Strategic Allocation of Irrevocable and Durable Benefits[*]

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Abstract

The logic behind redistribution theories is that incumbents target benefits to build and sustain linkages with voters. However, a recent literature shows that some benefits can have a countervailing effect in environments plagued by clientelism: by permanently boosting voters' incomes, irrevocable and durable benefits might reduce the voters' dependence on incumbents. This article explains how parties strategically allocate these benefits when trading off the income effect relative to the standard electoral rewards of redistribution. The theory highlights a previously unstudied rationale to target opposition areas: to weaken voters' dependence on machines. The framework is tested with administrative data on the allocation of cisterns by state governments across Brazilian semi-arid municipalities, where clientelism is rampant. States favor areas governed by copartisans, but only where local clientelistic mobilization is weak. Where it is strong, states favor municipalities led by the opposition, while avoiding their own local strongholds.

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Political parties employ a diversified portfolio of strategies to win elections (Calvo and Murillo, 2019; Diaz-Cayeros, Estévez, and Magaloni, 2016; Garay, 2016), which often includes the targeted redistribution of resources. The typical explanation behind the success of this strategy emphasizes how material rewards are used to create and sustain ties with voters (Golden and Min, 2013). However, a recent literature on developing countries has uncovered a countervailing policy effect: **irrevocable** and **durable** benefits that generate permanent income gains can also break the dependence of voters on incumbents. This is the case of an urban titling program in Mexico (Larreguy, Marshall, and Trucco, 2018); water cisterns in Brazil (Bobonis et al., 2019); entrepreneurial grants in Uganda (Blattman, Emeriau, and Fiala, 2018); or access to financial services in the Philippines (Hite-Rubin, 2015).

These findings have direct implications for parties competing in political environments plagued by clientelism,[1] which is pervasive and particularly effective among the poor.[2] On the one hand, parties might target irrevocable and durable benefits to create or even strengthen voters' loyalties when linkages are based on norms of reciprocity (Finan and Schechter, 2012; Lawson and Greene, 2014),[3] or if the benefits provide a strong signal of *ex-ante* commitment (Gottlieb et al., 2019), or simply to benefit from retrospective voting.[4] On the other hand, the benefit's permanent income effect[5] might change both the "reservation value" of voters (Zarazaga, 2016) and the terms of future clientelistic exchanges, which could erode the grasp of machines on the electorate. While these joint effects make these benefits particularly attractive to non-dominant parties, they present a trade-off to established political machines. In this context, how do incumbents allocate these benefits across constituencies?

This article builds on this evidence, and answers this question proposing a theory for the spatial allocation of irrevocable and durable benefits, formalized in the appendix (page 1). Rather than focusing solely on building linkages with voters, politicians here also take into account the benefit's potential for distancing voters from machines.[6] I frame this argument within a context where a central govern-

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[1]Clientelism is a nonprogrammatic form of targeted redistribution where benefits are (implicitly or explicitly) conditional on voters extending electoral support to patrons (Stokes et al., 2013). I use the term political machine to refer to political groups that mobilize voters using clientelism (Stokes, 2005).

[2]One of the explanations for this pattern is that the poor has a higher marginal utility for these benefits. Other reasons behind the relationship between clientelism and poverty are discussed in Hicken (2011); Stokes et al. (2013).

[3]Machines often keep voters dependent with valuable, but revocable and perishable benefits (Weitz-Shapiro, 2014). However, not all clientelism requires monitoring and punishment. Relationships between patrons and clients are often sustained by repeated interactions that might accommodate *ex-ante* irrevocable gifts (Diaz-Cayeros, Estévez, and Magaloni, 2016).

[4]In this case the party-voter link would not be of a clientelistic nature.

[5]I highlight that irrevocable and durable benefits could improve the welfare of voters either through higher income or through a reduction in income volatility. The case of cisterns discussed in this paper likely does both.

[6]Larreguy, Marshall, and Trucco (2018) show that these countervailing effects played a role in how voters responded to an urban titling program in Mexico. The authors, however, do not assess the strategic allocation of that program.

ment allocates benefits across constituencies governed by either aligned or opposed local politicians. These local politicians also control the clientelistic mobilization capacity of their parties in the area, and use it to raise votes in higher-level elections. Thus, alignment and local mobilization capacity jointly determine the attractiveness of each constituency for these benefits, based on the trade-off between electoral rewards and the income effect. This logic offers a few simple predictions: (1) central incumbents distribute more benefits to constituencies controlled by aligned politicians, where electoral gains are likely higher, as long as their mobilization capacity is weak; (2) as local mobilization capacity increases, the income effect poses a higher risk to the clientelistic activity of local politicians. Thus, central incumbents increasingly target constituencies controlled by the opposition, while avoiding their own. This prediction is a sharp departure from the pattern of targeting core constituencies often displayed by machines with other benefits (Diaz-Cayeros, Estévez, and Magaloni, 2016; Gonzalez-Ocantos and Oliveros, 2019; Stokes et al., 2013); and (3) this strategy is more likely in areas where benefits are more valuable.

I test these hypotheses in Brazil, with previously unused administrative data from a water cisterns program implemented in the semi-arid, which is an ideal setting for a few reasons. First, Bobonis et al. (2019) show that these 16,000 liter cisterns not only improve the welfare of recipients, but also reduce both voters' dependence on clientelism and the electoral support for local incumbents. The authors use a randomized implementation of cisterns by a NGO across 40 semi-arid municipalities to precisely measure the causal effect of these benefits on clientelism.[7] The present article, instead, focuses on how cisterns were allocated by state governments across 1,130 municipalities, which are among the poorest in Brazil due to both adverse weather and lack of investment in infrastructure. The cisterns program is also unique among other federal policies implemented by PT for two reasons: (i) it was originated by the non-profit sector, which led NGOs to play an important role in the implementation and selection of beneficiaries; and (ii) despite the rigid programmatic eligibility criteria within municipalities, both NGOs and state governments had ample autonomy for the cross-municipal allocation.

Second, clientelistic politics are ubiquitous in the region, and characterized by the presence of subnational machines with different levels of mobilization capacity across states and municipalities (Hidalgo, 2012). What is more, the typical clientelistic relationship in the semi-arid is born out of the voter's poverty: voters typically demand goods and favors from local incumbents, which supply them

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[7]The authors do not focus on the strategic allocation of these goods. They use experimental evidence from a randomized implementation.

in exchange for public displays of electoral support (Nichter, 2018). In this context, the income effect of cisterns is likely to influence both the frequency and the terms of these exchanges. Clientelism, however, is only effective when machines have resources to allocate. Brazil's decentralized spending system gives mayors ample leeway to control budget resources, and to use them in these clientelistic exchanges (Nichter, 2018). This makes mayors important brokers for their parties in congressional elections (Novaes, 2018). In this context, the party alignment between mayor and state government is a good proxy for the state party's access to local resources for clientelism.

Third, Brazil also provides a good proxy for the local mobilization capacity of parties, as the Electoral Courts disclose the number of formal party members for each municipality over time. Brazil's party membership (10% of the adult population) is among the highest in the democratic world, which is an apparent paradox in a 'party-averse' environment (Samuels and Zucco, 2014). Party recruitment patterns suggest that, rather than being justified by ideological linkages, membership is driven by the interaction between voters and local party candidates, brokers and activists, which is consistent with a context where voters need to show explicit displays of attachment to local machines. Even though some party members are indeed brokers (*cabos eleitorais*), many more were themselves attracted by material rewards. I show that local party membership is highly correlated with self-reported vote buying, and with the ability of incumbent mayors to broker votes in statewide congressional elections.

Thus, the empirical strategy focuses on how cisterns are allocated across municipalities by state governments in 2003-2012, based on the two variables that determine the strength of local machines in municipalities: the state-mayor alignment, and the mayor's local party membership. The estimates are obtained with both panel regressions and a regression discontinuity design on close mayoral races.

In a nutshell, the findings align with the theory: states target more cisterns to municipalities controlled by aligned mayors where mobilization capacity is weak. This suggests that cisterns provide better electoral returns under copartisan mayors without mobilization capacity, and it is in line with the literature on intergovernmental transfers (Arulampalam et al., 2009; Berry, Burden, and Howell, 2010; Brollo and Nannicini, 2012; Solé-Ollé and Sorribas-Navarro, 2008; Curto-Grau, Solé-Ollé, and Sorribas-Navarro, 2018).[8] However, the attractiveness of aligned constituencies steeply decreases as mobilization capacity increases: where mayors are strong, states target the opposition over their own, which I interpret as the result of the income effect of these goods. Finally, the allocation pattern is

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[8]None of this previous work focused on the distribution of irrevocable and durable benefits, or on the mobilization capacity of local governments.

more intense where cisterns are more valuable (municipalities with dryer-than-usual weather).

Two placebo tests also provide additional evidence of the mechanism. First, as expected, I find no evidence of this allocation pattern on cisterns that were distributed by NGOs. Second, I also find no evidence that the federal government exercised political criteria in the program, which is in line with the PT's stance in other federal policies such as *Bolsa Família* (Zucco, 2013).

Finally, an alternative explanation for these findings is that party memberships simply reflect the preferences of the local electorate (instead of mobilization capacity), and states target areas where they are weak with the sole intent of building new ties with voters, without considering the income effect of the benefit. To address this, I discuss a additional empirical exercises that are more consistent with this article's theory that states allocate cisterns to both build and break voter-party ties.

First, I estimate the allocation pattern of other discretionary transfers from states to municipalities. Mayors have ample leeway to makes these resources revocable and conditional on electoral support (Nichter, 2018). Thus, if states really prefer to target areas where they are weak, we should expect the same pattern with these transfers, which is not the case: states strongly favor aligned mayors, moreso when local mobilization capacity is high. I also use both individual and municipality-level data on party recruitment to show that cisterns do not effectively increase the memberships of state parties that deliver them. On the contrary, they are (albeit weakly) associated with beneficiaries distancing themselves from all parties. These results should not be surprising in a program where NGOs play a significant role in delivering the goods, and in trying to curb credit claiming attempts. Finally, the performance of the mayor's party congressional candidates shows that cisterns are associated with a loss of electoral power by local incumbents with strong mobilization capacity, which is consistent with the experimental findings in Bobonis et al. (2019).

WATER, POVERTY AND CLIENTELISM IN THE SEMI-ARID

The semi-arid in Northeastern Brazil encompasses 24 million people in 1,133 municipalities and 9 states, with per capita GDP three times as low as the rest of the country (Figure 1). The region's long dry seasons make it susceptible to frequent and severe droughts. These droughts, combined with the absence of sufficient infrastructure for water storage and distribution, are responsible for chronic poverty, famine, social unrest, and mass migration waves (Lemos et al., 2002). Not surprisingly, climate-

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driven vulnerability plays a significant role in supporting clientelism in the area. Although governments have historically poured funds to alleviate the impact of droughts, these resources have often been captured by local elites (Bedran-Martins and Lemos, 2017).

Clientelism is pervasive in Brazil. Between 2000 and 2009, nearly 700 elected politicians have been prosecuted and ousted for vote buying. Surveys indicate that between 10% and 28% of voters in the country have experienced the practice, which is also more common in the Northeast (LAPOP, 2014; Sugiyama and Hunter, 2013; TSE, 2014). Water distribution with tanker trucks is not the only form of clientelistic exchange in the semi-arid, but it is fairly common.[9] In the severe drought of 2012, for example, the federal government put its own tanker truck operation under the control of the armed forces to "avoid the clientelistic use of the resource" (President Dilma Rousseff).[10] Also in 2012, the Supreme Electoral Court (TSE) investigated several accusations of vote buying with water,[11] and a prominent regional NGO ran a campaign called "Don't exchange your vote for water".[12]

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[9]In Portuguese: "Piauí: chantagem eleitoral para entregar água", http://bit.ly/373XQHw.
[10]In Portuguese: "Programas no Nordeste combatem efeitos da seca e do clientelismo, diz Dilma", http://bit.ly/2X4cPwf.
[11]In Portuguese: "Justiça Eleitoral apura troca de água por votos no semiárido do Nordeste", http://goo.gl/FgwXFv.
[12]In Portuguese:"Não troque seu voto por água", http://bit.ly/2X6jGpi.

Figure 1: 2012 per capita GDP in Brazil
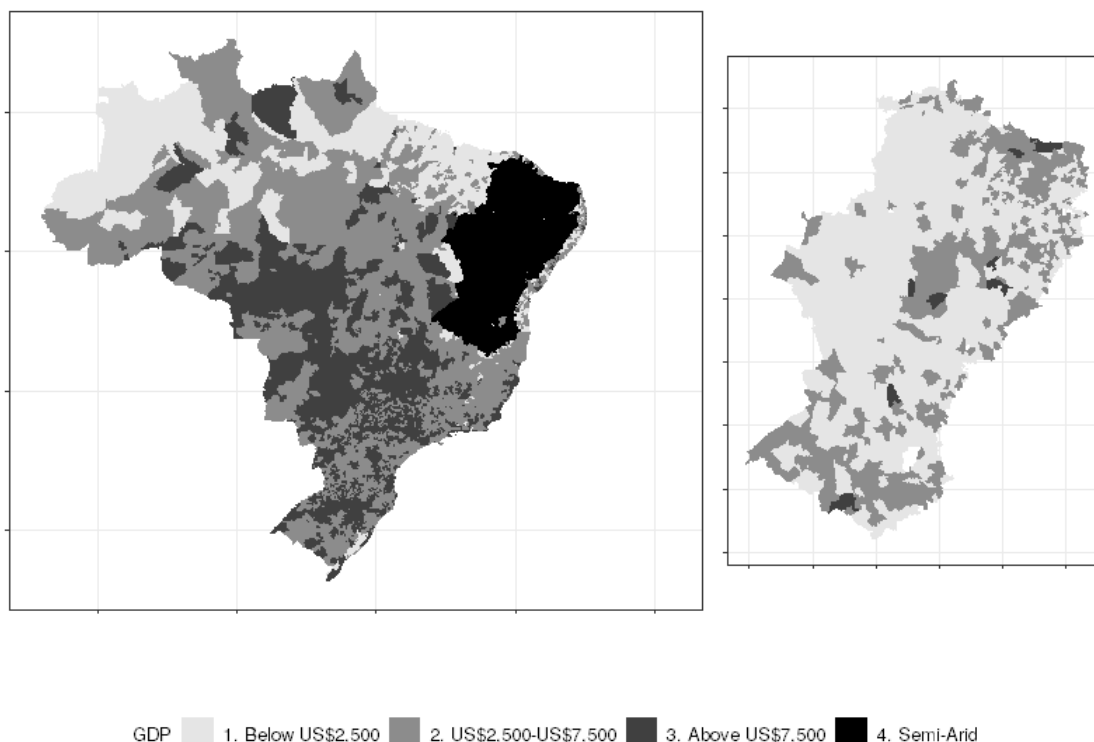
The semi-arid region is on the right side chart. 2012 per capita GDP in US$.

ONE MILLION CISTERNS AND LOCAL CLIENTELISM

In this context, the cisterns program (CP) was first conceived by ASA (*Articulação no Semi-Arido Brasileiro*), an organization that oversees more than 3,000 small regional NGOs in the semi-arid, which proposed it as a partnership to the recently elected Left-wing President (Lula, PT, 2002). In 2003, PT embraced CP with a target to deliver one million cisterns to the region. Each cistern is concrete-built to hold 16,000 liters of rainfall water, and to support a family of six for up to eight months. Once built, they are not easily removed or damaged,[13] and they have been shown to improve health, reduce missing days at work and school, and reduce time spent in search for water (Bobonis et al., 2019; Vaitsman and Paes-Souza, 2007).

The program's roots in the non-profit sector make it unique among other contemporaneous policies

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[13]See a picture in Figure A.8, appendix page 17. In a severe drought, the cistern might not store enough water for irrigation of crops, but it can sustain the consumption needs of the household.

implemented by PT, in two significant ways. First, the federal administration had a more limited role when compared to policies such as *Bolsa Família* (BF). The effort was mostly led by the NGOs that had the expertise for both the construction of cisterns and the training of beneficiaries. Second, CP carried an explicit motivation to undermine the pervasive clientelism in the region (Andrade and Cordeiro Neto, 2016; Mortara, 2017). Although PT's administration had recognized that this motivation was also present in BF,[14] this was one of the main selling points of CP: ASA's coordinator Naidison Baptista openly stated that the program "cut the roots of clientelism in the Northeast", as people "do not get in line to receive water anymore".[15] Accordingly, there is experimental evidence that cisterns indeed reduced the household's dependence on local politicians (Bobonis et al., 2019). This makes these goods particularly effective against the type of clientelism prevalent in the semi-arid, where poverty often leads voters to initiate the relationship with incumbents, due to their access to public resources, and where demands are then met with public goods "using political criteria, given that the number of requests often exceeds available resources" (Bobonis et al., 2019).

The involvement of state governments. CP was first structured around the organizational capacity of NGOs. The implementation involved three actors: the funding entity, the intermediary, and the executor. The federal government was the funding entity in most cases.[16] The role of intermediary, first occupied by ASA, was to negotiate funding for packages of cisterns for larger areas of the semi-arid, and to hire executors for the local implementation. Once cisterns were assigned to a municipality, the executors conducted the selection of beneficiaries and the construction. States and municipalities, originally alienated, were increasingly interested in this source of resources. To meet this demand, the federal government allowed them to become intermediaries, while keeping its original role as funding provider. The politicization of the program is clear (Figure 2): after a few years, states were building as many cisterns as NGOs.[17] This inclusion was likely due to the government's desire to quickly expand the program, which moved at a slow pace: many NGOs could only manage small projects, and only half the planned cisterns were built by 2012. In sharp contrast, BF was created in 2003, but quickly expanded to 3mn beneficiaries in the semi-arid by 2006. However, even for state-led projects, the vast

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[14]See: "Bolsa Família varreu o clientelismo do país, afirma Dilma", https://glo.bo/2SgDeG8.

[15]In "Presente de Dilma azeda o Natal no Semiárido", http://bit.ly/2WM0TPO, in Portuguese.

[16]Other players were not precluded from contributing, but the central government carried the bulk of the financial burden.

[17]Very few cisterns were built by municipalities. Given that most possessed neither the expertise nor the administrative capacity to manage such projects, the government preferred to focus on partnerships with states (Mortara, 2017).

majority of executors were still NGOs,[18] and some states even made this a requirement.[19]

Figure 2: Number of cisterns by provider
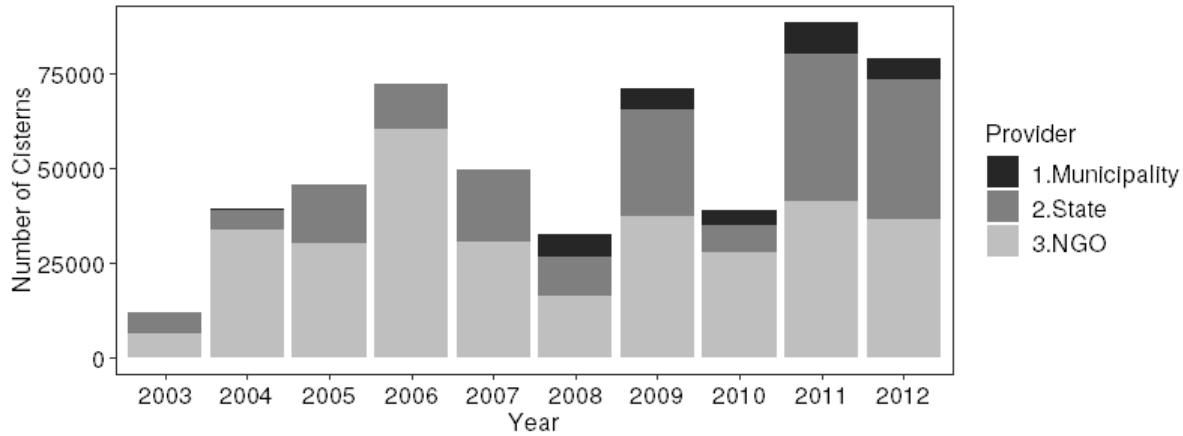
In the semi-arid municipalities.

As intermediaries, states had ample autonomy to allocate cisterns across municipalities – as documented by an internal program evaluation by the federal government (D'Alva and Farias, 2008, p. 33) – and so did the NGOs. Although CP had a well-defined eligibility criteria, in the same mold as other contemporaneous federal policies,[20] this was set at the household level (and not by municipality).[21] What is more, even if there were municipal coverage limits, the slow program expansion in 2003-2012 allowed states to discriminate across municipalities while still meeting the individual criteria.

At the municipal level, however, there was little scope for political criteria. In addition to the hurdles coming from the eligibility rules, the executor was the entity responsible for beneficiary selection, and these NGOs made an extended effort to keep the program apolitical (Andrade and Cordeiro Neto, 2016). However, this did not stop politicians from attempting to capture the credit for cisterns. There are multiple press reports showing mayors, members of congress, and state bureaucrats personally delivering the goods to voters.[22] What is more, state governors also used their role in CP to support their

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[18]See examples in Sergipe (http://goo.gl/MNPVqa), Bahia (http://goo.gl/Vvr2qF, http://goo.gl/MwqEZT), Pernambuco (http://goo.gl/MSmyVK), or Ceara (http://goo.gl/vDosc6).

[19]See some of the procurement documents: https://bit.ly/2wSo4iI, http://bit.ly/34qrDrW and https://bit.ly/346LaOP.

[20]Among other things, beneficiaries should be in *Cadastro Único*, they should also be the most vulnerable rural households, and priority was given to female-led households with children. This can be found in the procurement documents cited above.

[21]There was a general guideline that cisterns should reach municipalities with a high rain deficit and a low human developed index, in the Brazilian context. However, all semi-arid municipalities fall within these categories.

[22]Examples in the states of CE: https://bit.ly/3568NYw, PE: https://bit.ly/2Y0AVea, BA: https://bit.ly/3cDsZU7, and AL: https://bit.ly/2zpYbb5.

pro-poor stance in politics. Bahia's governor Jacques Wagner highlighted that cisterns "free the population from the well known politics of tanker trucks". Ceará's governor Camilo Santana emphasized the role of cisterns in "emancipating" poor households from the bondage of poverty.[23] Also in Bahia, the traditional right-wing political machine (DEM) even presented a formal complain to the electoral courts arguing the the state governor (PT) illegally distributed cisterns during the electoral period.

In page 18, I also discuss quantitative evidence showing that the federal government did not influence the allocation of cisterns using political criteria, i.e, I show that the allocation is not driven by the alignment of mayors with PT or coalition partners, which is in line with the administration's stance in other poverty alleviation policies. PT had a weak clientelistic presence in poor, rural municipalities. Thus, it is not surprising that it would rather focus on the programmatic delivery of widespread pro-poor benefits than on trying to compete with well established machines on the same grounds.

Subnational machines and party membership

Brazil's recent democratic experience has been characterized by the existence of subnational political machines operating with different degrees of power in states (Hidalgo, 2012).[24] The 1988 constitution ratified a significant decentralization in the policy responsibilities of the public sector. This process strengthened the position of "regional party machines", allowing them to autonomously finance and run public policies (Borges, 2011), and to curtail electoral competition "by mobilizing citizens through vote buying" (Montero, 2012), especially in the poor Northeast.

Successful machines rely on having resources to distribute, and the means to effectively mobilize, target and monitor voters. In Brazil, these two dimensions often depend on the party's ability to (i) control the office of mayor in the municipality (resources); and to (ii) control an effective local network of brokers (*cabos eleitorais*) to target and monitor voters (mobilization). In poor municipalities, local economic activity is mostly driven by the public sector, and local taxes play a minimal role in financing municipal budgets. Mayors, however, are responsible for most public spending in education, health, and infrastructure, and obtain these resources from the federal and state governments in the form of transfers. Because demand for public goods in these areas widely surpasses the supply, local incumbents can selectively provide access to goods and services that should be otherwise universal. Thus,

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[23]See http://goo.gl/N5RX9h and http://goo.gl/vDosc6, in Portuguese.

[24]This is strikingly different from other Latin American countries where the practice was monopolized by national dominant machines, as in Argentina (Stokes, 2005; Weitz-Shapiro, 2012), or Mexico (Magaloni, 2006).

clientelistic relationships tend to trump the appeal of programmatic policy promises, and poor voters often demand goods and favors in exchange for electoral support (Nichter, 2018).[25] Not surprisingly, mayors are in a disproportionately strong position to influence higher level elections and act as brokers for their parties (Brollo and Nannicini, 2012; Novaes, 2018). Accordingly, I assume that a state incumbent controls local resources in municipalities governed by aligned (copartisan) mayors.

I use the size of party membership rolls as a proxy for the underlying ability of parties to mobilize voters in each municipality. Brazil's rate of party affiliation is now around 10% of the voting population, one of the highest across democracies. This is an apparent paradox in a 'party-averse' political environment (Samuels and Zucco, 2014), where voters rarely even recognize parties' ideologies.[26] Nevertheless, the recruitment pattern sheds some light on the dynamics behind local membership (Figure A.6, appendix, page 16): parties significantly expand their ranks (only) in the year before the municipal election, which suggests that recruitment is predominantly a local phenomenon, driven by the interaction between voters and local party candidates, brokers and activists. Thus, my assumption is that, while the true clientelistic mobilization capacity of parties is unobserved, it should be closely related to the (observed) number of supporters that have joined the party.

This proxy is highly correlated with a self-reported measure of vote buying across municipalities, as shown by the America's Barometer survey (LAPOP, 2014).[27] The 2014 wave includes a specific question about vote buying in the 2010 election cycle (national and state elections): whether or not the voter was offered goods or services in exchange for a vote. The survey compiles data from 106 municipalities, where the average share of voters that experienced vote buying was 11%, and the rate of party membership was 7%. Figure 3 shows a positive, strong and statistically significant correlation between local party membership and the self-reported measure of vote buying in (See the OLS regression in the appendix, Table A.4, page 12). This correlation is also coherent with an electoral environment where, due to the secret ballot, clients often need to provide visible displays of support to the patron as a form of commitment (Nichter, 2018). In other words, it is likely that the membership rolls includes many voters that have been themselves "bought" by the local party machine.

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[25]Examples are private distribution of goods such as gasoline, cement, medicine, and water; or selective access to services as medical visits.

[26]Partisans of PT, and to a lesser extent PSDB, constitute exceptions to this rule.

[27]I thank the Latin American Public Opinion Project (LAPOP) and its major supporters (the United States Agency for International Development, the Inter-American Development Bank, and Vanderbilt University) for making the data available.

**Figure 3: Party membership and self-reported exposure to vote buying**
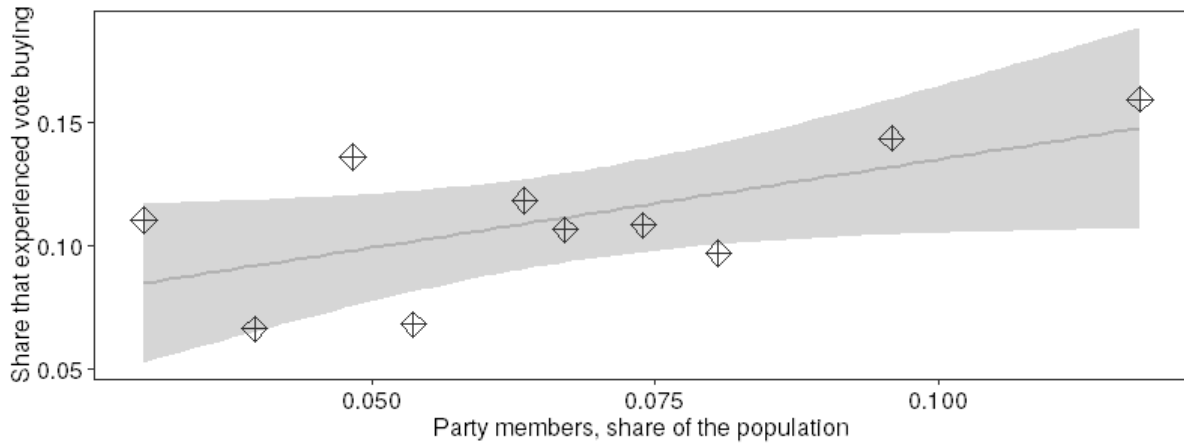
Source: The AmericasBarometer by the Latin American Public Opinion Project (LAPOP), www.LapopSurveys.org. The dependent variable is the share of respondents that were offered goods or services for their vote in the 2010 election.

Finally, Figure 4 illustrates the joint importance of these two variables in the success of subnational party machines in Brazil. Congressional elections are arguably one of the best ways to assess the brokerage of mayors for their parties, for two reasons. First, the election is proportional and all parties compete, which is not the case of gubernatorial races. Second, this is a very valuable election, as the number of congressional seats determines the party's access to campaign resources.[28] The plot shows the gain in vote shares between 2002 and 1998 (at the municipal level) for congressional candidates of parties with incumbent mayors in the region, compared to a control group formed by parties with a similar membership size that did not control the mayor in their municipalities.[29] The pattern is evident: when both parties have few members, incumbency alone does not boost the vote shares of the mayor's party. However, where both parties command large memberships, mayoral incumbency significantly boosts the party's performance in these elections.

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[28]One of the main sources of financing for parties in Brazil is public funds, which are allocated according to their congressional seats.

[29]The control group is obtained by finding a one-to-one match for every party-municipality pair that had a mayorship in 2002, from other municipalities in the semi-arid, and parties that did not control the mayor. Observations are matched based on both party membership size and the performance in the 1998 election.

Figure 4: Mayoral incumbency, party membership and electoral performance
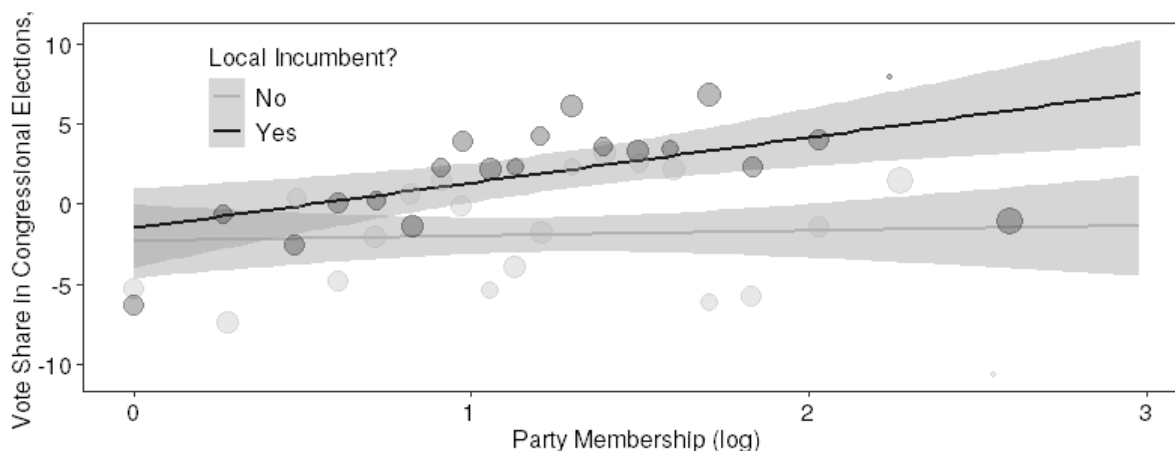
Only municipalities in the semi-arid. The Y-axis shows vote shares of congressional candidates in 2002, in the municipality, after adjusting for the party's vote share in 1998 (i.e. the 2002 shares are regressed on the 1998 shares). The dark color shows parties that had a mayor in the period. The lighter color shows parties without a mayorship (control group).

Hypotheses: electoral rewards and income effects

In keeping with the Brazilian context, the theory focuses on state incumbents that allocate cisterns across municipalities, based on both the partisanship of the mayor and on her mobilization capacity. The allocation framework also takes into consideration the two potentially countervailing effects of cisterns coming from electoral rewards and the income effect, which are discussed below.

Extensive work shows that voters reward incumbents for delivering valuable benefits, even when the distribution is unconditional. Retrospective voting "plays a key role in democratic accountability" (Healy and Malhotra, 2013), as it allows voters to sanction or reward politicians for their performance. Recent work in developing countries also shows that voters reward incumbents for reasons such as cash transfers (Zucco, 2013), credit claiming over foreign investment (Cruz and Schneider, 2017), or past economic performance (Campello and Zucco, 2016). It is also possible that even irrevocable benefits can be used to fuel clientelistic loyalties that are based on norms of reciprocity (Finan and Schechter, 2012; Lawson and Greene, 2014; Mares and Young, 2016), or if voters see the good as a signal to commit to further attractive policies (Gottlieb et al., 2019). Although I remain agnostic about the nature of the behavioral mechanisms behind these electoral gains, I assume that they should be higher

in aligned municipalities, given that opposition mayors might capture a share of the credit for cisterns for their own parties. I highlight that, despite the various attempts of politicians to claim credit over cisterns, the attribution from the perspective of voters is likely divided between the main stakeholders in the program (Mortara, 2017). Even for cisterns delivered by states, the "face" of the program is still the executor NGO, and the good is stamped with the "brand" of the federal government.

There is also a vast literature showing that clientelism is more efficient when voters are poor.[30] The prevailing explanations for this pattern emphasize the effect of poverty either on the "clients' assessment of the value of a clientelist offer" or on the "capacity of patrons to provide clientelist benefits" (Hicken, 2011). While both mechanisms are likely at play in the Brazilian semi-arid, recent work has emphasized the demand argument: Nichter (2018) shows that the clients themselves often demand targeted benefits from incumbents, and Bobonis et al. (2019) show that cisterns reduce the probability of households engaging in such exchanges. Two features of this income effect are relevant for the present theory. First, it is uncorrelated with the mayor's alignment status, by design, i.e., in isolation, the income effect affects clientelistic activity of all parties. Second, it should be more relevant in areas where mayors have higher mobilization capacity. I use these two concepts to derive three testable predictions for the allocation of cisterns across municipalities. In the appendix (page 1), I also develop a simple probabilistic voting model that formally generates the hypotheses described below.

H1: The marginal effect of alignment is positive when mobilization capacity is at its weakest. States distribute relatively more cisterns to municipalities under a weak aligned mayor, where party memberships are (very) small. This implies that, where mayors do not have any mobilization capacity, states allocate cisterns solely based on their electoral rewards.

H2: The marginal effect of alignment is decreasing in mobilization capacity. As party memberships increase, the relative importance of the income effect on clientelism increases, and states target more the municipalities governed by strong opposing mayors, while avoiding their own.

H3: These two patterns are more extreme where cisterns are more valuable to voters. The allocation pattern above is more likely to happen in municipalities affected by lower-than-average rain.

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[30]See reviews in Hicken (2011); Gonzalez-Ocantos and Oliveros (2019).

These hypotheses are tested with municipality-level data on the number of cisterns delivered by states in the semi-arid in 2003-2012, with data provided by the Ministry of Social Development (MDS). Brazil's electoral calendar determines that gubernatorial and municipal elections always happen in two-year intervals (Figure 5). Thus, every municipality has a potentially new state-mayor alignment status every two years.[31] I test this allocation framework using the five 2-year periods in 2003-2012.

A mayor is aligned with the state government when they both belong to the same party. In page 17, I discuss the results under an alternative definition of alignment that also includes other parties in the state government coalition. The mayors' mobilization capacity is measured by the share of local voters that are members of her party. This variable is updated after every municipal electoral cycle (2000, 2004 and 2008), in order to reflect the mayor's most current party membership.[32] Figure A.4 (appendix, page 15) has a map with the mobilization capacity of the three largest parties in the region (MDB, PSDB and DEM), and PT; measured in 2000 before the start of the program.

Figure 5: Timeline of events
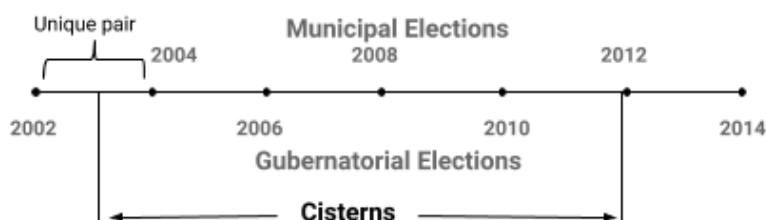
Timing of state and municipal elections in the sample.

The main outcome variable is coded as the number of cisterns delivered per 100 rural households (rhs) in a municipality, each 2-year period. On average, states built 2.2 cisterns/100rhs, per municipality-period. The value of a cistern to voters in any given municipality is based on weather patterns: cisterns should be more effective in locations that are suffering from a more severe dry season.[33]

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[31]Election results were obtained from the Supreme Electoral Court (TSE). Municipal elections follow the plurality system in one round in all but one municipality in the semi-arid. Campina Grande (PB), Feira de Santana and Vitória da Conquista (BA) have the runoff system, and are thus excluded from the sample. I only include municipal elections that had more than one candidate (97%), and exclude elections won by parties created after 2002 (PRB), or canceled by the courts.

[32]Membership rolls are provided by TSE.

[33]Weather data comes from the climate unit in the University of East Anglia, which provides monthly rain data for the period

The construction of other relevant variables is described in Table A.3 (appendix, page 12).

EMPIRICAL STRATEGY

The combined effects of alignment and party membership are estimated using equation 1.

$$y_{it} = \beta_0 + \beta_1 a_{it} + \beta_2 c_{it} + \beta_3 a_{it} c_{it} + \delta_i + \delta_t + \epsilon_{it} \tag{1}$$

where y_{it} denotes the cisterns/100rhs in municipality i, period t. The mayor's party membership is given by c_{it},[34] and alignment by a_{it}. Municipality and time effects (δ_i and δ_t) are also included.[35] Table 1 below provides a framework to interpret the coefficients in light of the theoretical hypotheses.

Table 1: Coefficients and expected distribution of cisterns

	$a_{it} = 0$	$a_{it} = 1$	Difference
$c_{it} = 0$	β_0[†]	$\beta_0^\dagger + \beta_1$	β_1
$c_{it} > 0$	$\beta_0 + \beta_2 \times c_{it}$	$\beta_0 + \beta_1 + (\beta_2 + \beta_3) \times c_{it}$	$\beta_1 + \beta_3 \times c_{it}$
Difference	$\beta_2 \times c_{it}$	$(\beta_2 + \beta_3) \times c_{it}$	$\beta_3 \times c_{it}$

† I highlight that this table illustrates the interpretation of the coefficient β_0 for a regression that does not include municipality and period fixed-effects. Only in this case the intercept reflects the average baseline number of cisterns in an unaligned municipality with weak mobilization capacity. Given that the results in Table 2 come from equation 2, which includes fixed effects, the intercept has no interpretation, and I only report the marginal effects (β_1, β_2 and β_3).

The marginal effect of alignment (MEA) on the distribution of cisterns is given by $\beta_1 + \beta_3 c_{it}$. Thus, β_1 measures the MEA precisely where the mayor's mobilization capacity is at its weakest ($c_{it} = 0$), and it is expected to be positive (H1). This coefficient can be interpreted as the marginal increase in cisterns coming solely from the electoral rewards captured by states when the goods go to aligned mayors. As the mobilization capacity of mayors increase, the income effect starts to play a more significant role in the allocation, leading the MEA to decrease (H2). This necessarily implies that $\beta_3 < 0$, and that

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1971-2012, for a grid of 0.5 degrees in latitude and longitude. Rain levels for each municipality are estimated matching grids with the coordinates of the city center.

[34]Due to outliers, I estimate the effects using the log-transformation of the variable. I use the inverse hyperbolic sine transformation, $log(y + (y^2 + 1)^{1/2})$, in order to accommodate zero values.

[35]I include the contemporaneous (2-year period) precipitation as a control. Nevertheless, the results are not sensitive to this inclusion.

$\beta_1 + \beta_3 c_{it}$ becomes negative for large enough party memberships. Finally, within the opposition group, states are expected to deliver more cisterns to mayors that command large memberships ($\beta_2 > 0$).

PANEL DATA RESULTS AND DISCUSSION

The results obtained with this analysis are presented in Table 2. Column (1) shows a simple regression without the interaction with c_{it}. Column (2) shows the main and preferred specification from equation 1, and the remaining columns show alternative specifications, as follows: (3) defines mobilization capacity as a binary variable;[36] (4) uses the mobilization capacity measured in the 2000 municipal election for all parties (i.e. before the cisterns program);[37] and (5) defines alignment ($a_{it} = 1$) based on co-partisanship between mayors and any of the parties in the state government coalition.

Table 2: Distribution of cisterns by state governments

Dependent Variable: Cisterns	(1)	(2)	(3)	(4)	(5)
Aligned (a)	-0.033	1.838*	0.647†	1.945*	1.321*
	(0.270)	(0.600)	(0.338)	(0.459)	(0.391)
Membership (b)		0.407	0.103	0.596*	0.717*
		(0.307)	(0.236)	(0.235)	(0.293)
Aligned * Membership (c)		-1.539*	-1.304*	-2.301*	-1.304*
		(0.478)	(0.442)	(0.516)	(0.247)
(b) + (c)		-1.132*	-1.201*	-1.705*	-0.587†
		(0.442)	(0.461)	(0.395)	(0.319)
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.

H1: Municipalities with weak aligned mayors receive 1.8 cisterns (per 100rhs) more than weak opposition mayors per period. This is a significant increase relative to the sample average of 2.2 state cisterns delivered every period. This result is robust across specifications, and suggests that states allocate cisterns with the expectation that they might elicit electoral support in (weak) aligned locations.

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[36]Mobilization capacity here is a dummy that assumes value of one when c_{it} is above the median for that state and 2-year period.

[37]The time dimension in this case comes solely from the changes in the party of the mayor over time.

H2: Figure 6 shows that the marginal effect of alignment ($\beta_1 + \beta_3 \times c_{it}$) falls with mobilization capacity. For roughly the first 45% of the sample, it remains positive, implying that weaker aligned mayors benefit more from electoral rewards than they lose from the income effect of cisterns ($\beta_1 > \beta_3 c_{it}$). However, β_3 is negative and highly significant across specifications. Thus, the MEA declines steadily as mobilization capacity increases and the income effect of cisterns dominates the effect of electoral rewards. In a municipality where c_{it} is at the upper quintile, voters under strong aligned mayors receive 1 less cistern (per 100rhs) than their strong opposition counterparts (down from 1.8 more cisterns when $c_{it} = 0$).

Figure 6: State cisterns: marginal effect of alignment
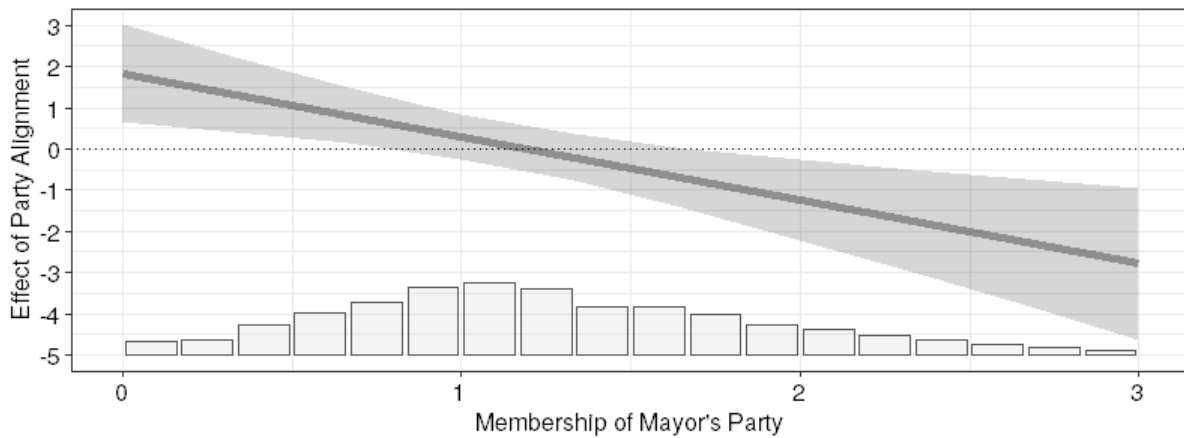
Confidence intervals at 95%. The bars show the density of the sample. Only for the purpose of presentation, the plot does not show values above 3 in the x-axis, 1% of the sample.

The results also suggest that the income effect is more relevant in the allocation within the aligned group. Even though β_2 is positive across specifications (as expected), it is lower in magnitude and has less statistical power than β_3. One possible explanation for this is found in column (5). Given that governors are often supported by a coalition of multiples parties, there are cases in which a mayor from a coalition party might be "aligned" with the governor without being a copartisan. Column 5 shows the estimation under this broader definition of state-mayor alignment, and here β_2 is higher in magnitude and statistically significant. This strongly suggests that the weak β_2 in the main specification captures the fact that state governors also avoid strong mayors from coalition partners in the allocation of cisterns

(in addition to their own).[38]

The appendix also shows two placebo tests of the theory. First, I estimate equation 1 with the number of cisterns distributed by NGOs, which allocated nearly twice as many cisterns as state governments in 2003-2012. Accordingly, there is no reason why their allocation should follow the pattern presented by states. Table A.7 and Figure A.5 (appendix, page 14 and page 16) show that this is indeed the case. Second, Table A.6 (appendix, page 13) shows that the federal government had little influence in the cross-municipal allocation of cisterns within states (page 8), and that it did not impose political criteria for the allocation (page 9). Here, I again estimate equation 1, but alignment is now coded based on the mayor's co-partisanship with PT, and with parties of the federal coalition. Again, the MEA is statistically indistinguishable from zero for all values of mobilization capacity.

H3: The allocation framework should also be stronger in areas where cisterns are more valuable. Table 3 provides evidence to this extent. It has the estimates obtained with equation 1, but also interacting all the relevant coefficients with a binary variable that indicates whether the municipality had above-median precipitation during each 2-year period. The results are much stronger for the municipalities that experienced drier-than-usual weather (column 1). For this group, β_3 is negative and stronger in magnitude, and β_1 is positive and also of higher value when compared to column 2.[39]

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[38]The preferred definition of alignment in this paper is based on the party of the state governor for the following reason: these governing coalitions are not binding in any other electoral dimension. They are neither repeated in mayoral elections nor in legislative elections, and coalition members actually compete against each other for congressional seats. In this context, mayors are also more likely to broker votes for their own parties instead of coalition members. Thus, state governors are also more likely to avoid allocating cisterns to their own aligned partisan machines when compared to coalition partners. The drop in the magnitude of β_3 in column 5 suggests that this is likely the case.

[39]The only coefficient that does not line up with the prediction is β_2, although the estimated difference in β_2 has much less statistical power.

Table 3: Heterogeneity in the distribution of cisterns

	Low Rain (1)	High Rain (2)	Difference (3)
Aligned (a)	3.076*	0.611	-2.465*
	(0.926)	(0.736)	(1.188)
Membership (b)	0.255	0.572†	0.317
	(0.331)	(0.347)	(0.275)
Aligned * Membership (c)	-2.335*	-0.786	1.549*
	(0.638)	(0.580)	(0.779)
(b) + (c)	-2.080*	-0.214	1.866*
	(0.615)	(0.522)	(0.730)
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. All coefficients come from a single regression, where the high-rain dummy is interacted with the variables that measure alignment and party membership (a_{it}, c_{it} and $c_{it} \times a_{it}$).

REGRESSION DISCONTINUITY RESULTS

The estimates have explored so far the variation across municipalities in both party alignment and mobilization capacity. I use a regression discontinuity design (RDD) to show that these results are also robust to potential bias coming from time-municipality specific confounders. The RDD compares municipalities where an aligned candidate barely won the election (treatment), to municipalities where she barely lost (control),[40] thus providing a quasi-random assignment of party alignment to municipalities. I estimate this effect for two different groups of municipalities, divided according to the size of the mayor's party. As usual, the estimation fits a local linear regression on each side of the discontinuity, as shown in equation 2.

$$y_{it} = \beta_0 + \beta_1 a_{it} + \beta_2 mv_{it} + \beta_3 a_{it} mv_{it} + (\beta_4 + \beta_5 a_{it} + \beta_6 mv_{it} + \beta_7 a_{it} mv_{it})c_{it} + \epsilon_{it} \qquad (2)$$

where mv_{it} is the running variable, alignment is given by a_{it}, and c_{it} is the binary version of the mobilization capacity variable.[41] Here, β_1 shows the effect of alignment for the weak-machine sample,

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[40]The strategy here is close to Brollo and Nannicini (2012), which compares mayoral candidates aligned and unaligned with the party controlling the presidency.

[41]This is the same specification used in column 3 of Table 2. Both the interpretation and presentation of RDD estimates are

and $\beta_1 + \beta_5$ shows the same effect for the strong-machine sample.

Table 4 shows the estimated coefficients for different bandwidths. Other tables and plots containing the usual validity checks for the RD design are included in the online appendix (page 4).[42] The signal of the coefficients perfectly matches those obtained with the panel analysis, with minor differences in the statistical power of the estimates. As before, municipalities under aligned mayors receive slightly more cisterns than voters under the opposition when machines are weak.[43] The results also show that strong aligned mayors receive less cisterns than their opposition counterparts. The effect can be seen in line (a)+(c), and it is robust across bandwidths and specifications (Table 4, appendix, page 20). Figure 7 illustrates the results.

Table 4: Distribution of cisterns by state governments (RDD)

|	(1)	(2)	(3)
Aligned (a)	1.474[†]	1.696	1.600*
	(0.852)	(1.248)	(0.642)
Membership (b)	2.779*	1.845	2.190*
	(1.106)	(1.347)	(0.895)
Aligned * Membership (c)	-4.246*	-4.924*	-3.454*
	(1.386)	(1.797)	(1.123)
(a) + (c)	-2.772*	-3.228*	-1.854*
	(1.093)	(1.293)	(0.921)
Bandwidth	10.12	5.06	20.23
Observations	857	450	1365

[†]$p<0.1$, *$p<0.05$. Standard errors are clustered by municipality and presented in parenthesis. Column (1) has the optimal bandwidth, calculated based on Calonico, Cattaneo, and Titiunik (2014). Columns (2) and (3) present the results for half and double the optimal bandwidth; respectively.

more intuitive when the treatment effect is interacted with a discrete variable.

[42]They include the McCrary test, the balance of covariates around the discontinuity, and the results for different polynomial specifications, and results including covariates.

[43]Because membership is measured discretely here, this coefficient is likely also capturing some of the income effect of cisterns, which might explain the imprecision in the estimate.

Figure 7: RDD: distribution of cisterns
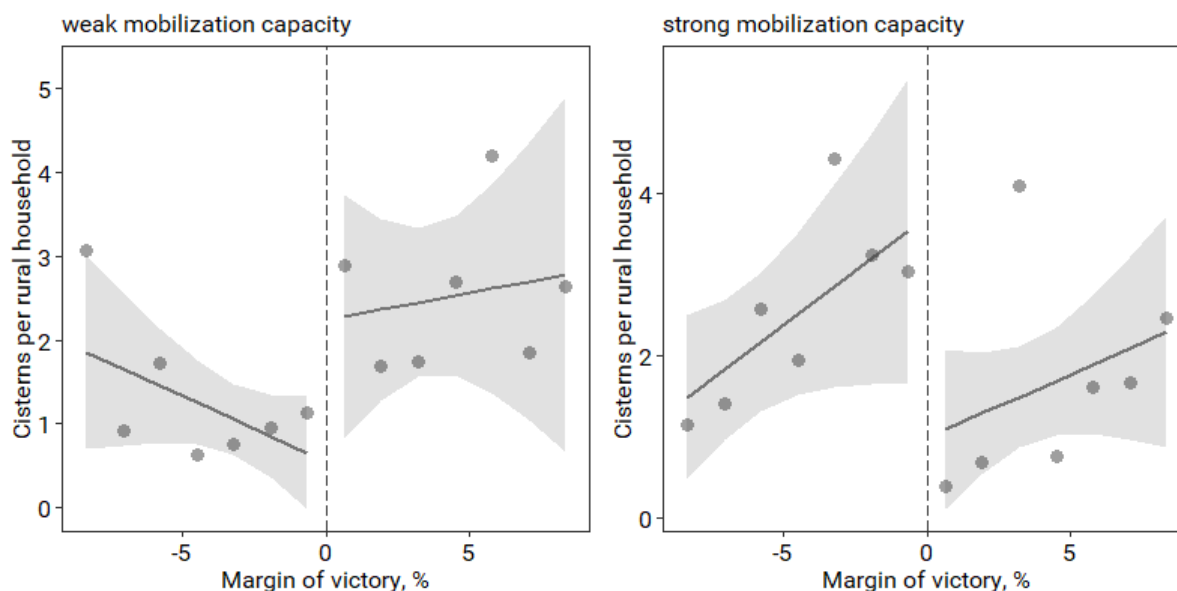
Aligned municipalities are always in the right side of every plot. Weak (Strong) mobilization capacity means that the mayor's party has membership size below (above) the median. Points represent the average of the outcome variables for every bin. The line represents the linear fit.

Testing an alternative explanation

An alternative explanation for the main findings is that memberships are a proxy for the preferences of local voters for the party (as opposed to mobilization capacity), and states target cisterns to areas where they are weaker with the sole intent to build new linkages with the electorate (i.e. without considering their potential income effect). I discuss below how five empirical exercises can help us adjudicate between this narrative and this paper's allocation framework.

RDD. The RDD results already rule out a simple version of this alternative theory, where mobilization capacity is a proxy for the mayor's electoral strength, and cisterns are used by states to support aligned mayors that are weaker than their opponents. Given that it only uses the sample with municipalities that had close mayoral elections, the RDD shows that the allocation pattern is still present precisely where mayors and their opponents have, by construction, the same electoral strength.

State Mobilization Capacity. In the appendix I examine the heterogeneity of the main estimates by the mobilization capacity of the state party in opposition areas – where they do not control the mayor

(Table A.2, page 11). The marginal effect of alignment on the allocation is still strong and significant when the state party membership is nearly the same across aligned and opposition municipalities. In other words, states significantly favor strong opposition mayors over strong aligned ones, even when the state's mobilization capacity is also high in the unaligned location. This shows that the allocation of cisterns cannot be simply explained by states targeting areas where their mobilization capacity is weak. On the contrary, their focus on the mobilization capacity of the opposition mayor is more consistent with the allocation of benefits that could undermine opposing machines.

Other state transfers. Here I examine the allocation of discretionary budget transfers from states to municipalities.[44] Brazilian mayors heavily rely on resources from higher levels to meet their budget needs. Although most of these funds are allocated by pre-determined formulas, states have discretion to sign funding agreements with municipalities (*convênios*).[45] Control over local budgets is key to the party's ability to raise votes in congressional elections, and these resources are often used in exchange for political support. Thus, if states simply prefer to target weak areas in the semi-arid, we should observe the same allocation pattern with these funds. However, Figure 8 shows that states rather target these funds to areas were they are strong, consistent with the systematic pattern observed for other clientelistic machines in Latin America (Gonzalez-Ocantos and Oliveros, 2019). Not only they are allocated to aligned mayors,[46] but the MEA significantly increases in the mayor's party membership.[47]

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[44]This data was obtained from FINBRA (http://www.tesouro.fazenda.gov.br/contas-anuais), and it is only available for 61% of the municipality-period pairs in the sample.

[45]States provide around 14% of municipal revenues. Discretionary transfers represent R$0.2mn/year (2.1% of the budget).

[46]This is also in line with Brollo and Nannicini (2012) that show how discretionary federal transfers are targeted based on the alignment of mayors with PT coalition partners.

[47]Table A.5, appendix (page 13), shows the coefficients estimated with equation 1.

**Figure 8: Discretionary budget transfers: marginal effect of alignment**
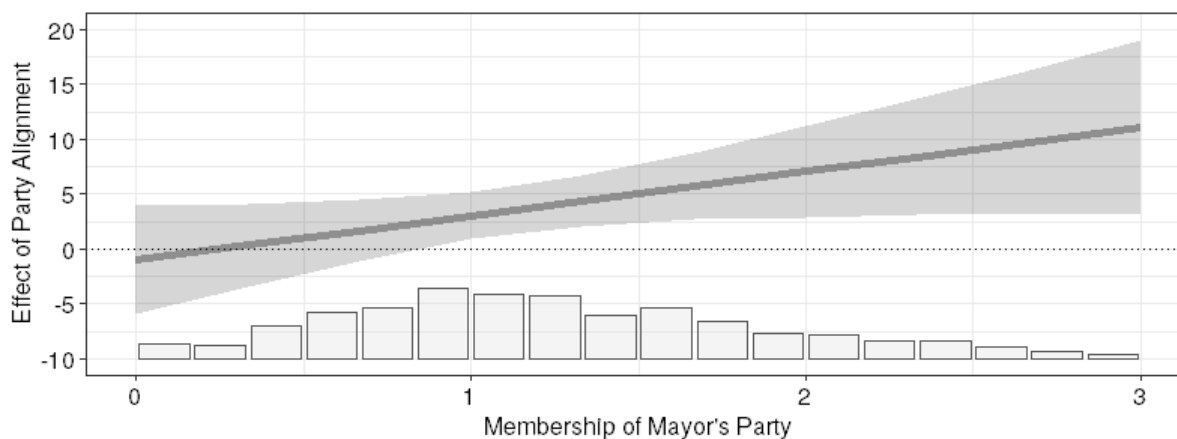
Cisterns and party recruitment. The results so far suggest that cisterns are not allocated to reinforce existing party loyalties. However, if irrevocable and durable goods are more effective in creating new ties with voters (than budget resources, for example), this could explain the targeting of both weak-aligned and strong-opposition mayors. In this case, if mobilization capacity reflects local party support, state cisterns should increase the membership of the parties that delivered them. This is not necessarily the case if cisterns are also used to "level the electoral playing field" by distancing voters from strong machines. To explicitly adjudicate between these mechanisms, I first use a subset of individual beneficiaries of state cisterns that can be linked to the CadUnico database – the registry used to manage federal benefits.[48] CadUnico has information on millions of poor voters, allowing me to match cistern recipients to non-recipients that are very similar in many dimensions (e.g. gender, age, race, income, etc.), within a municipality. I then merge this data with the party membership rolls to check whether cisterns had an effect on future party enrollment (Figure 9). In short, beneficiaries are no more or less likely to join the mayor's or the state government's party after receiving a cistern. In fact, they are less likely to become formal party members, in general, when compared to non-recipients.

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[48]See appendix C for a detailed description of the data construction process for this exercise – page 7.

Figure 9: Probability of joining a party: cistern beneficiaries vs. other poor households
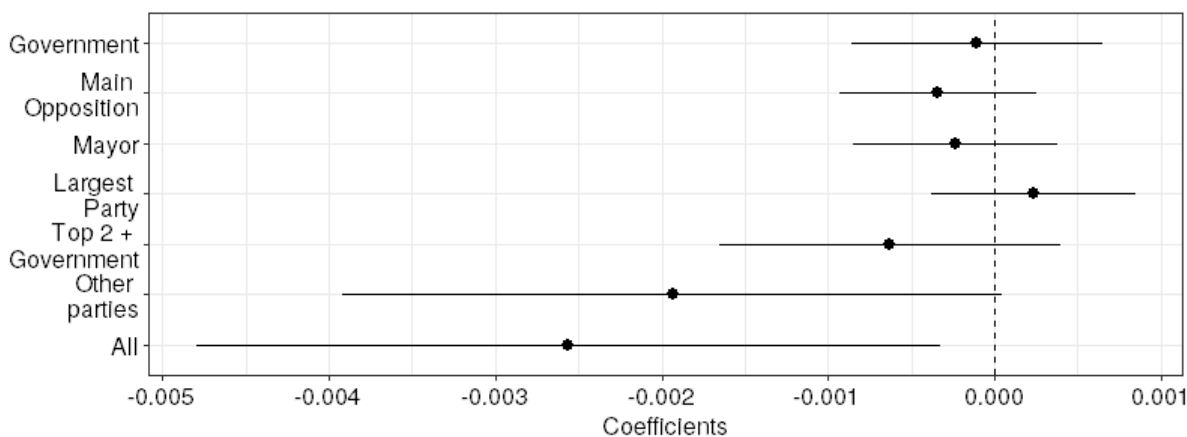
Total of 76,450 observations. Regressions are estimated with municipality-period effects (i.e. the 2-years period between elections), and standard errors are clustered at the same level. The coefficients are the effect of receiving a cistern on future party membership for each one of the parties listed, as follows: (i) Government: state party; (ii) Mayor: mayor's party; (iii) Main opposition: mayor's party in opposition municipalities, or the runner-up in the mayoral race in aligned ones; (iv) Largest party: party with the largest membership in that municipality; (v) Top 2 + Government: party of the top 2 candidates in the last municipal election, plus the state party; (vi) Other parties: all parties not in Top 2 + government; and (vii) All: all parties.

In the appendix (Table A.8, page 14), I also show a similar pattern with the municipality-level correlations between state party memberships and state cisterns. I regress the 2012 local membership of all parties that held the state government in 2003-2012 on the number of cisterns that they sent to each municipality (and control by the party size in 2000). Using only within-municipality variation, the correlations between party membership and cisterns are not statistically significant, and mostly negative. Overall, these two pieces of evidence are not consistent with cisterns being solely (and effectively) used to increase party-voter linkages in the semi-arid, which is not unexpected in a program where the strong participation of NGOs at the delivery-end limits credit claiming opportunities by politicians.

Electoral impact of cisterns. I use the performance of the congressional candidates of the mayor's party to show that cisterns are associated with a loss of electoral power by local incumbents with strong mobilization capacity. This measure precisely captures the ability of mayors to mobilize voters in favor of their parties at a higher level.[49] Given that cisterns are not randomly distributed, the estimates

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[49]For the following reasons: (i) this is the most valuable legislative election in terms determining formal and informal access to campaign resources; (ii) the statewide proportional system allows me to observe vote shares for all parties, which is not the case of gubernatorial or mayoral elections; and (iii) mayors have been shown to be important party brokers in these elections due to their control over local budget resources (Novaes, 2018).

cannot be interpreted as causal effects, but rather as evidence of a correlation between cisterns and electoral results. That being said, I take a few steps to mitigate potential confounders. First, I compare the vote shares for a balanced panel of municipalities, including only two "out-of-sample" elections in 2002 (before), and 2014 (after). I also use municipality and election fixed effects to mitigate bias coming from either time-invariant municipal characteristics or time trends that might jointly affect the number of cisterns and the mayor's brokerage ability. Finally, I aggregate the total cisterns distributed in 2003-12 from all sources (states, municipalities and NGOs – Figure 2), given that the income effect of a cistern does not depend on who delivered it, by definition. Thus, I estimate the equation below.

$$pct_{mt} = \tau_0 + \tau_1 cis_{mt} + \tau_2 c_{mt} + \tau_3 c_{mt} cis_{mt} + \eta_t + \eta_m + g_m + o_m + \theta_{mt} + \mu_{mt} \qquad (3)$$

where for municipality m, pct_{mt} is the vote share of the congressional candidates of the mayor's party in period $t \in (2002, 2014)$. The number of cisterns per hundred voters is cis_{mt} (in 2002, $cis_{mt} = 0$ for all m), c_{mt} is the mayor's mobilization capacity, g_m is a dummy that indicates whether the mayor's party held the governorship in the state in 2003-2012, and o_m indicates whether the mayor's party opposes PT at the federal level. Finally, θ_{mt} is the rain level in the 12 months before the election, and η_t and η_m are fixed effects for election and municipality. Thus, τ_1 is the marginal change in vote shares coming from cisterns, and τ_3 is the change in this marginal effect as the mobilization capacity increases.

Column 1 of Table 5 shows that, on average, cisterns do not have a statistically significant effect on the mayor's brokerage ability. Column 2 shows, as expected, that mayors with better mobilization also raise more votes for their parties. Column 3, however, clearly shows that the effect of cisterns is heterogeneous: while they have little effect on the brokerage of weak mayors, cisterns significantly undermine the ability of strong mayors to raise votes (i.e. the interaction is negative and significant).

Put together, all this evidence suggests that the main empirical results in this article are more consistent with states allocating cisterns in a way that could both build and break voter-party ties.

Table 5: Electoral effect of cisterns by mobilization capacity

	(1)	(2)	(3)
Cisterns (a)	-0.291		0.515
	(0.214)		(0.327)
Membership (b)		7.043*	8.646*
		(1.145)	(1.276)
Cisterns * Membership (c)			-0.625*
			(0.222)
Observations	2260	2260	2260

†p<0.1, *p<0.05. Standard errors are clustered by municipality and presented in parenthesis. The regressions use the log-linear version of c_{mt}.

CONCLUSION

This article examines how state governments strategically allocate irrevocable and durable benefits across municipalities (cisterns), taking into account both the political alignment of mayors and their ability to mobilize voters through clientelism. The results show that the marginal effect of party alignment in the allocation is decreasing in the mayor's mobilization capacity, i.e., states only target their mayors over the opposition when both are weak. When they are strong, states prefer to target the opposition over their own, in sharp contrast with the pattern often observed in clientelism (Diaz-Cayeros, Estévez, and Magaloni, 2016; Stokes et al., 2013) of targeting core constituencies. I interpret the findings within a novel framework where the delivery of these goods can elicit electoral rewards, but also undermine the ability of (all) parties to effectively engage in clientelism, due to their income effect.

These findings have at least two implications for future research of nonprogrammatic redistribution. First, they delineate a path that leads to increased electoral competition in areas formerly dominated by monopolist machines, without emphasizing a shift towards programmatic politics. Second, they unveil an allocation strategy that is particularly useful to nondominant parties that cannot easily replicate the mobilization capacity necessary to compete against entrenched machines. More so in developing countries were nondominant parties often gain control of the central government before they win significant victories in poor, rural areas. (e.g. PAN in Mexico, 2000; PT in Brazil, 2002).

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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.

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[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

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

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

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:

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

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

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:

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

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.

$$g_1 = \frac{\psi_m \gamma_m}{\kappa N^2} \left[c - t p_m \right]$$

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

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.

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

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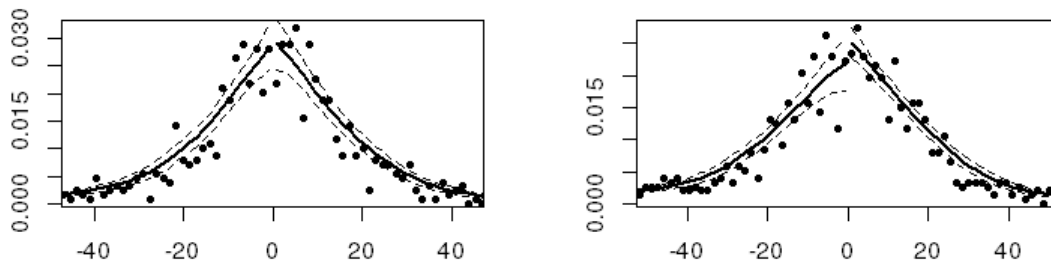
p-values of 0.90 and 0.22 for the McCrary test. Weak machines on the left, strong machines on the right.

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.

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Figure A.2: Balance of covariates
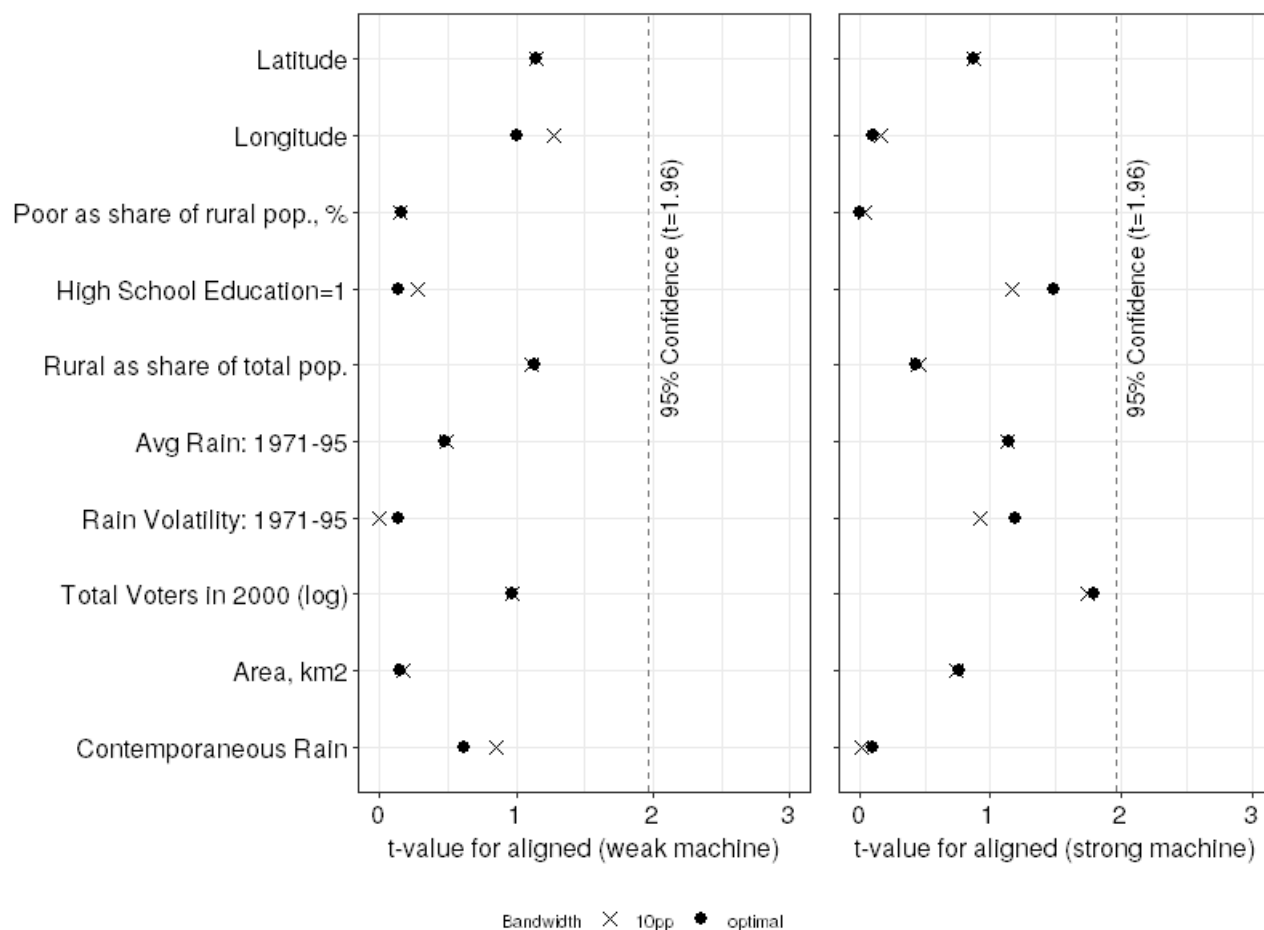
The points represent the t-values of the coefficient for alignment, in both relevant subsamples. I show the coefficient for the optimal bandwidth for each variable, and for a bandwidth of 10 percentage points in margin of victory, which is similar to the optimal bandwidth for the main outcome variable.

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

†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

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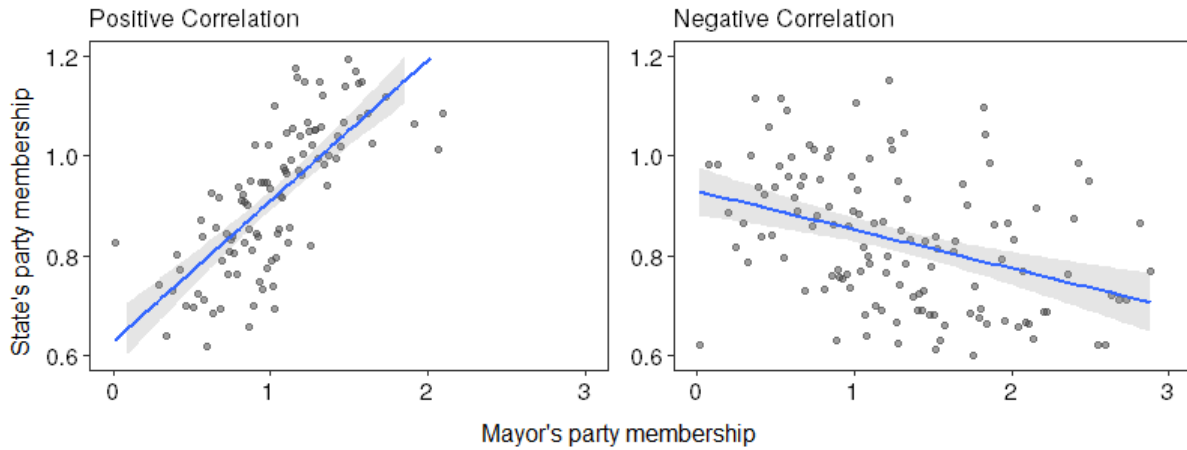
The definition of the samples in described in the text. For the purpose of presentation, the observations are aggregated by the average value of these variables in 150 bins, in each sample. The line represent a linear fit.

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 sub-samples, 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

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[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	Negative Correlation	Difference
	(1)	(2)	(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

PT

DEM

PMDB

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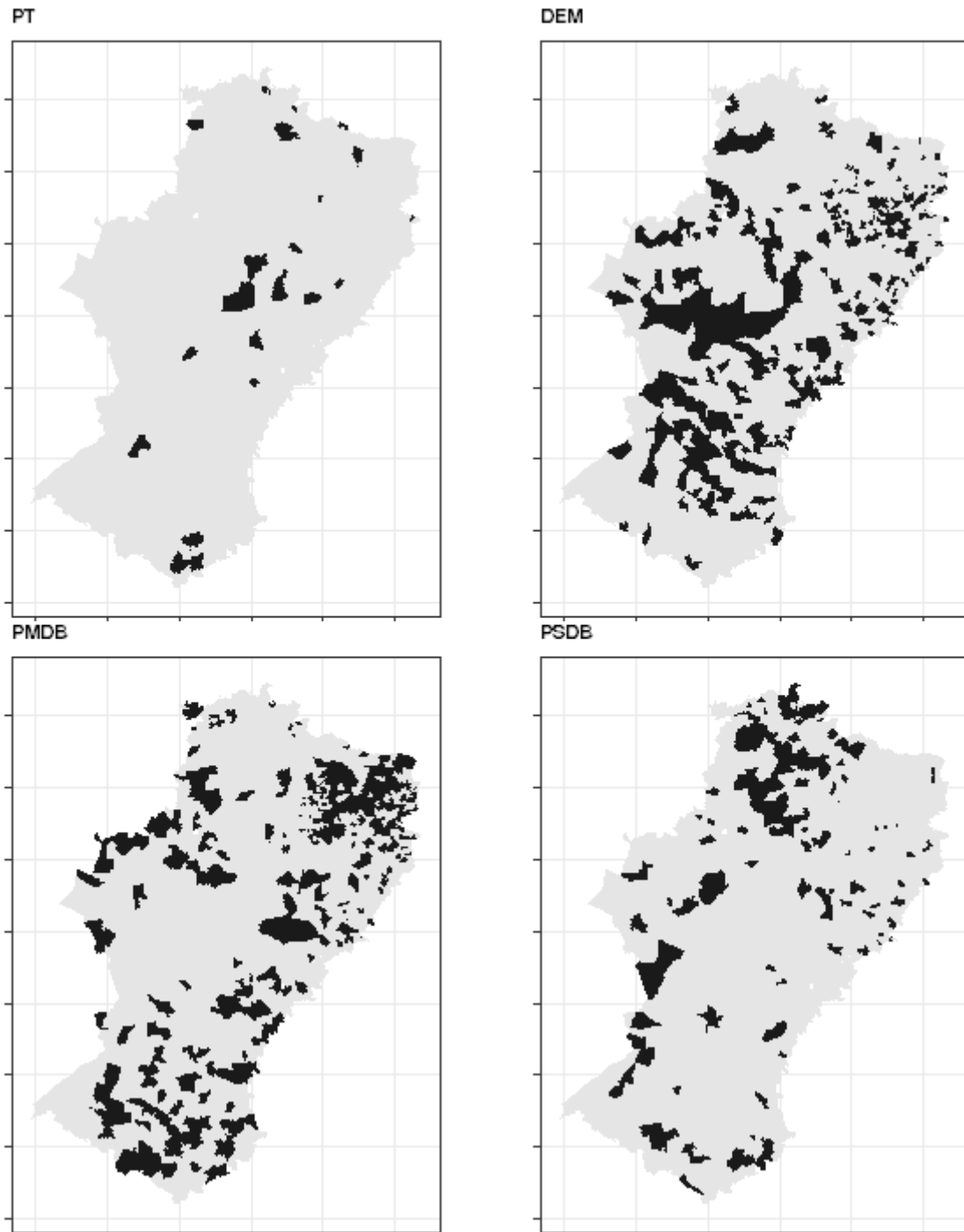
Municipalities in dark are the ones were the party holds the largest number of partisans.

**Figure A.5: NGO cisterns: marginal effect of alignment**
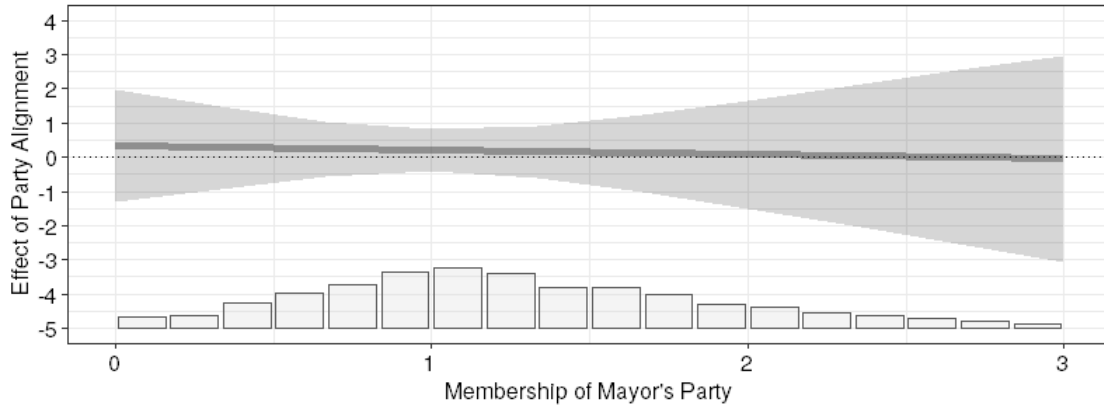
Confidence intervals at 95%. The bars show the density of the sample. For the purpose of presentation, the plot does not show values above 3 in the x-axis, 1% of the sample.

Figure A.6: Party recruiting in Brazil
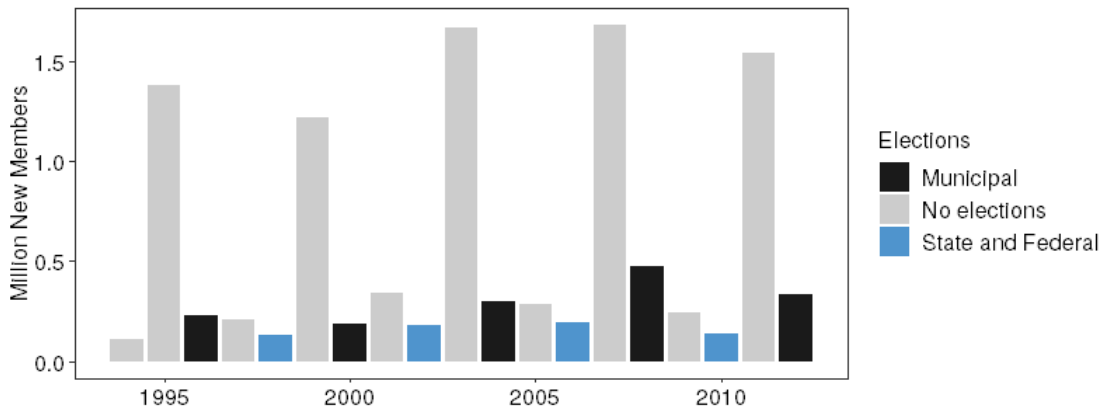
The bars represent the number of registered members every year.

Figure A.7: Party membership in the semi-arid: 2008 vs. 2000
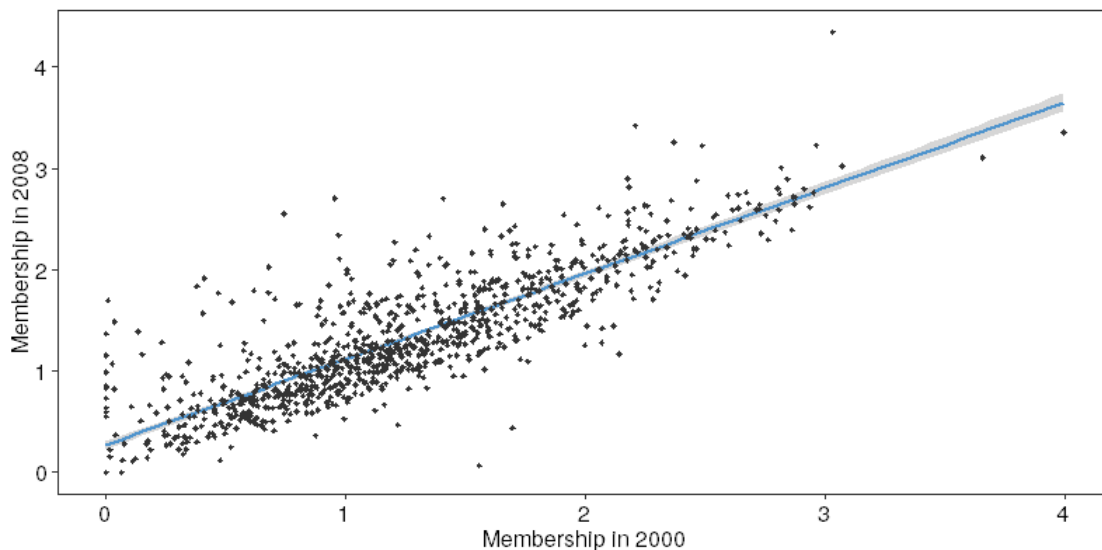
Membership is denoted as the percentage of voters in the previous election that were party members (in log transformation). Compares the membership in 2008 vs. 2000 for parties that help the mayorship in 2001-04, for all municipalities in the sample.

Figure A.8: Cistern

source: State Government of Maranhão.