brazil is a presidential democracy with a three-tiered federal system consisting of 26 states, a federal district (Brasilia) and 5,570 municipalities. Voters elect chief executives (president, governors and mayors) at each tier. The president is elected in a single-district, majoritarian election with run-off and so are mayors of large municipalities (above

[8]Feierherd (2020) estimates the alignment effect in Brazil and finds that it may be negative if voters are unsatisfied with the incumbent mayor. Our condition is fully compatible with that result.
[9]Interested readers will find additional information in Appendix S1.

200,000 inhabitants). Mayors in the remaining municipalities are elected using a relative majority (i.e. plurality) rule. Elections take place every four years, with mayoral and presidential elections alternating every 2 years.

The Brazilian political landscape is fragmented. The four presidents appearing in our sample belong to: the Workers' Party 'PT' (Lula and Rousseff), the Brazilian Democratic Movement Party 'MDB' (Temer) and the Social Democratic party 'PSDB' (Henrique Cardoso).

Our sample includes mayoral elections held in 1996, 2000, 2004, 2008, 2012 and 2016, and presidential elections held in 1998, 2002, 2006, 2010 and 2014.[10] Data come from *Tribunal Superior Eleitoral*.

### State of emergency and transfers

For their funding, *federal and state governments* mostly rely on taxes and fees that they set and collect. Instead, *local governments* rely mainly on intergovernmental transfers: local taxes typically represent only about 5.5% of the total budget (Brollo and Nannicini, 2012).

A large share of transfers is discretionary (*Transferências voluntárias da União*), including those for infrastructure and those assigned following a declaration of local state-of-emergency. Droughts being the most frequent natural disaster in Brazil, they account for approximately half of such declarations.

The government has been extensively using drought emergency-aids since the 1960s. Protocols are more discretionary for droughts than for other natural disasters. Indeed, drought-related aid reliefs in Brazil are known to be a source of clientelism and to lead to strategic behaviours for political gains (Bobonis *et al.*, 2022).

The allocation procedure requires a preliminary Presidential declaration of the state of emergency for the targeted municipalities. Then, a body within the federal Ministry of National Integration (SEDEC) decides, for each targeted municipality, the composition of the aid-relief-package, which may include funds, goods, human resources or special authorisation to relax red-tape constraints. Such procedure matches the setting of our model in that the president has a strong influence on the set of targeted municipalities.[11]

The list of municipalities that were granted the drought-motivated 'state of emergency' status between 1997 and 2016 comes from *Sistema Integrado de Informações sobre Desastres Naturais* - S2ID (for more details, see Section 1 in Appendix S1).[12] For the sake of readability, we henceforth use *state of emergency, aid-relief, funds* and *transfers* without specifying that we refer to those that are drought-motivated.

### Drought

We innovate on most of the economic literature that uses data on droughts, which usually measures them through precipitations alone (e.g. Rocha and Soares, 2015;

[10]Roussef's (PT party) 2016 impeachment, and her *ad interim* replacement with Temer – affiliated to a different party (MDB) – would bring ambiguity in our designation of aligned municipalities. Hence, we limit our analysis to pre-2016.

[11]Note that aid reliefs are allocated by the president directly to the municipality. State governors are not involved in the process. Hence, we can safely concentrate on the behaviour of the federal and local governments.

[12]Most of the populated areas of the country received them at least once.

Shah and Steinberg, 2017). Specifically, Albert, Bustos, and Ponticelli (2021) and this paper independently introduce in economics the use of the Standardised Precipitation Evapotranspiration Index (*SPEI*), which measures the moisture deficit relative to the historical average. The moisture deficit combines information on precipitations and on moisture retained in the soil (evapotranspiration), which, in turn, is a function of temperatures. Accounting for evapotranspiration, *SPEI* represents a proxy for the actual moisture of the ground at any point in time, hence it is superior to indexes that predict aridity through rainfalls only (Vicente-Serrano *et al.*, 2010). Measuring aridity in a reliable manner allows us to identify transfers that are not entirely justified by a drought emergency.

We obtain average precipitation and potential evapotranspiration since 1901 from the Climate Research Unit at the University of East Anglia, widely used in the climatology literature. Their database provides monthly data at 0.5 grid-level, representing approximately $55 \times 55$ km. We overlay the grid data over a shapefile that delimits Brazilian municipal borders.

### Our variables

Subscript $b$ refers to the biennium between two consecutive elections. We use the electoral data to compute *party alignment* between the president and mayors. $Alg_{i,b}$ is an indicator variable taking value 1 if, during biennium $b$, the mayor of municipality $i$ is affiliated to the president's party and 0 otherwise.

If $t$ is the time of an election and $x = \begin{cases} 4 & \text{if municipal elections at } t \\ 2 & \text{if presidential elections at } t \end{cases}$, then $t - x$ is the time of the previous mayoral election.[13]

For municipality $i$, we define $\mathrm{VS}^{A}_{i,t-x}$ and $\mathrm{VS}^{BR}_{i,t-x}$ as the vote shares at $t - x$ elections accrued respectively by: (i) the candidate affiliated to the party of time-$t$ president and (ii) the best-ranked among all the other candidates. The Margin of Victory ($\mathrm{MV}_{i,t-x}$) is computed at $t$, based on the electoral results at $t - x$ (last mayoral election), as the (normalised) difference in vote shares:

$$\mathrm{MV}_{i,t-x} = \frac{VS^{A}_{i,t-x} - VS^{BR}_{i,t-x}}{VS^{A}_{i,t-x} + VS^{BR}_{i,t-x}} \tag{5}$$

We can compute $\mathrm{MV}_{i,t-x}$ only for municipalities in which, at the $t - x$ elections, a candidate affiliated to the same party as the time-$t$ incumbent president has been running for elections. If $\mathrm{MV}_{i,t-x} > 0$, the mayor and the incumbent president are aligned at time $t$, while a negative margin implies non-alignment.[14] Figure OA2 in Appendix S1 illustrates the outcome of the McCrary Density test, which confirms that there is no discontinuity

[13] Remember that 2 years pass between a mayoral election and the subsequent presidential election, while an interval of 4 years separates two mayoral elections.

[14] It is worth stressing that any change of the incumbent president's party (following any presidential elections) has an impact on how the margin of victory is computed. For instance, in 2002 the incumbent (Henrique Cardoso, PSDB) lost against the opponent (Lula, PT). Both for the 2002 presidential elections and for the 2004 municipal elections, the margin of victory is computed based on the electoral results of the 2000 municipal elections. However, for the 2002 elections, $\mathrm{MV}_{i,t-2}$ compares the vote share of the PSDB candidate and the best-ranked opponent. Instead, for the 2004 elections, $\mathrm{MV}_{t-4}$ focuses on races involving the PT candidate against the best-ranked opponent.

in the density function of the forcing variable margin of victory, both for municipal and federal elections.

The measure of aridity is based on the previously discussed *SPEI* index, computed at a biannual level. In particular, to facilitate the interpretation of our results, we use the negative of the *SPEI*, as defined in Vicente-Serrano *et al.* (2010):

$$\mathrm{SPEI}_{i,b} = \frac{(\mathrm{PET}_{i,b} - P_{i,b}) - \mathrm{mean}(\mathrm{PET}_i - P_i)}{\mathrm{sd}(\mathrm{PET}_i - P_i)}, \tag{6}$$

where $\mathrm{PET}_i$ and $P_i$ define, respectively, the yearly Potential Evapotranspiration and Precipitation in municipality $i$, while $\mathrm{PET}_{i,b} = \sum_{t-2}^{t} \mathrm{PET}_i$ and $P_{i,b} = \sum_{t-2}^{t} P_i$ are, respectively, the cumulative $\mathrm{PET}_i$ and $P_i$ for biennium $b$. The mean and SD are computed over the period 1901–80. $\mathrm{SPEI}_{i,b} > 0$ implies a below-average water balance, hence relative aridity.

We define three indicator-variables using *SPEI*: $\mathrm{LowAridity}_{i,b}$ takes value 1 if $\mathrm{SPEI}_{i,b} < 0$, $\mathrm{ModerateAridity}_{i,b}$ takes value 1 if $\mathrm{SPEI}_{i,b} \in [0, 1]$, $\mathrm{SevereAridity}_{i,b}$ takes value 1 if $\mathrm{SPEI}_{i,b} > 1$, that is, the index takes up values greater than one SD above the mean.[15]

Table 1 provides descriptive statistics on our variables of interest. An observation is a pair 'municipality-election' for which $\mathrm{MV}_{i,t-x}$ can be computed. Our initial sample consists of respectively 8,343 and 5,312 observations in our analysis of mayoral and presidential elections.

Focusing on mayoral elections, 2,446 observations correspond to municipality-election pairs in which the incumbent mayor and president are aligned; in the remaining 5,897 observations, they are not aligned. The *% of aid granted* columns show, for each type of municipality, the share of observations that received government drought-aid-reliefs. For instance, 19.5% of aligned municipality-election pairs obtained aid relief in the two years before municipal elections, as opposed to 13.2% of non-aligned.

Data are also decomposed by the level of aridity. We observe low aridity in 3,552 cases, moderate in 2,647 cases, and severe in 2,144 cases. We detect a noticeable pattern in line with our main message. When municipalities are in the low-aridity condition there is not much room for manoeuvre in allocating aid relief to politically aligned municipalities. Indeed, the means (0.100 and 0.112) are very close to each other, consistent with the idea that co-partisanship will not be of much help to a municipality in search of aid relief. But if we only focus on the cases of moderate aridity, a different picture emerges. Non-aligned municipalities receive aid-relief 15% of the time, as opposed to above 25% for aligned municipalities. A similar pattern can be observed for observations in the severe-aridity category.

## Estimation strategy and results

Propositions 1 and 2 combined immediately suggest that the assignment of transfers varies depending on the level (mayoral or presidential) of the upcoming election. Figure 2 focuses

[15]Our definition is consistent with previous studies (e.g. Mueller and Osgood, 2009; Rocha and Soares, 2015; Brito *et al.*, 2018).

TABLE 1
*Descriptive statistics*

| | | *Before mayoral elections* | | | | | *Before presidential elections* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Obs* | *% of aid granted* | *Mean (SD)* | *Min* | *Max* | *Obs* | *% of aid granted* | *Mean (SD)* | *Min* | *Max* |
| ***Main variables*** | | | | | | | | | | | |
| SPEI (aridity)[a] | | 8,343 | — | 0.258 (1.373) | −5.325 | 6.063 | 5,312 | — | −0.359 (1.419) | −6.791 | 8.938 |
| Margin of victory | | 8,343 | — | 0.004 (0.238) | −0.988 | 1.000 | 5,312 | — | −0.020 (0.249) | −0.988 | 1.000 |
| ***Decomposition of municipalities by political alignment*** | | | | | | | | | | | |
| aligned | | 2,446 | 0.195 | — | 0 | 1 | 2,466 | 0.172 | — | 0 | 1 |
| non-aligned | | 5,897 | 0.132 | — | 0 | 1 | 2,846 | 0.189 | — | 0 | 1 |
| ***Decomposition of municipalities by level of aridity*** | | | | | | | | | | | |
| Low-aridity | | 3,552 | 0.108 | — | 0 | 1 | 2,835 | 0.109 | — | 0 | 1 |
| Moderate-Aridity | | 2,647 | 0.175 | — | 0 | 1 | 1,706 | 0.243 | — | 0 | 1 |
| Severe-aridity | | 2,144 | 0.191 | — | 0 | 1 | 771 | 0.311 | — | 0 | 1 |
| ***Decomposition of municipalities by level of aridity and alignment*** | | | | | | | | | | | |
| Low-Aridity | & aligned | 1,210 | 0.100 | — | 0 | 1 | 1,330 | 0.096 | — | 0 | 1 |
| | & non-aligned | 2,342 | 0.112 | — | 0 | 1 | 1,505 | 0.120 | — | 0 | 1 |
| Moderate-Aridity | & aligned | 624 | 0.258 | — | 0 | 1 | 795 | 0.238 | — | 0 | 1 |
| | & non-aligned | 2,023 | 0.150 | — | 0 | 1 | 911 | 0.248 | — | 0 | 1 |
| Severe-Aridity | & aligned | 612 | 0.319 | — | 0 | 1 | 341 | 0.317 | — | 0 | 1 |
| | & non-aligned | 1,532 | 0.140 | — | 0 | 1 | 430 | 0.307 | — | 0 | 1 |

[a] SPEI indicates the Standardised Precipitation Evapotranspiration Index.

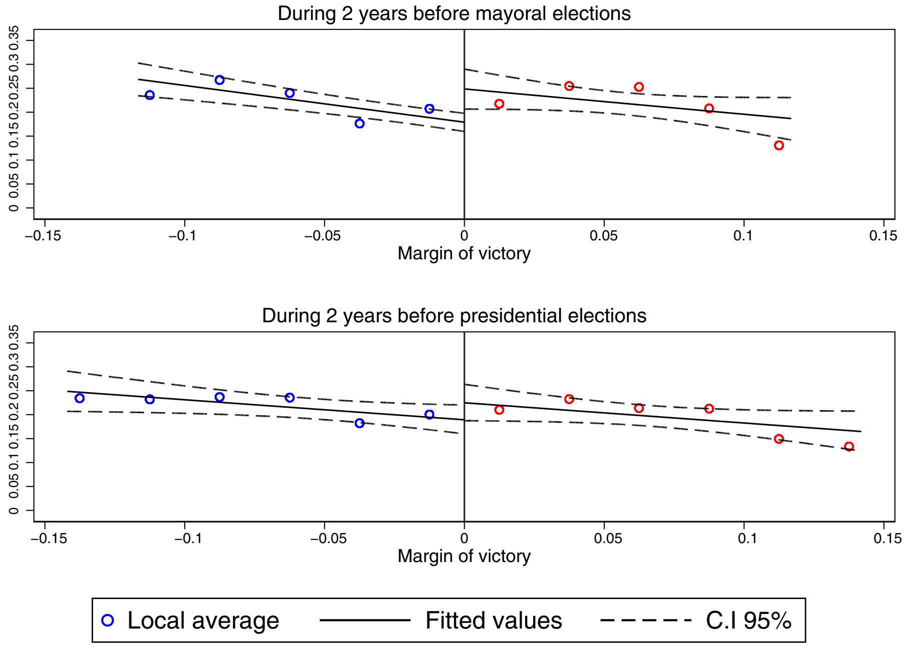


Figure 2. Regression discontinuity design.
*Notes*: Graphs represent predicted values of RDD. The dependent variable is aid relief. The forcing variable is the margin of victory of the candidate affiliated to the incumbent president's party at the previous mayoral election. Optimal bandwidth selected according to Calonico, Cattaneo, and Titiunik (2014). The polynomial order chosen is one. The top graph shows the predicted values in the years preceding a municipal election. The bottom graph represents predicted values for the years leading up to a presidential election. Circles represent the local mean, and dashed lines represent 95% confidence intervals.

on the contrast between before mayoral and before presidential elections and shows the advantage of aligned municipalities in getting transfers. Consistent with our theory, we find a positive and statistically significant bias in favour of aligned municipalities only before mayoral elections.

We now introduce the additional dimension of the intensity-of-drought, to estimate the effect of alignment on the allocation of transfers, conditional on the aridity level. The preliminary inspection of the data (Table 1) already showed that aligned municipalities in the moderate-aridity range are more likely to have the state-of-emergency declared by the federal government before municipal elections, compared to non-aligned municipalities.

Consistent with the findings in Table 1, Figure 3 descriptively shows the relative probability of receiving drought-aid-relief, conditional on a given level of the *SPEI* index. Municipalities with similar *SPEI* are grouped together. Positive values on the vertical axis represent a greater probability of aid relief in favour of aligned municipalities. It is only in the intermediate range of *SPEI* levels before mayoral elections that aligned municipalities are systematically more likely to receive those funds compared to non-aligned municipalities.

Figure 4 represents the smooth plots of the local polynomial estimates using a kernel function of the probability of transfers on SPEI, separately for aligned and

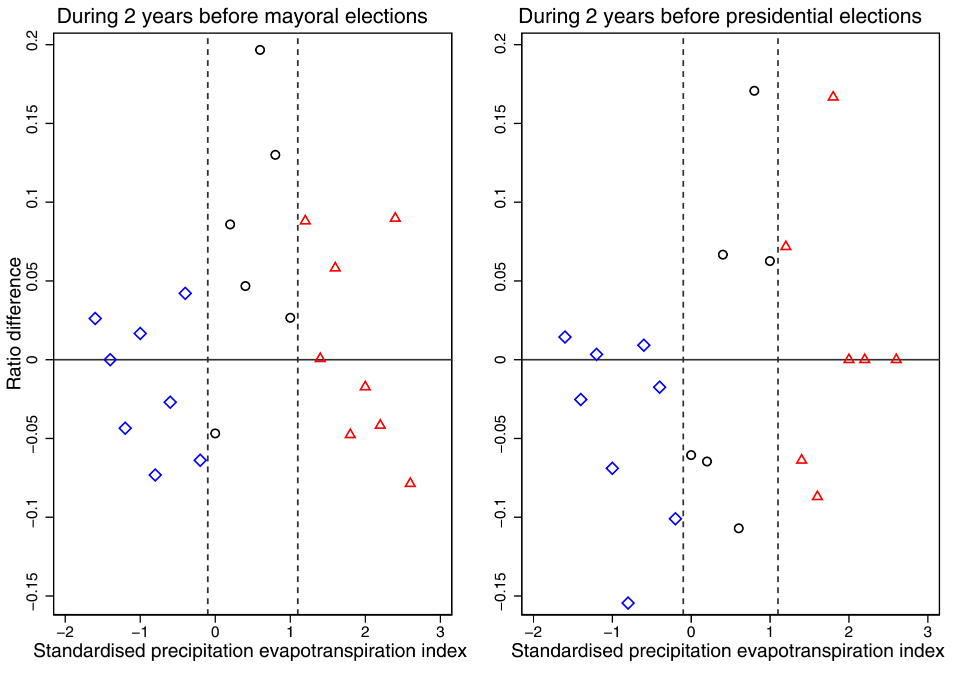


Figure 3. Share of municipalities that obtained aid-relief: difference between aligned and non-aligned municipalities.
*Notes*: The vertical axis represents the difference between the share of aligned municipalities that received aid and the same share for the non-aligned municipalities. Positive values correspond to when the share of aligned municipalities that received aid is larger than the one for non-aligned municipalities. Each dot corresponds to a different degree of aridity, measured by the Standardised Precipitation Evapotranspiration Index (*SPEI*). The two dashed vertical lines delimit the area defined as moderate aridity

non-aligned municipalities. The y-axis shows the kernel function of the likelihood of transfers for different levels of SPEI. The areas indicate the 95% confidence intervals.

As expected, higher values of SPEI are generally associated with a higher likelihood of receiving a transfer.[16] Note that before mayoral elections (left panel) the probability of receiving a transfer grows faster for aligned municipalities (blue, short-dashed line) than for their non-aligned counterpart (red, long-dashed line). Also, aligned municipalities with moderate aridity ($SPEI \in (0, 1)$) have a significantly greater probability of receiving transfers as compared to non-aligned municipalities. Instead, before presidential elections (right panel), there is no statistically detectable difference between aligned and non-aligned municipalities.

Political alignment, however, could be correlated with factors that are unobservable to the econometrician and possibly correlated with the dependent variable. For instance, an omitted variable bias might occur because some characteristics of the incumbent mayor, such as competence and political preference on environmental issues, may be correlated

[16]The only exception to it is the reduction in the estimated likelihood of receiving a transfer in the SPEI range above 2 before presidential elections (right panel). However, such a range includes less than 1% of the observations in the sample.

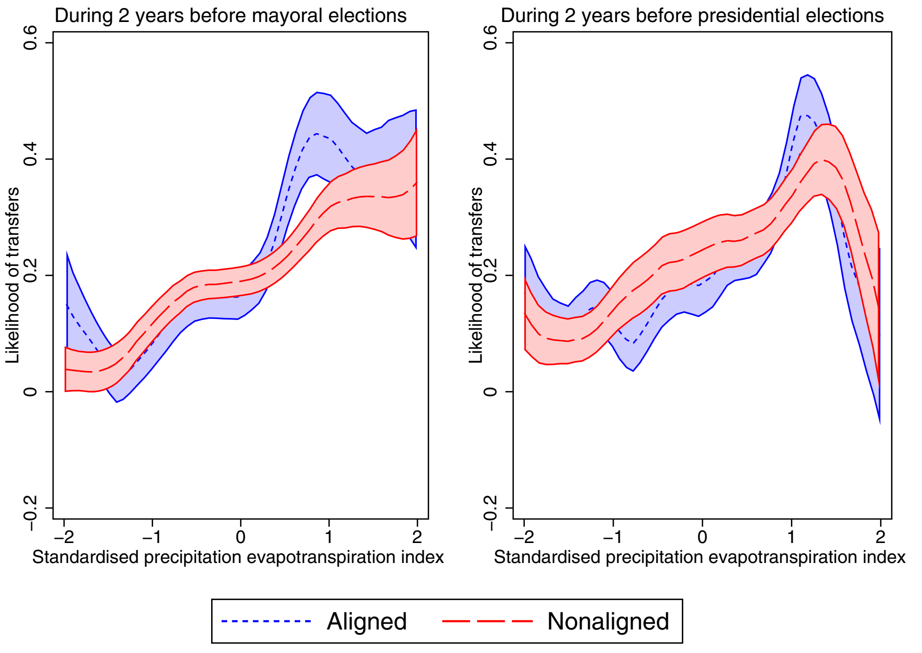


Figure 4. Kernel plots of the likelihood of receiving transfers.
*Notes*: The dashed lines represent local polynomial estimates using a kernel function of the probability of transfers on SPEI. The horizontal axis determines the level of SPEI. The vertical axis indicates the likelihood of transfers. The coloured areas indicate 95% confidence intervals

both with political affiliation and with the ability to obtain aid relief from the central government.

To address this concern, we use a RDD to simulate partisan alignment between governments in a quasi-experimental way. The maintained assumption is that municipalities with a nearly zero margin of victory ($\mathrm{MV}_{i,t-x}$) have statistically-similar unobservable characteristics, except for their alignment status. The McCrary density test confirms no discontinuity in $\mathrm{MV}_{i,t-x}$ (our forcing variable) both for municipal and federal elections.[17]

Equation (7) represents the baseline RDD specification to study the impact of alignment on municipality $i$'s probability of receiving discretionary transfers:

$$\mathrm{Aid}_{i,b} = \beta_0 + \beta_1 \mathrm{Alg}_{i,b} + \gamma_p \mathrm{MV}_{i,t-x} + \theta_p Alg_{i,b} \times \mathrm{MV}_{i,t-x} + \epsilon_{i,b}, \tag{7}$$

where $\mathrm{Aid}_{i,b}$ indicates whether municipality $i$ received transfers during the pre-election biennium.[18] In our linear estimations, we focus on tight elections in which $\mathrm{MV}_{i,t-x}$ can take positive or negative values. $\gamma_p$ represents the prediction of the margin of victory

[17]See the Appendix S1.
[18]For instance, if considering the 2016 mayoral election, $\mathrm{Aid}_{i,b}$ considers transfers granted over biennium $b =$ 2015–16. Similarly, if considering the 2014 presidential election, $\mathrm{Aid}_{i,b}$ considers transfers granted over biennium $b =$ 2013–14.

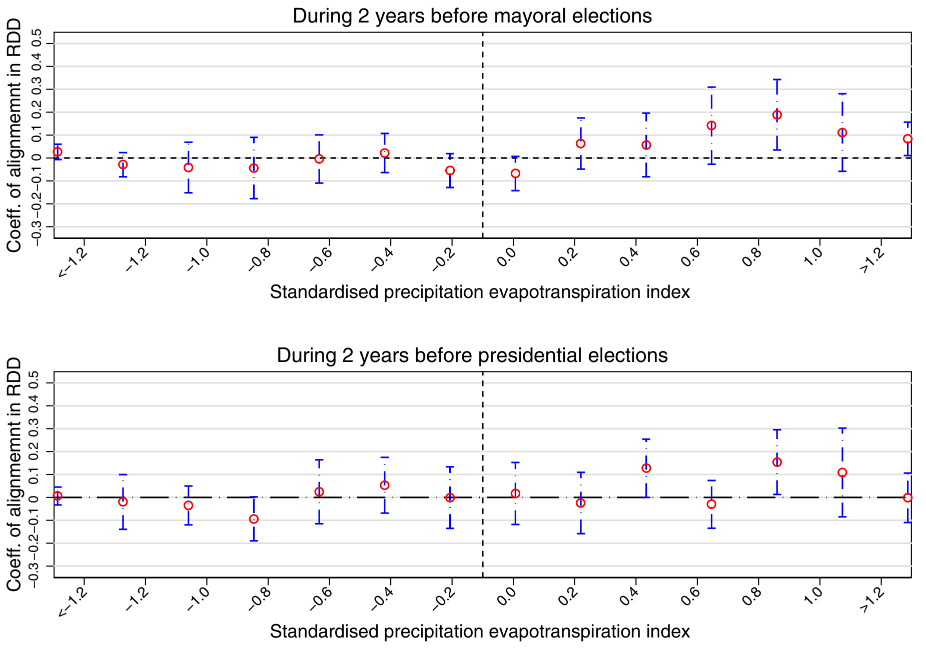


Figure 5. Alignment impact on obtaining aid relief for SPEI ranges.
*Notes*: This figure shows the estimated coefficients of alignment in an RDD setup for each range of SPEI values. The optimal bandwidth is selected according to Calonico *et al.* (2014). The polynomial order chosen is one. The vertical line at each dot represents a 95% confidence interval

of the aligned candidate. $\theta_p$ allows the prediction of the aligned candidate's margin of victory to be different if the candidate has won the elections.[19] We selected the optimal bandwidth according to Calonico *et al.* (2014). In all our specifications, SEs are clustered at the municipality level. Section 5 in Appendix S1 motivates our clustering choice and discusses some alternatives.

Figure 5 plots the coefficients and 95% confidence interval of $\beta_1$ for municipalities within each 0.2 interval of *SPEI* values.[20] The vertical axis displays the relative size of the coefficient of aligned versus non-aligned municipalities. In other words, conditional on a given value of *SPEI*, the greater the estimated value for aligned municipalities, the higher the dot in this graph. In the top graph, corresponding to the period before the mayoral elections, the coefficients are statistically indistinguishable from zero for SPEI $< 0$. That is, when aridity is low, being politically aligned with the president does not lead to a greater probability of receiving aid relief.

A different picture emerges for positive values of SPEI. The coefficients display an inverted U-shape with a peak at a value of SPEI close to 0.8, which is also statistically significant. The results in this top graph are again consistent with the main message of

[19]The subscript $p$ points out that both $\gamma_p$ and $\theta_p$ can be vectors.
[20]*SPEI* is truncated at $-1.2$ and 1.2 because the number of observations drops and Calonico *et al.* (2014) optimal bandwidth cannot be computed. At each end, we grouped the remaining municipalities together. A separate regression is run for each range of SPEI values.

the paper: it is at moderate levels of aridity when politicians in the presidential party have more degrees of freedom to allocate aid funds to aligned municipalities.

The bottom graph repeats the exercise for the period before the presidential elections. For SPEI $< 0$, a similar picture emerges as all coefficients are close to zero and not statistically significant. For positive values of SPEI, both positive and negative coefficients can be found and, furthermore, no consistent pattern emerges. In contrast to the top graph, one cannot conclusively claim that being aligned with the presidential party will lead to a higher probability of aid relief.[21]

Turning to the main empirical specification, we extend the baseline specification in equation (8) to account for the heterogeneity in the level of aridity:

$$\begin{aligned}\text{Aid}_{i,b} = {} & \beta_1\text{LowAridity}_{i,b} + \beta_2\text{LowAridity} \times \text{Alg}_{i,b} \\ & + \beta_3\text{ModerateAridity}_{i,b} + \beta_4\text{ModerateAridity} \times \text{Alg}_{i,b} \\ & + \beta_5\text{SevereAridity}_{i,b} + \beta_6\text{SevereAridity} \times \text{Alg}_{i,b} \\ & + \gamma_p\text{MV}_{i,t-x} + \theta_p\text{MV}_{i,t-x} \times \text{Alg}_{i,b} + \epsilon_{i,b}. \end{aligned} \tag{8}$$

For each of the three aridity levels, we test whether the coefficients for aligned and non-aligned municipalities are statistically different. Rejecting the null hypothesis implies that the federal government shows systematic partisanship bias. To ease the interpretation of the coefficients, we omit the constant term ($\beta_0$) as we do not explicitly account for any baseline category. That is, the coefficients $\beta_1$ to $\beta_6$ indicate the probability of receiving government aid for each type of municipality.

Table 2 presents results combining a RDD with a set of fixed effects. The dependent variable is a dummy taking value one in case of receiving aid relief and zero otherwise. That is, we decompose the sample into six bins depending on their alignment status and aridity level. Columns 1–4 present the set of observations before mayoral elections, while columns 5–8 redo the exercise before presidential elections. The samples obey two restrictions. First, values of the forcing variable ($\text{MV}_{i,t-x}$) are within the optimal bandwidth selected according to Calonico *et al.* (2014); second, we limit our sample to municipalities that appear at least twice, as we account for municipality fixed effects.

Column 1 includes no fixed effects and already displays the main message of this paper. Aligned with theoretical predictions, being politically aligned with the presidential party has no impact on the probability of receiving aid relief in the absence of clear drought signals. The $F$-statistic comparing the estimated coefficients takes a value of 1.38 and is therefore non-significant.

Once we move to the moderate-aridity case, municipalities aligned with the presidential party are clearly more likely to receive aid relief. In particular, while the probability of aid relief is approximately 22% for non-aligned municipalities, it jumps to 40% for aligned ones; the difference is statistically significant ($F$-statistic $= 12.09$). Finally, this difference of 18 p.p. diminishes to only 6 p.p. for the observations allocated in the severe-aridity category. In summary, it is only when aridity conditions are moderate that

[21] For completeness, we observe in the raw data a statistically significant effect at SPEI close to 0.8. However, the effect disappears when including the proper controls.

TABLE 2

*Impact of alignment on the assignment of aid relief*

| *Dep. variable:* | *Aid-relief* | *Before mayoral elections* | | | | *Before presidential elections* | | | |
|---|---|---|---|---|---|---|---|---|---|
| *(drought-state-of-emergencies)* | | *(1)* | *(2)* | *(3)* | *(4)* | *(5)* | *(6)* | *(7)* | *(8)* |
| Low-Aridity | & aligned | 0.149*** | 0.007 | 0.017 | 0.045 | 0.167*** | -0.009 | 0.128** | 0.068 |
| | | (0.093–0.205) | (−0.060 to 0.074) | (−0.063 to 0.097) | (−0.039 to 0.129) | (0.109–0.225) | (−0.081 to 0.064) | (0.022–0.234) | (−0.043 to 0.179) |
| | & non-aligned | 0.111*** | | | | 0.127*** | | | |
| | | (0.076–0.147) | | | | (0.082–0.172) | | | |
| Moderate-Aridity | & aligned | 0.407*** | 0.233*** | 0.230*** | 0.212*** | 0.317*** | 0.174*** | 0.189*** | 0.151** |
| | | (0.317–0.497) | (0.143–0.324) | (0.109–0.352) | (0.098–0.327) | (0.247–0.387) | (0.093–0.256) | (0.063–0.314) | (0.027–0.274) |
| | & non-aligned | 0.226*** | 0.106*** | 0.107*** | 0.088** | 0.322*** | 0.209*** | 0.166*** | 0.164*** |
| | | (0.173–0.280) | (0.049–0.162) | (0.028–0.186) | (0.016–0.161) | (0.254–0.390) | (0.140–0.279) | (0.044–0.287) | (0.052–0.277) |
| Severe-Aridity | & aligned | 0.406*** | 0.235*** | 0.263*** | 0.270*** | 0.423*** | 0.256*** | 0.362*** | 0.312*** |
| | | (0.311–0.500) | (0.140–0.331) | (0.129–0.396) | (0.134–0.407) | (0.317–0.529) | (0.147–0.365) | (0.216–0.507) | (0.167–0.457) |
| | & non-aligned | 0.340*** | 0.205*** | 0.176*** | 0.192*** | 0.425*** | 0.314*** | 0.277*** | 0.296*** |
| | | (0.259–0.421) | (0.124–0.286) | (0.062–0.289) | (0.080–0.303) | (0.318–0.532) | (0.215–0.413) | (0.128–0.425) | (0.159–0.432) |
| Observations | | 1,507 | 1,507 | 1,507 | 1,507 | 1,395 | 1,395 | 1,395 | 1,395 |
| *R*-squared | | 0.279 | 0.320 | 0.775 | 0.795 | 0.305 | 0.352 | 0.681 | 0.711 |
| Bandwidth | | 0.117 | 0.117 | 0.117 | 0.117 | 0.142 | 0.142 | 0.142 | 0.142 |
| Year FE | | No | Yes | No | Yes | No | Yes | No | Yes |
| Municipality FE | | No | No | Yes | Yes | No | No | Yes | Yes |
| *F-statistics tests*:(aligned = non-aligned) | | | | | | | | | |
| (1) in Low-Aridity municipalities: | | 1.380 | 0.043 | 0.176 | 1.095 | 1.210 | 0.059 | 5.669 | 1.458 |
| *P*-value | | 0.241 | 0.836 | 0.675 | 0.296 | 0.272 | 0.808 | 0.018 | 0.228 |
| (2) in Moderate-Aridity municipalities: | | 12.09 | 6.398 | 3.819 | 3.877 | 0.012 | 0.524 | 0.092 | 0.034 |
| *P*-value | | 0.001 | 0.012 | 0.051 | 0.049 | 0.914 | 0.469 | 0.762 | 0.854 |
| (3) in Severe-Aridity municipalities: | | 1.332 | 0.300 | 1.742 | 1.370 | 0.001 | 0.662 | 0.767 | 0.029 |
| *P*-value | | 0.249 | 0.584 | 0.187 | 0.242 | 0.980 | 0.416 | 0.381 | 0.865 |

*Notes*: The forcing variable is the margin of victory in the previous mayoral election of the candidate associated to the party of the incumbent president. Optimal bandwidth selected according to Calonico *et al.* (2014). The polynomial order chosen is one. 95% confidence intervals in parentheses. Errors were clustered at the municipality level.
*** *P*-value < 0.01, ** *P*-value < 0.05, * *P*-value < 0.10.

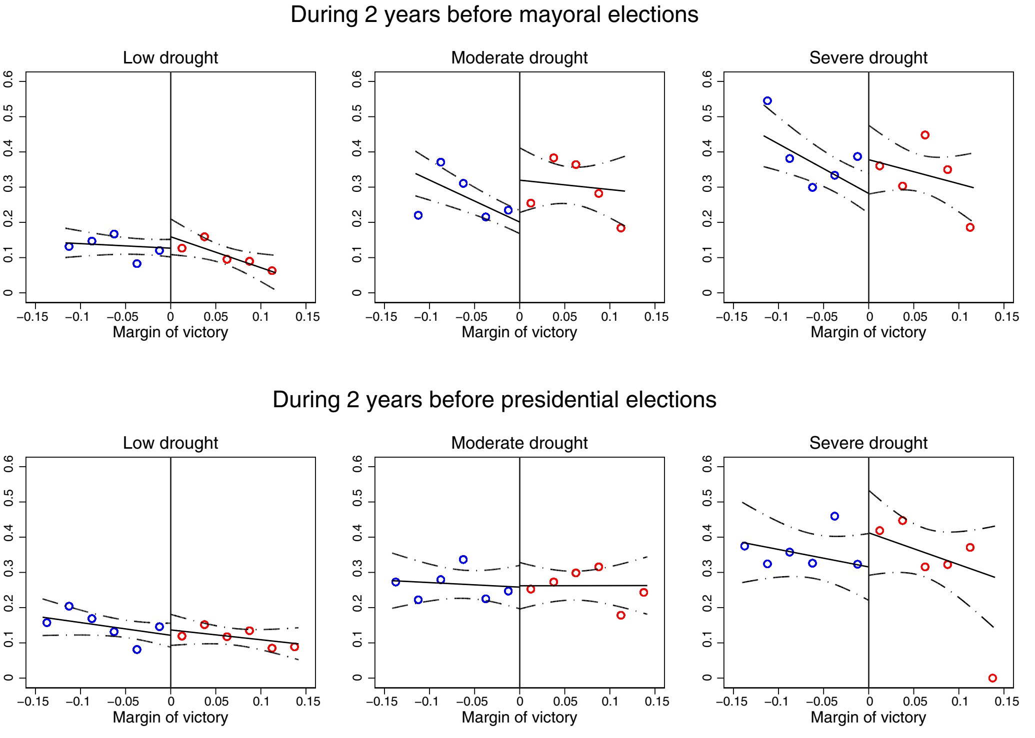


Figure 6. Regression discontinuity design by aridity levels.
*Notes*: The dependent variable is aid relief, the forcing variable is the margin of victory of the candidate associated to the party of the incumbent president at the previous mayoral election. The top three graphs show the predicted values estimated in an RDD setting separately for the municipalities at each aridity level in the years preceding a municipal election. The bottom three graphs represent predicted values for the years leading up to a presidential election. Circles represent the local mean and dashed lines represent 95% confidence intervals

the presidential party biases its support towards aligned municipalities. A similar picture emerges when including year fixed effects (column 2), when including municipality fixed effects (column 3), and when including both sets of fixed effects (column 4). Remarkably, the last two columns state that the political bias towards aligned mayors also emerges when only using variation *within* a municipality over time.[22]

Columns 5–8 present the results before the presidential elections. Consistent with our theory, we do not find signs of favouring politically aligned municipalities. The $F$-statistics are not statistically significant.

Figure 6 shows the differences in predicted values around the RDD threshold between aligned and non-aligned municipalities. We split the sample of municipalities based on aridity (low, moderate, severe) and implement the regressions separately. The top three graphs correspond to the two years before mayoral elections and the bottom ones to the two years before presidential elections. Consistent with previous results, the only

[22]Following the inclusion of fixed effects, variable 'low-aridity & non-aligned' is omitted due to collinearity and will be considered as the baseline.

statistically significant discontinuity occurs in municipalities with moderate aridity in the years preceding municipal elections.

### Robustness and external validity

*Measurement of aridity*

Section 3 in Appendix S1 replicates the analysis using standardised rainfalls (and, in particular, the Standardised Precipitation Index) as a measure of aridity. SPI is still predominantly used in the economics literature. However, the meteorology literature regards it as inferior to SPEI, as it fails to consider an important determinant of aridity, that is, evapotranspiration. We find some differences between the two, although the qualitative results remain broadly unaltered.

The use of SPI instead of SPEI before municipal elections generally attenuates the effects (and in particular the positive effect of alignment on the probability of receiving the aid-relief), especially for municipalities with moderate drought. To the contrary, it has no discernible effects before presidential elections. The limited difference, in our paper, between the two measures, is explained by the meteorology literature, which shows that SPEI and SPI differ especially when comparing long periods of time or far away geographical areas. This is not the case in our analysis, which considers Brazil over 20 years. That notwithstanding, the differences that emerge between SPEI and SPI are concentrated at moderate levels of aridity, which are important, as they represent the focus of our paper. Finally, Section 3 in Appendix S1 also provides evidence suggesting that SPEI improves the precision of our estimates.

To define different levels of aridity, we adopted the usual classification, according to which a standardised index between 0 and 1 corresponds to moderate aridity, while for values above 1 the aridity level is classified to be severe. Section 4 in Appendix S1 shows that our results are robust to alternative classifications. We repeat our main analysis both using a five-level classification of aridity and using an alternative three-level classification. We did not detect significant changes.

*Non-close elections*

Our identification strategy requires focusing only on close elections. Since transfers are likely to be more effective precisely in those swing locations, it may be reasonable to expect that our effects fade out or are attenuated when the elections are less tight. Section 6 in Appendix S1 provides non-causal evidence suggesting that, indeed, the effects may be weaker when the elections are less tight. However, our results do not disappear entirely.

*Urban vs. Rural Municipality*

The level of urban development of a municipality may, potentially, be important for our analysis. As a matter of fact, more rural areas may be more heavily affected by prolonged periods of aridity. Table OA9 in Appendix S1 confirms that the effect is stronger for rural municipalities that suffer a moderate drought.

## IV. Final remarks

Our analysis establishes a novel pattern of distributive politics in federal countries, based on the sequence of upcoming central and local elections. We show evidence that the alignment advantage emphasised in the previous literature (Brollo and Nannicini, 2012; Bracco *et al.*, 2015; Curto-Grau *et al.*, 2018) materialises only in the period before municipal elections (when being aligned implies an increase in the chances of receiving a transfer by 6.3 p.p.), while it disappears in the period before presidential elections. Furthermore, we show that even before mayoral elections the alignment bias is large and significant (18 p.p.) for districts with intermediate levels of aridity, while it is statistically indistinguishable from zero otherwise.

Finally, the probability that a municipality receives the drought-relief increases when transitioning from low to moderate and from moderate to severe aridity. We rationalise these findings in a model of symmetric information with selfish and office-motivated politicians.

Our results hint at the importance of the sequence of upcoming elections in federal countries in determining the welfare effects of discretionary funds. A reduction of the distortions requires timing the discretionary allocations as far as possible from local elections and as close as possible to central elections. A related research question would involve understanding the partisan bias in countries in which central and local elections overlap.

An alternative measure to limit the distortions is to design geographically-different districts for voting and for transfer purposes, making it hard for the central government to target any specific voting district.

## Appendix A: Proofs

*Proof of Proposition 1.* The incumbent's electoral benefit of granting a transfer to a municipality is increasing in droughts:

$$\frac{\partial B_i^T}{\partial D} = \phi\left(\frac{\partial u(c(\overline{T} - D_i))}{\partial D} - \frac{\partial u(c(-D_i))}{\partial D}\right) > 0,$$

where the concavity of $c$ guarantees the sign. Therefore, the best strategy for the president is to grant transfers in order of severity of the drought, starting from the most severe.

Because the utility function is increasing and concave, the marginal utility of transfers is more significant for agents in municipalities that suffered a more severe drought, which means that the president's optimal strategy is also the strategy that maximise social welfare (as defined by the utilitarian social welfare function). □

*Proof of Lemma 1.* Substituting in $E(g_i) = Pr(\epsilon_i < u(c_i) - \underline{u})g_i$ we obtain

$$E(g_i) = \left(\frac{1}{2} + \phi(u(c(\overline{T} - D_i)) - \underline{u})\right)\gamma\phi\left(u(c(\overline{T} - D_i)) - u(c(-D_i))\right). \quad \text{(A1)}$$

The condition for $E(g_i)$ to be increasing in droughts is $\frac{\partial E(g_i)}{\partial D_i} > 0$, that is

$$\frac{\phi^2 u'(c(\overline{T}-D_i))\left(u(c(\overline{T}-D_i)) - u(c(-D_i))\right)}{\left(\frac{1}{2}+\phi(u(c(\overline{T}-D_i)) - \underline{u})\right)\phi} + u'(c(\overline{T}-D_i)) < u'(c(-D_i)). \quad \text{(A2)}$$

The equation simplifies into

$$\frac{u'(c(-D_i))}{u'(c(\overline{T}-D_i))} > \frac{\phi\left(u(c(\overline{T}-D_i)) - u(c(-D_i))\right)}{\left(\frac{1}{2}+\phi(u(c(\overline{T}-D_i)) - \underline{u})\right)} + 1 \equiv \Psi_i, \quad \text{(A3)}$$

from which it is immediate to notice that $\frac{\phi\left(u(c(\overline{T}-D_i))-u(c(-D_i))\right)}{\left(\frac{1}{2}+\phi(u(c(\overline{T}-D_i))-\underline{u})\right)} \in (0,1)$ and $\Psi \in (1,2)$, given the maintained assumption that $\underline{u} < u(c(-\underline{D})) + \frac{1}{2\phi}$. □

*Proof of Proposition 2.* The president assigns transfers to the municipalities that generate more electoral gains. From Lemma 1 we know that, given alignment, transfers will go to municipalities that suffered more severe droughts.

We still don't know whether the severity of drought is the only criterion for the allocation of transfers or whether alignment matters too. To check that, we start by defining $D_a$ to be the least severe level of drought among all the aligned municipalities that received a transfer. Similarly, $D_m$ denotes the least severe levels of drought among all the non-aligned municipalities that received a transfer.

Lemma 1 can be rephrased in the following way: if and only if $\frac{u'(c(-D_i))}{u'\left(c(\overline{T}-D_i)\right)} > \Psi$, the president grants a transfer to all aligned municipalities with $D_i \geq D_a$ and to all non-aligned municipalities with $D_i \geq D_m$.

The only missing step to prove the proposition is to verify if $D_a < D_m$. The expected electoral gain for the president is defined by equation (A4) for the aligned municipality that suffered drought $D_a$ and by equation (A5) for the non-aligned municipality that suffered drought $D_m$.

$$E(g_i) = \left(\frac{1}{2} + \phi(u\left(c\left(\overline{T}-D_a\right)\right) - \underline{u})\right)\gamma_a\phi\left(u\left(c\left(\overline{T}-D_a\right)\right) - u(c(-D_a))\right). \quad \text{(A4)}$$

$$E(g_i) = \left(\frac{1}{2} + \phi(u\left(c\left(\overline{T}-D_m\right)\right) - \underline{u})\right)\gamma_m\phi\left(u\left(c\left(\overline{T}-D_m\right)\right) - u(c(-D_m))\right). \quad \text{(A5)}$$

Comparing equations (A4) and (A5), it is immediate to notice that, if $D_a = D_m$, the expected benefit is the same for aligned and misaligned municipalities only if $\gamma_a = \gamma_m$.

Suppose that $\frac{u'(c(-D_i))}{u'\left(c(\overline{T}-D_i)\right)} > \Psi$. Since $\gamma_a > \gamma_m$ by assumption, it follows immediately that the expected benefits are equal if and only if $D_a < D_m$. Clearly, the result would be inverted ($D_a > D_m$) if $\gamma_a < \gamma_m$.

The welfare-maximising allocation of transfers would require them to be assigned based on the severity of droughts only, irrespective of alignment. Any deviation from that is welfare-inferior. Hence, every time that $\gamma_a \neq \gamma_m$, the president's allocation is not optimal in terms of voters' welfare. □

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## Supporting Information

Additional Supporting Information may be found in the online Appendix:

**Appendix S1.** The online appendix is available at https://doi.org/10.13140/RG.2.2.29618.07364

Data replication package: the data replication package is available at https://doi.org/10.3886/E188961