Strategic Allocation of Irrevocable and Durable Benefits

Appendix for Online Publication

Contents

A Probabilistic Voting Model

Consider a state with M municipalities where the state incumbent party (P) competes in a proportional election against the opposition (O).[1] For simplicity, assume that all municipalities have the same size (N) and the same poverty level. Party P allocates cisterns across municipalities. In doing so, it defines the total number of cisterns built in a municipality m (given by G_m), but it cannot target specific voters.[2] Define $g_m := G_m/N$ as the share of voters in municipality m that receive the good.

Party alignment between state and mayor is given by $a_m \in \{0, 1\}$, i.e., whenever the mayor belongs to party P, $a_m = 1$. Cisterns affect electoral results in two ways: first, voters retrospectively reward state governments for the utility given by the cistern. The present value of the future income flow provided by cisterns is C, so voters assign a value $c := u(C)$ to the good ($u_C > 0$). When mayor and state are unaligned, electoral rewards are shared by the two parties, with the opposition party 'stealing' a share $\theta \in [0, 1/2]$ of c. Second, cisterns also reduce vulnerability, and thus the effectiveness of vote buying. I assume that only mayors can buy votes for their parties in these elections, using the rents of office. Mayors always offer a revocable or perishable good of exogenous value T to a p_m share of voters. Voters assign utility $t := v(T)$ to these transfers ($v_T > 0$), and we assume that cisterns themselves are always more valuable to voters than T (or $c > t$). Accordingly, the share of voters receiving these offers in municipality m ($p_m \in [0, 1]$) is increasing in the effectiveness of the local machine controlled by the mayor. For simplicity, I assume that when voters have a cistern, they assign no value to T.

The probability that a cistern works and effectively reduces the voter's vulnerability is given by $\gamma_m \in [0, 1]$ and reflects, for instance, weather patterns in municipality m. Finally, voter i in municipality m has an idiosyncratic preference for the opposition denoted by ξ_{im}. This variable is distributed uniformly in $[-1/2\psi_m, 1/2\psi_m]$, as it is usual in these models. Parties know the distribution of preferences in each municipality, but not the specific value for each voter.

Voters choose a party based on the utility they receive from parties P and O, and on their idiosyncratic preference shock. The equation below shows the utility differential between two parties ($u^P - u^O$) for either a voter that received a cistern or one that did not.

[1] This illustrates the state-wide legislative elections used in the empirical application, where the number of seats are defined by the share of votes of each party.

[2] Cistern are randomly assigned to voters in each municipality

$$(u^P - u^O | G_{im} = 1) = \gamma_m \Big[c(1-\theta(1-a_m)) \Big] + (1-\gamma_m) \Big[(2a_m - 1)tp_m \Big] - \xi_{im}$$

$$(u^P - u^O | G_{im} = 0) = (2a_m - 1)tp_m - \xi_{im}$$

Every voter i with a positive utility differential in a given municipality prefers party P in the state elections. Thus, I can use the distributional assumptions to estimate the share of votes for the state incumbent in each municipality (π_P). This can be done separately for the group of voters with a cistern, and for the group of voters without one:

$$(\pi_P | G_{im} = 1) = \sum_M \psi_m \left(\gamma_m \Big[c(1-\theta(1-a_m)) \Big] + (1-\gamma_m) \Big[(2a_m - 1)tp_m \Big] + \frac{1}{2\psi_m} \right)$$

$$(\pi_P | G_{im} = 0) = \sum_M \psi_m \left((2a_m - 1)tp_m + \frac{1}{2\psi_m} \right)$$

Accordingly, the total share of votes for the incumbent in each municipality is a combination of the shares in the two groups, and it is given by:

$$\pi_P = \frac{G_m}{N} (\pi_P | G_{im} = 1) + (1 - \frac{G_m}{N})(\pi_P | G_{im} = 0) \tag{1}$$

Incumbents face a cost of building cisterns, given by $\kappa/2 \sum_m G_m^2$. This function assumes that the marginal cost of building a cistern increases with the total number of cisterns in each municipality. The timing of events is as follows: (1) the state party observes both alignment and the strength of the machines controlled by mayors, and allocate cisterns to municipalities so as to maximize its share of votes in the state, which is the sum of the share of votes in each municipality, subject to the cost; (2) before elections, mayors target a share of voters with transfers T; (3) voters evaluate their utility and state elections happen. I can use the first order condition of this maximization problem to find the explicit value of g_m:

$$g_m = \frac{\psi_m \gamma_m}{\kappa N^2} \Big[\underbrace{c(1-\theta(1-a_m))}_{\text{Retrospective Rewards}} - \underbrace{t(2a_m - 1)p_m}_{\text{Income Effect}} \Big] \tag{2}$$

The term in brackets highlights the role of retrospective rewards and the income effect on how cisterns affect voting behavior. This article is particularly interested on how the marginal effect of alignment on the distribution of cisterns, and how this effect varies with the strength of the mayor's political machine. Below I show the predicted share of voters with a cistern for both aligned (g_1) and unaligned (g_0) municipalities.

$$g_1 = \frac{\psi_m \gamma_m}{\kappa N^2}\left[c - tp_m\right]$$
$$g_0 = \frac{\psi_m \gamma_m}{\kappa N^2}\left[c(1-\theta) + tp_m\right]$$

It is easy to see that when the mayor and state party are aligned, the retrospective rewards from cisterns are higher than in unaligned municipalities, given that $(1-\theta) > 0$. However, state incumbents face a trade-off between these rewards and the income effects of cisterns, which in the case of aligned mayors, undermine local clientelistic activity by party P. In municipalities governed by an opposition mayor, the effect of cisterns on votes is unambiguous: it generates gains from both retrospective rewards and from undermining clientelistic activity by party O.

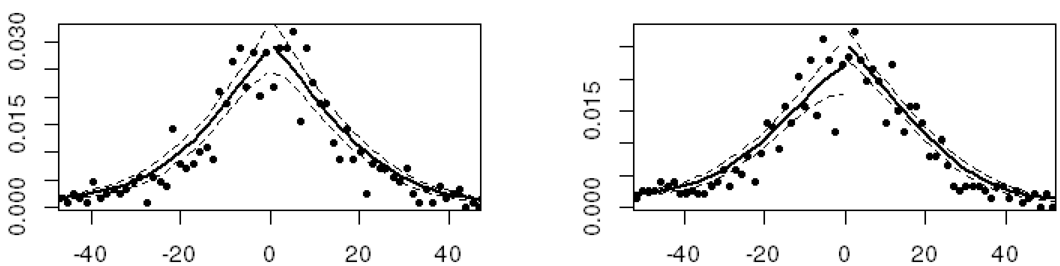
The equation below shows the marginal effect of alignment. Without loss of generality, assume that we compare two municipalities with the same values of ψ_m, γ_m, and p_m. For low enough values of p_m (and a large enough value of θ), cisterns are more attractive in aligned municipalities as their rewards compensate for losses in clientelism. As p_m increases, unaligned municipalities become more attractive. Finally, the effectiveness of cisterns, given by γ_m, indicates that these marginal effects of alignment are more extreme the more efficient cisterns are in generating utility value to voters.

$$g_1 - g_0 = \frac{2\psi\gamma_m}{\kappa}\left[\theta c - tp_m\right] \tag{3}$$

B Additional Details on the RD design

One common concern for this identification strategy is that, if the position of municipalities can be manipulated around the treatment assignment threshold, the estimated effects might be biased. For example, if aligned candidates win municipal elections more often within the entire sample of municipalities, this does not represent a threat to the research design here. However, in close elections, aligned candidates cannot win or lose elections with a higher probability. As it is the practice for RD designs, I show in Figure A.1 below that the density of observations is not significantly different around the discontinuity for both subsamples (weak and strong machine mayors), which is also confirmed by the p-values of 0.79 and 0.24 found using the McCrary test for these subsamples.

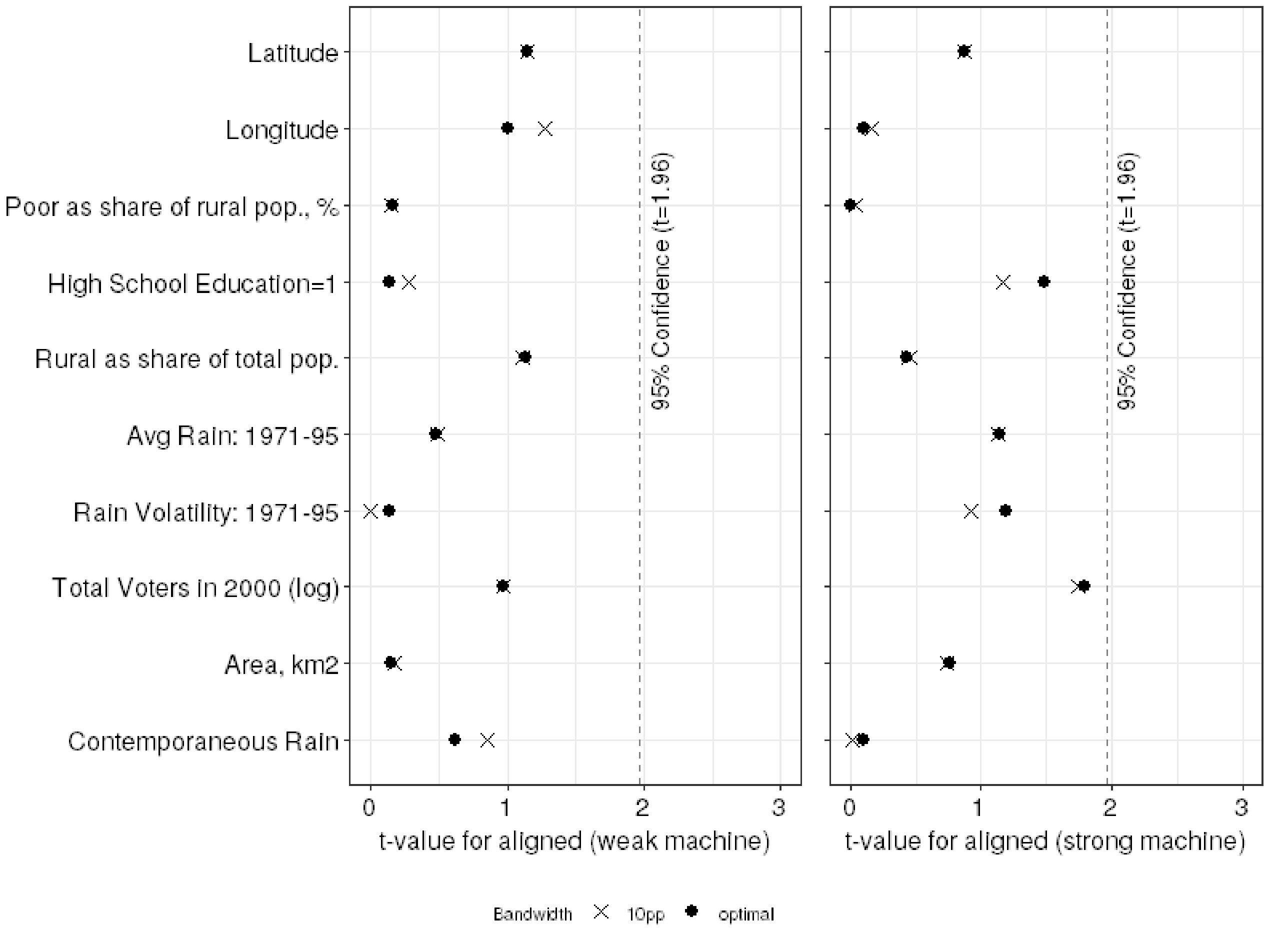
Figure A.1: Distribution of observations around the discontinuity



p-values of 0.90 and 0.22 for the McCrary test. Weak machines on the left, strong machines on the right.

As it is also usual in RD designs, I show in Figure A.2 that many characteristics of municipalities that are fixed or determined pre-treatment are balanced at the discontinuity threshold, for both subsamples. In other words, this test aims to show that these other traits of municipalities are not the factors that determine the differences found in the outcome variables. No variable shows a significant difference at the discontinuity in either sample. Nevertheless, in Table 4 of this appendix I show that the RD results are robust to the inclusion of these outcomes as covariates.

Figure A.2: Balance of covariates



The points represent the t-values of the coefficient for alignment, in both relevant subsamples. I show the coefficient for the optimal bandwidth for each variable, and for a bandwidth of 10 percentage points in margin of victory, which is similar to the optimal bandwidth for the main outcome variable.

In Table A.1 I also show alternative specifications for the RD estimates, which include a quadratic polynomial on the running variable (in addition to the linear baseline), and the inclusion of the covariates listed in Figure A.2. All regressions are estimated under the edge kernel. The first column reflects the baseline results already discussed in the main text. The coefficients remain relatively constant in all alternative specifications.

Table A.1: Robustness of the RDD estimates for cisterns

Dependent variable: Cisterns	(1)	(2)	(3)	(4)
Aligned (a)	1.225	1.474†	1.310	1.354
	(0.897)	(0.852)	(1.217)	(1.268)
Membership (b)	2.176*	2.779*	2.348†	1.904
	(1.042)	(1.106)	(1.296)	(1.234)
Aligned * Membership (c)	-4.134*	-4.246*	-4.361*	-4.579*
	(1.300)	(1.386)	(1.736)	(1.686)
(a) + (c)	-2.909*	-2.772*	-3.051*	-3.225*
	(1.054)	(1.093)	(1.237)	(1.191)
Bandwidth	10.12	10.12	12.42	12.42
Observations	857	857	1015	1015
Polynominal	Linear	Linear	Quadratic	Quadratic
Covariates	No	Yes	No	Yes

$^{\dagger}p<0.1$, $*p<0.05$. Standard errors are clustered by municipality and presented in parenthesis. The covariates are all variables listed in Figure A.2, plus state fixed effects. Bandwidths are optimal.

C Party membership of individual beneficiaries of cisterns

I use data on individual beneficiaries of state cisterns to examine whether the distribution of these irrevocable and durable goods can be an effective strategy to increase the local mobilization capacity of different political parties. In this section, I describe the procedure used to produce the estimates found in Figure 9 in the main text.

The data here is built based on three different administrative datasets obtained from the federal government: (i) the party membership rolls, (ii) the *Cadunico* registry used by the federal government to manage social programs; and (iii) the list of individual cistern recipients. First, I merged the list of individual cistern recipients with the CadUnico database. CadUnico is a centralized registry used by the federal government to enroll households in different social programs. It was created to manage *Bolsa Família*, and contains extensive (self-reported) information on millions of households and its members, collected at the moment of their first registration. I used this information to create a control group for the recipients of state cistern, composed by other poor households in the same municipality that are similar in many dimensions, but did not receive a cistern.

These two datasets were merged by the beneficiary's name, which as the only identifying information in the cisterns' database. In order to avoid double matches, I excluded from both databases all people with duplicated names within the same municipality. These reduced the cisterns database by only 2%, but had a more significant impact in CadUnico (8% of observations were excluded – the larger database was expected to have more repeated names). Also, I only considered the CadUnico observations for which the voter registration number was present, which was necessary to later merge it with party membership rolls. All Brazilians have a voter registration document, but many were missing from Cadunico (this reduced my potential sample by 45%).

After merging the two datasets, I matched beneficiaries of state cisterns to poor voters without a cistern in the same municipality. The matching was one-to-one, exact on sex, race, year of CadUnico registration, and on a dummy indicating whether the voter was a party member before the treated household received a cistern. I also matched only households with reported monthly income within a maximum difference of R$5 (around US$2 at the time). Overall, the sample still ended up with very large number of cistern beneficiaries (roughly 38,000), and a much larger number of potential matches (roughly 371,000). The one-to-one matches were then obtained picking one control observation for every treated voter at random (results are very robust to different randomization seeds).

I then merged this matched database with the party membership rolls using the voter registration numbers. This allowed me to observe whether beneficiaries of cisterns were more or less likely to join parties than their control counterparts after they receive the good. Around 2.2% of all households in this sample joined a party in the post-cistern period. Using this data, I then coded the following binary outcomes, depending on the party that the voter joined, as follows: (i) Government: voter joined state party; (ii) Mayor: mayor's party; (iii) Main opposition (to state): mayor's party in unaligned municipalities, or the runner-up in the mayoral race in aligned ones; (iv) Largest party: party with the largest membership in that municipality for each electoral cycle; (v) Top 2 + Government: party of the top 2 candidates in the last municipal election, plus the state governor's party; (vi) Other parties: all parties not in *Top 2 + government*; and (vii) All: all parties. I regress these outcomes on a treatment dummy that takes value one for voters that received a state cistern (and zero for non-beneficiaries). All regressions are estimated with municipality-period effects (the period refers to the 2-years between elections in Brazil), and standard errors are clustered at the same level. The results are discussed in the main text, and shown in Figure 9.

D Heterogeneous effects by the membership of the state party in the control group

The theory in this paper predicts that state governments avoid allocating cisterns to municipalities where they control a powerful political machine. The strength of the state's local machine comes from a combination of two factors: (i) having an aligned mayor in the location, and therefore access to budget resources for patronage; and (i) having local mobilization capacity to efficiently allocate those resources across targeted voters (party membership). In this context, this paper focuses on the mayor's party at the local level, and examines how the distribution of irrevocable and durable goods (cisterns) is shaped by both the partisanship and the mobilization capacity of mayors.

In doing so, however, the empirical exercise does not directly examine how the allocation of cisterns responds to the size of the state party's membership in unaligned municipalities (control group), where the state party does not hold the mayorship. Even though the state party does not control local budget resources in these places, it would be interesting to know whether its local membership also affects the allocation. At first, the data indicates that the size of the state party's membership in the control group is negatively correlated with the distribution of cisterns.[3] Nevertheless, this is not conclusive evidence that the state's local membership impacts the allocation strategy. If the party sizes of the state and the mayor are negative correlated in the municipality, this coefficient could be simply reflecting the fact that allocation of cisterns increases with the size of the mayor's party in the control group (in line with the paper's theory and empirical results).

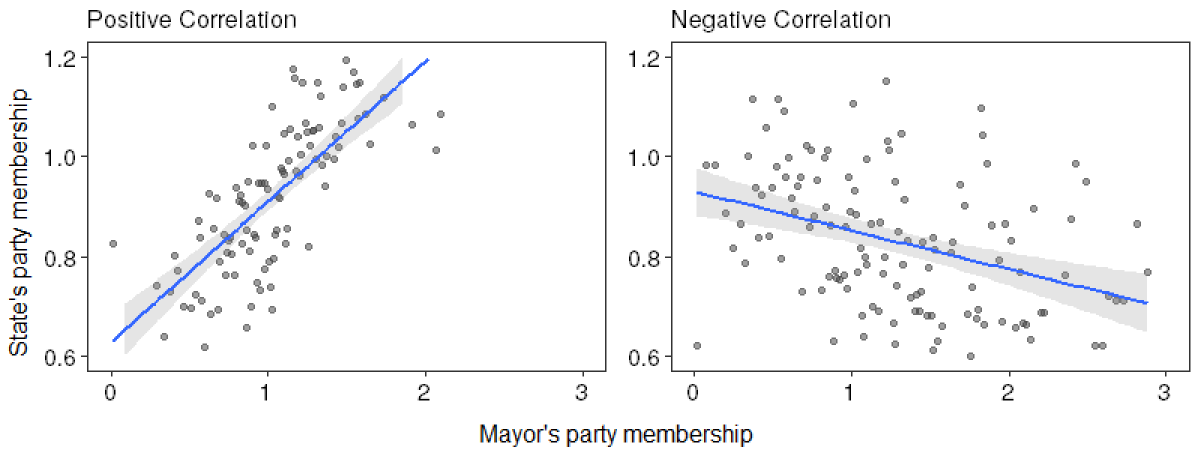
In this section I systematically test how the state party's size in the control group affects the estimates, using the heterogeneity of the main results by two subsamples, based on the mobilization capacity of the "secondary" party in the municipality. For the control group, this is the state party. For the treatment group, this is the municipal runner up. Accordingly, the first subsample is called the *positive-correlation* group. Here, the size of the mayor's party in the municipalities is very similar to the size of the secondary party (e.g. they are positively correlated). The remaining municipalities are the *negative-correlation* sample.[4] Figure A.3 shows the correlation between the state party and the mayor's

[3] A regression of the cisterns variable on the state party's membership, in the control group, yields a coefficient of -1.12, statistically significant at a 99% confidence level.

[4] In practice, I create a variable that measures the absolute difference between the membership sizes, with values adjusted by municipality and period fixed effects, and split the sample using the median value of this variable into low and high *difference* groups. The group with the low differences is the positive correlation sample.

party in the control group of the two subsamples.

Figure A.3: The size of the state and the mayor's parties in unaligned municipalities



The definition of the samples in described in the text. For the purpose of presentation, the observations are aggregated by the average value of these variables in 150 bins, in each sample. The line represent a linear fit.

There are two reasons why this comparison is very interesting in the context of this paper's theory. First, if the main results significantly differ across these two samples, there is evidence to believe that the state party also considers its own membership size in the allocation of cisterns, even when it does not control the mayorship. Second, if the results disappear in the positive correlation sample, this could suggest that one of the main predictions of the theory is incorrect, i.e., that states do not really care about the membership size of opposition mayors, but primarily consider their own party membership in the allocation of these goods. For example, consider two municipalities where mayors have high mobilization capacity, one aligned and one opposition. The main results show that states give more cisterns to the opposition mayor, partially because they prefer to *hurt* the unaligned machine. However, this is only true if the result is observed where the state party also has a large membership in the unaligned municipality.

Table A.2 below shows the estimation results.[5] The coefficients are similar across the two subsamples, and all differences are small and not statistically significant. All-in these results suggest that the state's primary concern in the control group is with the party that controls budget resources (the mayor's), over the membership size of its own party. In that, they reinforce this paper's theory that

[5]They come from a single regression, where the *positive-correlation* dummy is interacted with the variables that measure alignment and party membership (a_{it}, c_{it} and $c_{it} \times a_{it}$).

states actively allocate cisterns in a way that could also undermine the mobilization efforts of opposition mayors.

Table A.2: Distribution of cisterns by different control groups

	Positive Correlation (1)	Negative Correlation (2)	Difference (3)
Aligned (a)	2.063*	1.375	-0.688
	(0.810)	(0.933)	(1.299)
Membership (b)	0.098	0.333	0.235
	(0.345)	(0.220)	(0.350)
Aligned * Membership (c)	-1.368*	-1.477*	-0.109
	(0.556)	(0.618)	(0.765)
Observations	5292	5292	5292

†p<0.1, *p<0.05. Standard errors are clustered by municipality and presented in parenthesis. All regressions include fixed effects for time and municipality. These results reflect the coefficients from a single regression, where the positive-correlation dummy is interacted with the variables that measure alignment and party membership (a_{it}, c_{it} and $c_{it} \times a_{it}$).

E Additional Tables and Figures

Table A.3: Description of the main variables

Variable	Mean	SE	Median	Min.	Max	Obs.
State cisterns	2.178	11.978	0.000	0.000	663.636	5292
Discretionary transfers	19.333	28.118	10.018	0.000	409.522	3208
Average LT precipitation	67.253	14.786	66.258	31.516	128.510	5292
Recent precipitation	64.419	17.742	62.692	19.517	142.579	5292
Rural share of population	52.935	18.911	54.155	0.413	93.302	5292
Mayor aligned	0.177	0.381	0.000	0.000	1.000	5292
Mayor's partisanship	2.138	2.209	1.521	0.000	34.960	5292
PT	0.051	0.221	0.000	0.000	1.000	5292
PSB	0.079	0.270	0.000	0.000	1.000	5292
MDB	0.175	0.380	0.000	0.000	1.000	5292
PSDB	0.134	0.341	0.000	0.000	1.000	5292
DEM	0.184	0.388	0.000	0.000	1.000	5292

The variables are defined as follows: (1) **State cisterns:** cisterns distributed by States in a 2-year period, per 100 rural households; (2) **Discretionary Transfers:** Average annual amount of discretionary state transfers, in R$ per voter. This variable is only available for 61% of the sample. (3) **Average LT precipitation:** cm per year, 1971-1995; (4) **Recent precipitation:** cm per 2-year period; (5) **Rural share:** share of rural population in 2000; (6) **Mayor aligned:** share of period with state-mayor party alignment; (7) **Mayor's party membership:** share of voters affiliated to the mayor's party, in 2000; (8-12) share of elected mayors by each party.

Table A.4: Party membership and self-reported vote buying

	(1)	(2)	(3)
Membership, % of voters	1.135*	1.011†	1.235*
	(0.418)	(0.523)	(0.548)
Population, (log)		-0.003	-0.005
		(0.008)	(0.008)
Observations	106	106	106
Region Fixed-effects	No	No	Yes

†p<0.1, *p<0.05. Source: The AmericasBarometer by the Latin American Public Opinion Project (LAPOP), www.LapopSurveys.org. The dependent variable is the share of respondents that were offered goods or services for their vote in the 2010 election. Standard errors are presented in parenthesis. All regressions control for the median age and income of the respondents in each of the 106 municipalities.

Table A.5: Allocation of state discretionary transfers

Dependent Variable: Transfers	(1)	(2)	(3)	(4)
Aligned (a)	4.763*	-1.897	3.834*	-0.995
	(1.262)	(2.911)	(1.085)	(2.516)
Membership (b)		-1.395		-1.578
		(1.188)		(1.001)
Aligned * Membership (c)		5.636*		4.028*
		(2.422)		(2.049)
Observations	2618	2618	3210	3210

†p<0.1, *p<0.05. Standard errors are clustered by municipality and presented in parenthesis. Transfers are calculated in R$ per voter. All regressions include fixed effects for time and municipality, and control for contemporaneous rain level, the overall size of the municipal budget in each 2-year period, and the share of budget coming from all intergovernmental transfers (state discretionary excluded). Columns (1) and (2) exclude the municipalities that did not receive any state discretionary transfers in the period, columns (3) and (4) include them.

Table A.6: Allocation of cisterns to mayors from parties in the federal coalition

Dependent Variable: Cisterns	(1)	(2)	(3)	(4)
President's party (a)	0.443	0.323	0.142	-0.182
	(0.563)	(1.130)	(0.237)	(0.365)
Membership (b)		0.392		0.270
		(0.379)		(0.256)
President's party * Membership (c)		0.142		0.334
		(1.170)		(0.350)
Observations	3720	3720	2143	2143

†p<0.1, *p<0.05. Standard errors are clustered by municipality and presented in parenthesis. The dependent variable is the number of cisterns per rural household in every 2-year period. All regressions include fixed effects for time and municipality, and control for contemporaneous rain level.

In columns (1) and (2), *President's party* is defined as a binary variable that assumes value of one when the mayor belongs to PT. The estimates in these columns exclude periods where the governor belonged to PT, so as to avoid the confounding with the mechanism proposed by this paper. In columns (3) and (4), *President's party* is defined as a binary variable that assumes value of one when the mayor DOES NOT belong to any of the large opposition parties (PSDB, DEM, PDT and PPS). The estimates in these columns exclude periods where the governor belonged to any party in the federal coalition, so as to avoid the confounding with the mechanism proposed by this paper.

Table A.7: Distribution of NGO cisterns by ASA

Dependent Variable: NGO Cisterns	(1)	(2)	(3)	(4)	(5)
Aligned (a)	0.199	0.323	0.508	0.476	-0.164
	(0.345)	(0.840)	(0.497)	(0.717)	(0.498)
Membership (b)		0.624	0.461	0.261	0.522
		(0.565)	(0.294)	(0.460)	(0.618)
Aligned * Membership (c)		-0.120	-0.631	-0.318	0.218
		(0.763)	(0.654)	(0.719)	(0.458)
(b) + (c)		0.504	-0.170	-0.057	0.740
		(0.718)	(0.608)	(0.563)	(0.496)
Observations	5292	5292	5292	5292	5292

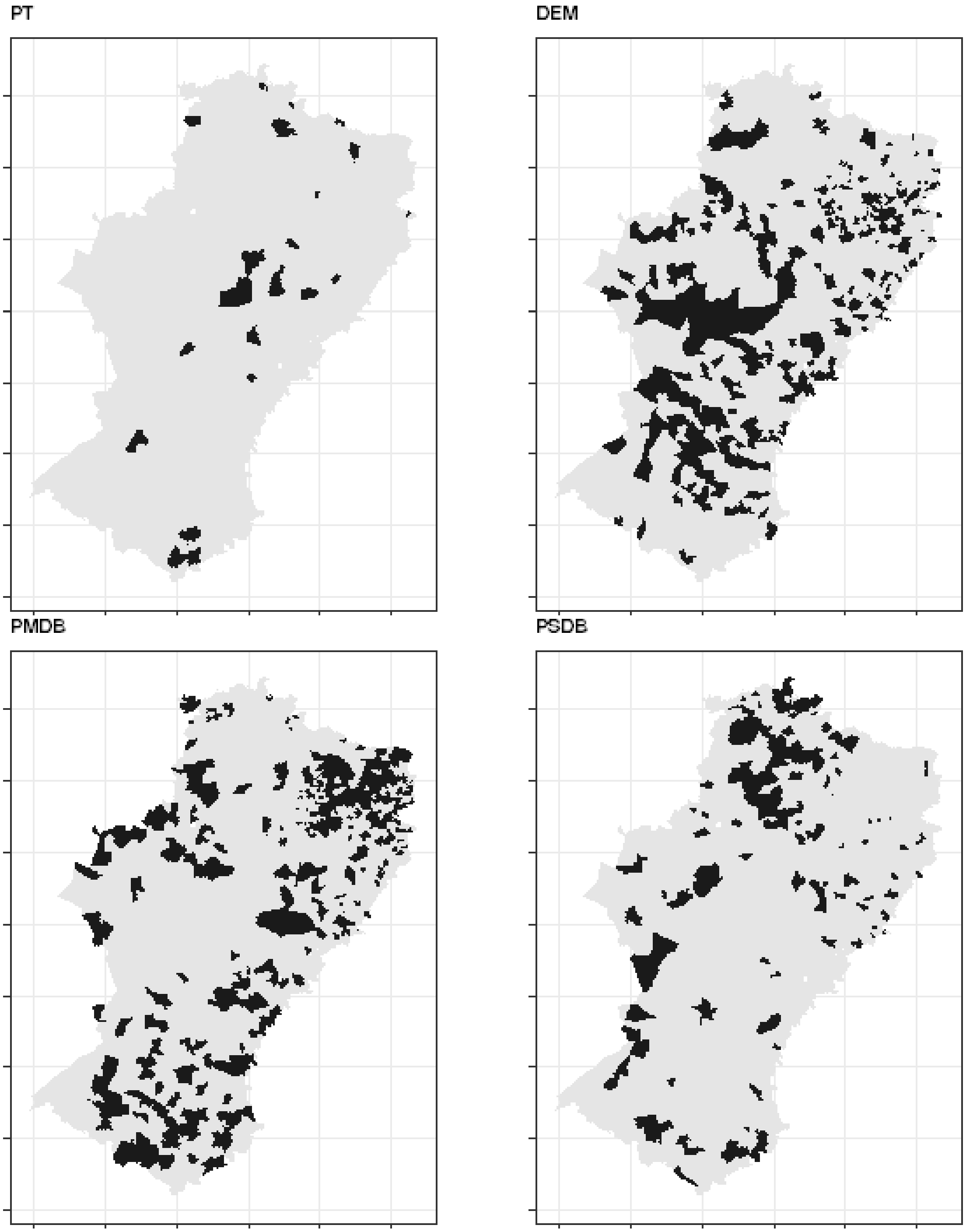
†p<0.1, *p<0.05. Standard errors are clustered by municipality and presented in parenthesis. All regressions include fixed effects for time and municipality, and control for contemporaneous rain level. Columns (1), (2) and (5) use the log-linear variable for c_{it}. Column (3) codes mobilization capacity as a binary variable. Column (4) uses the 2000 size of party memberships. Column (5) codes alignment based on all parties in the state government coalition.

Table A.8: Allocation of state cisterns and changes in party membership

Dep. Variable: 2012 Party Membership	(1)	(2)	(3)	(4)
Cisterns (a)	0.008	0.003	0.002	0.000
	(0.007)	(0.009)	(0.003)	(0.004)
Aligned (b)		0.101*		0.047*
		(0.042)		(0.018)
Aligned * Cisterns (c)		0.018		0.006
		(0.016)		(0.007)
(a) + (c)		0.021		0.006
		(0.013)		(0.006)
Observations	2649	2649	2649	2649

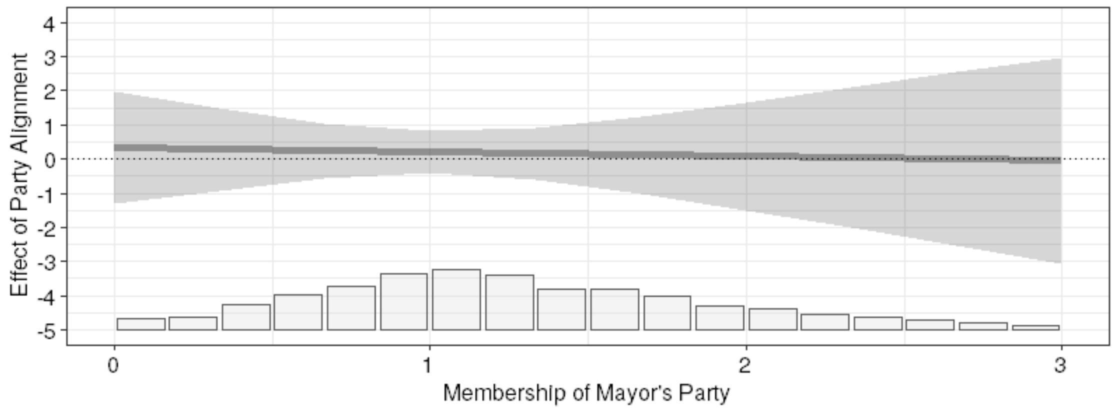
†p<0.1, *p<0.05. Standard errors are clustered by municipality and presented in parenthesis. The dependent variable is the party memberships in 2012 of all parties that occupied the state government in 2003-2012 (there are 2,651 party-municipality pairs). Columns (1) and (2) have the linear variable, columns (3) and (4) have the log-linear version. The dependent variable is regressed on the total number of cisterns (per household) that each state party sent to the municipality in 2003-12, and interacted with a dummy that indicates whether cisterns were sent to aligned or opposition municipalities. All regressions control for the past party memberships in the municipality (in 2000), and include municipality fixed-effects.

Figure A.4: Largest political parties by municipality



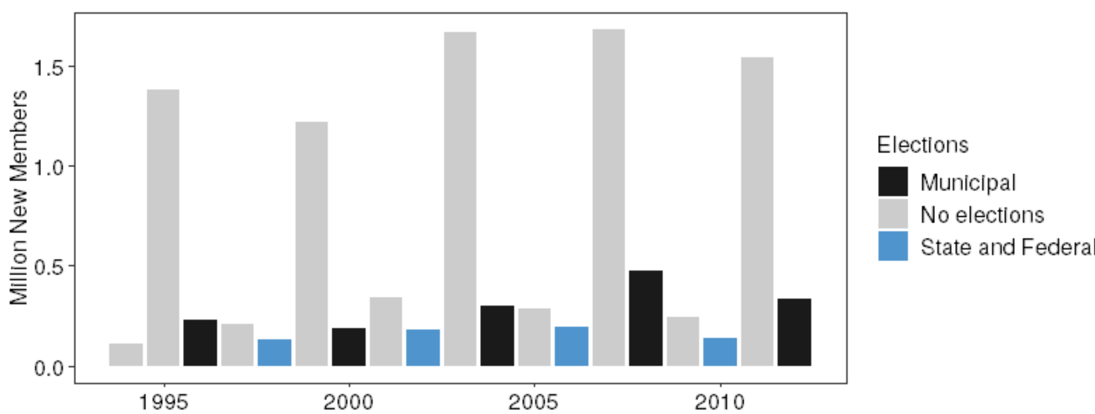
Municipalities in dark are the ones were the party holds the largest number of partisans.

Figure A.5: NGO cisterns: marginal effect of alignment



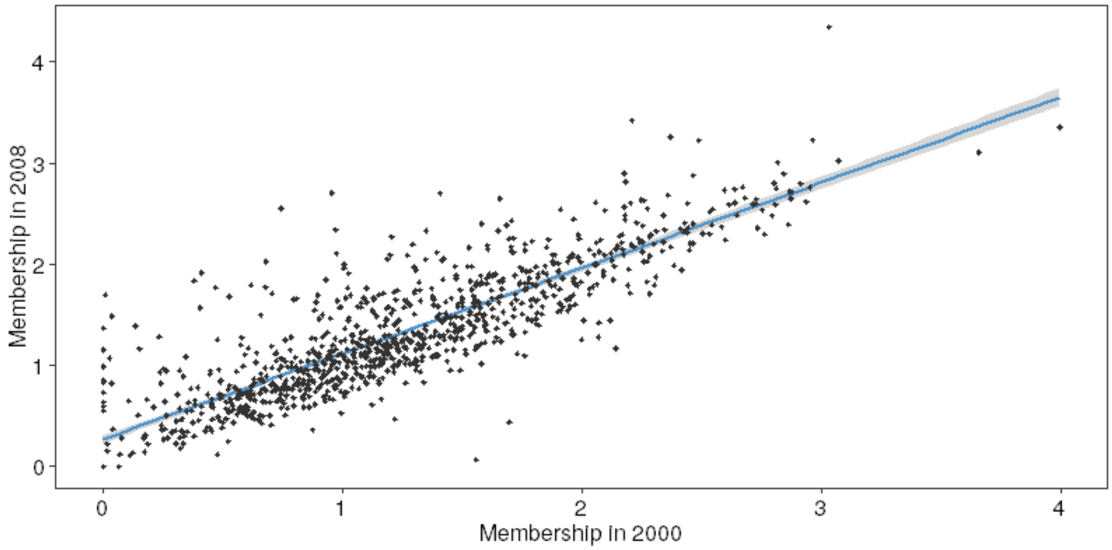
Confidence intervals at 95%. The bars show the density of the sample. For the purpose of presentation, the plot does not show values above 3 in the x-axis, 1% of the sample.

Figure A.6: Party recruiting in Brazil



The bars represent the number of registered members every year.

Figure A.7: Party membership in the semi-arid: 2008 vs. 2000



Membership is denoted as the percentage of voters in the previous election that were party members (in log transformation). Compares the membership in 2008 vs. 2000 for parties that help the mayorship in 2001-04, for all municipalities in the sample.

Figure A.8: Cistern

source: State Government of Maranhão.