Political Opposition, Politician Performance, and Public Service Delivery: Evidence From Brazil

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Abstract

An important feature of democracies around the world is separate executive and legislative branches providing checks and balances against each other, with multiple political parties vying for control. This paper measures the extent to which political opposition in the city council improves the mayor's performance and thus the quality of public services. Using data from Brazilian federal audits as well as health indicators, I employ a regression discontinuity design to estimate the causal effect of the marginal politically opposed legislator on measures of corruption, public service provision, and public health. I find that the marginal politically opposed city councillor significantly reduces embezzlement opportunity, increases the probability that a physician will be present at the local health clinic by 28 percentage points, and decreases the infant mortality rate by 2.3 per 1000 births for uneducated mothers. These findings have implications for the methods of proportional representation most likely to encourage good governance, and highlight the importance of legislative oversight for incentivizing the executive to act according to voter's preferences.

Keywords: Politicians, Corruption, Separation of powers, Public services, Regression discontinuity (RD)

JEL: D72, D73, H11, H83, O17

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1 Introduction

The effects of poor governance are felt by billions of people worldwide, and it is often in the poorest areas that politicians are least accountable. At best, low accountability leads to low politician effort. At worst, politicians may divert large amounts of public resources for their own gain, leaving government services unable to meet the basic needs of those who are most disadvantaged. It is therefore of great importance for those interested in economic development to understand what institutional arrangements can improve politician performance and the quality of public services.

A common feature of governments throughout the world is the separation of powers, with distinct executive, legislative, and judiciary branches exercising some measure of influence on each other, providing checks and balances, and discouraging the abuse of power. In such a democracy, politicians are kept in check both by voters *and* by other politicians (Persson et al. 1997). Recent empirical work has shown the positive effect that democratization has on public service provision and health, how electoral accountability and judicial checks can decrease corruption, and how voting technology can increase politician responsiveness and improve health outcomes (Martinez-Bravo et al., 2014; Kudamatsu, 2012; Ferraz and Finan, 2011; Litschig and Zamboni, 2015; Fujiwara, 2015). So while previous work shows how *voters* keep politicians in check, this paper shows how *politicians* keep politicians in check.

While the executive branch implements policies and programs, the legislative branch is often given the responsibility to oversee these activities and assure that they are administered properly. Though the legislative branch may be given oversight responsibilities, it is unlikely that legislators will execute this oversight properly when they are from the same political party or coalition as the executive. Legislators may denounce a corrupt or low-performing executive, but the executive will likely put a higher probability on this happening if there is also political leverage to be gained from opposing parties. In the context of an informal economic model, we could think about political opposition increasing the expected cost of poor performance for the executive.[1] Political opposition may improve public services both by inducing higher politician effort and by decreasing corruption. Given available data, it is difficult to

[1] A simple internet search will yield a number of results that support this view. There are a various news articles covering stories of corrupt mayors being denounced by city councillors from opposing parties, and even a video of a city councillor giving a speech during city council meeting in front of an audience of constituents, denouncing the mayor for having attempted to buy him off (Rodrigues; Morais; 'Vereador denuncia:', 'Vereador denuncia prefeito').

disentagle the two channels, because corruption on the part of the mayor is usually observationally equivalent to corruption on the part of subordinantes, which in turn may be due to low effort on the part of the mayor. I remain agnostic as to what channel the effect is operating through, though it is clear from the results presented below that political opposition improves politician performance.

To show this I use a regression discontinuity (RD) design to estimate the causal impact of the marginal politically opposed legislator on measures of corruption, public service provision, and public health. I follow a body of literature that exploits close elections as an RD design (Lee, 2008; Pettersson-Lidbom, 2008; Caughey and Sekhon, 2011; Eggers et al., 2015), so that the estimator compares municipalities where the opposition just barely won an additional seat in the legislature to those where the opposition just barely did *not* win an additional seat. I examine how the marginal opposing legislator affects various types of corruption (embezzlement, fraud, and overinvoicing), the quality of public service provision (particularly in the health sector), and actual health outcomes.

I find that the marginal politically opposed city councillor can significantly reduce the number of embezzlement opportunities found by auditors, though there is no effect on fraud or overinvoicing. Whether this reflects a less corrupt mayor or a mayor exerting higher effort (or both), I also show that this passes through to improve the quality of public service provision as well as public health, increasing the probability that a physician will be present at the local public health clinic by 28 percentage points and decreasing the infant mortality rate by 2.3 per 1000 births for uneducated mothers. These findings imply that legislative oversight has a significant role to play in decreasing corruption and ameliorating public service provision, and that methods of proportional representation should be chosen carefully so as to not disproportionately favor larger parties (as Brazil's system does), particularly when the executive's party is generally one of the stronger parties (as is the case in Brazil).

This article's main contribution is to the literature on political institutions and politician performance. While this literature has principally considered the direct effect of electoral incentives on performance (Dal Bó and Rossi, 2011; Ferraz and Finan, 2011; Lim, 2013; Martinez-Bravo et al. 2014; Gulzar and Pasquale, 2017), a smaller strand of this literature has examined the effect of checks from other branches of government (Alt and Lassen, 2008; Litschig and Zamboni, 2015). My contribution is to exploit exogenous variation in the intensity of legislative checks, and show

its effect on a chain of outcomes ranging from politician behavior to the welfare of constituents.

Thus, I also contribute to the literature on political institutions and economic and welfare outcomes (Besley and Kudamatsu, 2006; Kudamatsu, 2012; Acemoglu et al. 2014; Madsen et al. 2015). So far this literature has examined the broad effects of democracy on economic growth and health. I show channels through which democracy affects outcomes by examining a specific feature of democracies and its effect on a chain of intermediate outcomes that lead to development.

There is also a large recent literature that studies the impact that centralized audits can have on corruption and public service provision at the local level (Olken, 2007; Ferraz and Finan, 2008; Litschig and Zamboni, 2016; Nishijima, Ellis, and Cati, 2016, Lichand et al., 2016; Avis, Ferraz, and Finan, 2017). My work can be seen as complementary to this literature, since I study the effect of the auditing unit that is already *built in* to many democracies— the legislative branch.

Finally, this article is also a contribution to the literature on political partisanship and corruption (Anduiza, Gallego, and Muñoz, 2013; Eggers, 2014), which finds that voters are more tolerant of corruption in own political party. This paper shows that this result also holds for politicians, and that this tolerance has real impacts on outcomes such as health.

2 Institutional Background

Brazil is a federal republic much like the United States. There are 3 spheres of government: the federal government, the states, and the municipalities. Executive and legislative branches exist in all three spheres and are directly elected.

Municipal governments in Brazil are made up of of the mayor, his or her appointed secretaries, and the city council (*Câmara de Vereadores*). As the executive branch, the mayor and secretaries are responsible for implementing laws and policies through the Ministries of Health, Education, Agriculture, and so on. As the legislative branch, the city council is given the responsibility to (1) make laws, and (2) audit and review municipal spending, which includes reviewing the accounts of the mayor and his or her secretaries.

Internally, the city council elects a board of directors— a president, vice-president, and secretaries— which serves a purpose similar to the speaker of the house in the

U.S. House of Representatives. Among other things, this board is responsible for proposing projects and authorizing procurement of public goods. The city council's twofold responsibility will require a corrupt mayor to either buy off the city council, or find some other way to get around them. If auditing responsibilities are divided up among city councillors, more city councillors from opposing parties may make it more difficult to steal money or exert low effort. Corruption frequently manifests itself in the form of fraudelent projects, which must be approved by the city council. More opposing politicians in the legislature could mean more power to block these projects from being approved. Thus, the legislature could improve executive performance and/or restrain the executive's rent-seeking either through (1) legislation it does or does not choose to pass or (2) through its auditing responsibilities.

If city councillors notice some irregularities in the mayor's accounts, they are charged with creating a Parliamentary Commission of Inquiry in order to investigate possible malfeasance. Legislators may threaten the executive with denunciation, but if they are politically opposed, these threats will be much more credible both because political leverage stands to be gained and because politicians may not want their political enemies to have access to additional resources gained from rents.

On the other hand, there is anecdotal evidence that suggests that corruption in Brazil may be institutionalized and that party doesn't matter; in other words, corruption could be largely due to 'cultural norms'. As one Brazilian anticorruption organization has said, 'It seems there is some unwritten pact, a type of code of honor among the corrupt... and they meet their terms, even when they are political enemies' (Chizzotti et al. 2012). Corruption schemes may be inhereted from previous administrations, despite the transfer of power from one party to another, with city councillors recieving monthly payments from the mayor to keep quiet.

Politics is highly fragmented in Brazil due to a proportional represention system—in my data 25 different parties had mayors elected in the municipalities of Brazil. This fragmentation makes pure majorities in the legislature almost impossible to get, and so coalitions are key to getting representatives elected and advancing a policy agenda. Four main parties dominate the political landscape in Brazil, with smaller parties generally allying themselves with larger parties according to current political issues. Parties form coalitions both for the election of both executives and legislators, with candidates running under a specific party and coalition. These political coalitions are seen by some as exacerbating the problem of corruption. Coalitions between parties

are often formed based on promises to be fulfilled after the election, which could lead to fraudelent schemes in order to transfer money to party leaders as a reward. In 2015 legislation was introduced to prohibit coalitions in proportional elections, but the legislation did not pass.

Brazil has an open party-list proportional system where seats are allocated according to the D'Hondt Method[2], which will be discussed later as an important part of my identification strategy. The D'Hondt Method is widely used— 44 countries[3] in the world use some form of it, principally in Europe and Latin America. The findings in this paper will have important implications for the merits of the D'Hondt Method versus alternative methods like the Webster Method[4] or the Huntington-Hill Method[5].

Brazilian municipalitites are an ideal setting to study the effect of political opposition on politician performance because we can observe a cross-section of thousands similar local-level governments, and because governance is highly decentralized in Brazil, meaning that local-level politics can have a large impact important outcomes.

3 Data

3.1 Audit Data

One of the most difficult parts of studying corruption or politician effort is getting accurate and informative data. In this paper I use rich data provided by an anticorruption program in Brazil. Beginning in the year 2003, the Brazilian Federal Government began a lottery program in which every few months, municipalities from across the country would be randomly chosen to be audited with respect to all federal funds they had received in recent years. When a city is chosen by the lottery, a team

[2]First introduced by Thomas Jefferson to allocate seats to states in the US House of Representatives, but it is most often associated with the Belgian mathematician Victor D'Hondt who introduced it a century later

[3]According to Wikipedia, these are Albania, Argentina, Armenia, Austria, Belgium, Brazil, Bulgaria, Cambodia, Cape Verde, Chile, Colombia, Croatia, the Czech Republic, Denmark, the Dominican Republic, East Timor, Ecuador, Estonia, Fiji, Finland, Guatemala, Hungary, Iceland, Israel, Japan, Kosovo, Luxembourg, Macedonia, Moldova, Montenegro, Netherlands, Northern Ireland, Paraguay, Peru, Poland, Portugal, Romania, Scotland, Serbia, Slovenia, Spain, Turkey, Uruguay, and Wales.

[4]Introduced by American statesman Daniel Webster. This method was formerly used to allocate seats to the states in the US House of Representatives.

[5]This is the method currently in use to allocate seats to states in the US House of Representatives; however, it is not currently used by any legislature to allocate seats to parties.

of federal employees spends a few weeks in the city, inspecting receipts, budgets, bank statements, as well as the physical premises of projects targeted by federal monies, to ensure that projects have taken place. Programs audited include primary schooling, health clinics, poverty relief, and road construction. Audits are administered by the Controller-General of the Union (CGU), an agency within the System of Internal Control of the federal government's executive branch. The federal auditors are highly paid and trained professionals, and Ferraz and Finan (2008) find no evidence that they are successfully bribed by municipal governments to manipulate audit reports.

After being in the city for a few weeks reviewing documents, federal auditors write up a report (usually between 50 and 200 pages) listing all 'irregularities' pertaining to each program and service item within the program, including how much money was involved in each project and service item. About 90% of funds audited are related to either health, education or social programs. I use data from audits performed during the 3 terms from 2005-2016.[6] My data comes requested from the CGU, and lists all irregularities found in audits from the 20th to the 40th lottery.

Following classifications in Ferraz and Finan (2011), I examine 3 main types of corruption found in the reports: (1) embezzlement (diversion of funds), (2) fraud in procurement, and (3) overinvoicing. In the reports, what these respectively look like is (1) the local government spends public money and doesn't prove where it went (presumably transferred to private bank accounts, etc.); (2) the bidding process for public projects is simulated or manipulated, either using fake firms or 'friendly' firms; or (3) government officials pay higher-than-market prices for goods or projects (and then presumably receive a kickback from the private providers). As outcome variables, I use each of these 3 types of corruption, as well an aggregate of all other irregularities not classified as embezzlement, fraud, or overinvoicing. This includes serious procedural errors and other irregularities.

In my data, I see 87,000 individual irregularities over the 1,200 audits performed from the years 2006 to 2015.[7] In order to create measures for corruption, I use regular expressions to search for words and phrases that isolate an irregularity as corruption. Details on these regular expressions can be found in the appendix in section 8.6. Given the regular expressions I use, it is clear that my fraud and overinvoicing variables are

[6] Terms are 4 years long

[7] I omit the data from lotteries 29 and 30 because these audits happened in the second half of the first year of a term, making it unclear if corruption findings are due to the current or previous administration. Corruption found in audits performed in the first 6 months of a term are attributed to the previous administration.

measuring corruption at some level of the government (whether the mayor directly or his or her subordinates). However, my embezzlement variable measures situations in which money was spent by the municipal government and there are no receipts or documents showing that the money was actually spent as specified, thus opening the way for diverting public resources for private purposes. So while I cannot conclude that every such circumstance was a case of embezzlement, there is evidence (presented in the results section) that at least a significant portion of them are.

Audit reports are subdivided by ministry (of health, education, etc.) and then by service item, and the CGU classifies each irregularity as either 'major' or 'minor' based on potential monetary losses to the government. My main corruption outcome variables will be the amount of service items found to have been involved in each type of corruption, differentiated by major irregularities and minor irregularities. Summary statistics are provided in table 1.

Table 1: Audit Data Summary Statistics

	count	mean	sd	min	max
Total Audit Service Items	788	24.01269	9.552229	7	95
Embezzlement, Maj.	788	.2525381	.7634811	0	8
Fraud, Maj.	788	.2918782	.8910597	0	8
Overinvoicing, Maj.	788	.3274112	.9977917	0	12
Other Major Irregularities	788	3.332487	3.435536	0	30
Embezzlement, Min.	788	.286802	.710408	0	7
Fraud, Min.	788	.2715736	1.12038	0	18
Overinvoicing, Min.	788	.2233503	.6283137	0	7
Other Minor Irregularities	788	14.65482	5.804537	2	60

Each variable is the count of audit service items where the given type of irregularity was found, differentiated for major and minor irregularities (as classified by the CGU).
The sample is municipalities that fit the requirements for the RD design (detailed in section 4.1).

3.2 Public Service Provision Data

When the CGU sent auditors to inspect documents for the program outlined above, they also surveyed local residents to assess the quality of public service provision, particularly to assess the quality of Brazil's Family Health Plan (*Programa Saúde da Família*). A high fraction of healthcare in Brazil is provided by the government (Family Health Plan covers over 90% of Brazilians) and is implemented at the local

level. For the poor of Brazil, Family Health Plan is generally their only way to receive care. If public funds are being stolen, municipal health clinics will be underfunded and will not be able to provide people with proper healthcare. Similarly, if the municipal government is exerting low effort, healthcare providers may not be hired or incentivized to come to work, and people will not recieve care.

In each municipality, CGU auditors picked a random sample of residents to interview (22 families on average) and asked a series of questions relating to the quality of care received at local health clinics. In addition, this dataset also has nonsurvey data in which the auditors assessed the quality of public service provision based on documentation provided by the local government, including if Community Health Agents (CHA)[8] had been hired by irregular means. The questions asked are shown in table 12 in the appendix and summary statistics are provided in panel A of table 2.

Table 2: Healthcare Data Summary Statistics

Panel A: Survey Data					
	count	mean	sd	min	max
Nurse Present	5334	.9478815	.2222868	0	1
Dentist Present	4386	.7763338	.4167484	0	1
Physician Present	5359	.8303788	.3753347	0	1
Irregular Hiring	487	.3326489	.4716465	0	1
Lines at Health Unit	5278	.5617658	.4962173	0	1
Panel B: DATASUS Data					
Preterm Rate, Uned	45191	8.960052	7.841882	0	100
Infant Mort. Rate, Uned	45192	14.76405	30.48358	0	2000
Preterm Rate, Educ.	45258	8.147874	5.623468	0	100
Infant Mort. Rate, Educ.	45260	8.873812	17.66823	0	1000

All variables in panel A are binary variables indicating the respondent's answer to the questions in table 12. Sample sizes differ slightly by variable because some respondents may not have needed to see each type of medical professional during their last visit. The 'Irregular Hiring' variable has much lower sample size because it is based on responses of auditors rather than survey respondents. Panel B contains infant health indicators for uneducated and educated mothers. Preterm rate is the fraction of births born before 37 weeks, infant mortality rate is the number of infant deaths per 1000 live births.

[8]Community Health Agents in Brazil are government employees (within the Brazilian Unified Health System) with only basic healthcare training and report to a physician or nurse. They are generally selected from members of the community and make regular visits to families and promote good health.

3.3 Health Outcome Data

If poor politician performance has an adverse affect on public service provision, we may expect to see some negative effect on outcomes that these public programs are targeted at. Thus, I investigate the effect that the marginal opposing city counselor has on two infant health outcomes: fraction of infants born preterm (before 37 weeks) and the infant mortality rate per 1000 live births. I obtain this data from DATASUS, the data arm of Brazil's Unified Health System (*Sistema Único de Saúde*), the system that implements the Family Health Program. One advantage of this dataset is that unlike the CGU data, this data is available for every year in my sample and almost every municipality in Brazil (around 5,500). Thus I have a very high sample size and thousands of clusters.

Underfunding of Brazil's Family Health Program is most likely to affect low-income families who depend on it for their healthcare (wealthier families can seek private care). While health outcomes are not available by income level, they *are* available by education level. Thus, I classify mothers who received 1-7 years of schooling as 'uneducated' and mothers who received 8+ years of schooling as 'educated'.[9] In my data 34% of births are to uneducated mothers, 64% are to educated mothers, and 2% of mother's education levels are unreported. Summary statistics are in panel B of table 2.[10]

3.4 Election Data

I observe data on all candidates, parties, coalitions, votes received, and seats won, for the 2004, 2008, and 2012 Brazilian municipal elections. This data is available on the website of the Superior Electoral Court of Brazil (TSE).

In tables 13 through 17 in appendix 8.1 I present some tabulations that paint a

[9]This is similar to the classification in Fujiwara (2015), though Fujiwara classifies 'uneducated' mothers as recieving 1-9 years of schooling. Though it may be ideal to reuse Fujiwara's classification, education level data for mothers is only provided in bins, and the Brazilian government reported the data in different bins during the period I study.

[10]While only 2% of mother's education levels are unreported for births, 35% of mother's education levels are unreported for infant deaths, leading to some measurement error for the infant mortality rate for educated or uneducated mothers. I assume this is because healthcare workers are in general less preoccupied with gathering this information from a mother after she has lost her infant, regardless of her educational attainment. However, even *if* lower education mothers are more likely to have their education levels unrecorded, my RD design still ensures that this measurement error is uncorrelated with regressors, and thus it will not bias my estimates.

Table 3: Election Data Summary Statistics

	RD Sample	Non-RD Sample	Diff.
Tot. City Council Seats	9.311	9.344	-0.033
	(1.963)	(1.562)	(0.053)
Second Term	0.279	0.315	-0.037^{**}
	(0.448)	(0.465)	(0.015)
Mayor's Coalitions's seats	4.767	5.35	-0.583^{***}
	(1.548)	(2.319)	(0.069)
Num. Coalitions in Municipality	4.654	5.12	-0.466^{***}
	(2.5)	(2.576)	(0.082)
Num. Coalitions Supporting Mayor	1.852	2.165	-0.313^{***}
	(1.105)	(1.316)	(0.041)
Mayor Coalition Rank	1.462	1.449	0.013
	(0.818)	(0.805)	(0.026)
Anti-Mayor Coalition Vote Share	50.688	45.62	5.068^{***}
	(14.251)	(21.451)	(0.64)
Opposition Seat Share	0.484	0.425	0.059^{***}
	(0.155)	(0.236)	(0.007)
T	0.505	.	.
	(0.5)	.	.
R	0.001	.	.
	(0.011)	.	.
	4192	1275	.

Full sample for 2004 election year (the year corresponding to most of the audit data). Means are presented in the main row, standard deviations/errors are below in parenthesis.

picture of what the typical city council looks like in my data.[11] From these tabulations and the summary statistics in table 3, we can see that the typical (or median) city council has 9 seats and on average there are about 4.6 different coalitions of parties competing for votes. While various separate coalitions may compete with one another in the elections for city council, multiple coalitions sometimes unite into one super-coalition for the election of a single candidate for mayor. Thus we see in table 16 that while the typical mayor has 1 coalition that supported him or her in the election, it is also common for 2 coalitions to unite into one to support a single mayoral candidate. On average the mayor's coalition wins 4.8 of the seats in the city council, and as we can see from table 17, the typical mayor's coalition is the highest ranked coalition in terms of vote share. As seen in figure 3 in the appendix, in the bulk of municipalities, the opposing coalition has between 33% and 55% of the seats.

As will be discussed below, the RD design is only valid for a subset of my data. For example, in some municipalities the marginal seat in the city council may just be passing from one anti-mayor coalition to another, or from one pro-mayor coalition to another. Thus, the concept of being on the margin is not valid. These municipalities are dropped from the analysis, and in table 3 as well as table 10 (in the appendix), I compare the characteristics of the RD sample and the non-RD sample. As can be seen, municipalities in the RD sample have slightly fewer coalitions overall. This is expected given the criteria for dropping municipalities from the analysis. When there are fewer coalitions, it is more likely that the marginal seat is passing from a pro-mayor party to an anti-mayor party (or vice-versa), validating the RD design. Because there are less coalitions overall in the RD sample, there are slightly fewer coalitions supporting the mayor and fewer seats occupied by pro-mayor city councillors. Municipalities in the RD sample are also slightly less likely to have a radio or TV station originating from the municipality, have lower average incomes and urbanization rates, and have higher illiteracy rates.

[11] For these tabulations I use only municipalities for which I have corruption data and which fit the criteria outlined in section 4.1. Tabulations for the entire population of municipalities give similar results.

4 Econometric Model

4.1 Constructing the Running Variable

In order to identify causal effects I use a regression discontinuity (RD) model which exploits close elections.[12] As a key part of my RD model I construct a running variable that serves as a measure for how close a given election was. I use detailed knowledge of Brazil's electoral system in order to construct this running variable. Brazil has an open party-list proportional system, with seats allocated according to the D'Hondt Method and with coalitions treated as single parties. In order to illustrate how the D'Hondt Method works, consider the following example.

Imagine three different coalitions are competing for 6 seats in a fictional city council. The coalition of parties A & B receives 100,000 votes, the coalition of parties C & D receives 80,000 votes, and party E, which is running as an isolated party, receives 20,000 votes. The first thing that is done is that the 'electoral quotient' is calculated, which is the total amount of votes cast divided by the number of seats available. In our case, the electoral quotient is $(100,000 + 80,000 + 20,000)/6 = 33,333$. Only coalitions whose raw vote count exceeds the electoral quotient are eligible to be awarded seats. Thus, party E is already disqualified from winning seats, since it only received 20,000 votes. After this, a series of quotients is calculated, according to the formula

$$Q_s = \frac{V}{s+1}$$

where V is the total of votes the party received and s is the round of calculation (or number of seats already awarded to the party). In an election where n seats are available, coalitions are awarded 1 seat for each quotient they have among the highest n quotients.

This is illustrated in the table below, where both coalitions from the example above have been awarded 3 seats, since both have 3 quotients among the top 6 quotients.

I will construct the running variable for my sharp RD design as the margin of victory (or loss) for last city council member of the anti-mayor coalition, scaled by the total amount of votes cast.

In theory, each municipality has a series of cutoffs for each possible seat that can

[12] For identification of causal effects using the RD design see Hahn, Todd, and Van der Klaauw (2001). For a primer on RD see Imbens and Lemieux (2008).

D'Hondt Method Example (6 seats available)

	Q_0	Q_1	Q_2	Q_3	Q_4	Seats Won
Parties A+B	$100,000^*$	$50,000^*$	$33,333^*$	25,000	20,000	3
Parties C+D	$80,000^*$	$40,000^*$	$26,666^*$	20,000	16,000	3
~~Party E~~	~~20,000~~	~~10,000~~	~~6,666~~	~~5,000~~	~~4,000~~	0
Note: Asterisks denote quotients in the top 6.						

be won (the typical city council has 9 seats, though large cities generally have more), but we observe at most 2 of these cutoffs. By this I mean that we can look at the margin by which the anti-mayor coalition barely won its last seat, and we can look at by how much they just missed winning another seat. Because my dataset is not large enough to precisely estimate the treatment effect at each individual threshold (the effect of the 1st, 2nd, or 3rd opposing city councillor and so on), I stack all of the thresholds and my estimated treatment effect is a weighted average of the treatment effect at various thresholds (as discussed in Cattaneo et al., 2016) rather than the treatment effect at a single threshold. However, this presents a small problem—choosing which side of the cutoff a municipality is on. As a simple solution to this problem, I calculate the running variable for both theoretical margins (the 'barely lost' and the 'barely won' margins) and choose the value with the lowest absolute value. In other words, I put the municipality on the side of the cutoff it is closest to. The running variable R_i is formally defined as

$$BL_i = \frac{ResQ_{anti-mayor,i} - LowW_{mayor,i}}{TotVotes_i}$$
$$BW_i = \frac{LowW_{anti-mayor,i} - ResQ_{mayor,i}}{TotVotes_i}$$

$$R_i = \begin{cases} BL_i & \text{if} \quad |BL_i| < |BW_i| \\ BW_i & \text{if} \quad |BL_i| \geq |BW_i| \end{cases}$$

- BL - The 'barely lost' margin
- BW - The 'barely won' margin
- $ResQ_{c,i}$ - Residual Quotient (Highest quotient that did not win a seat) for coalition c in municipality i

- $LowW_{c,i}$ - Lowest quotient that won a seat for coalition c, municipality i

In practice, there are often 3 or more coalitions in the legislative election, rather than just a pro-mayor and an anti-mayor coalition. I make the simplifying assumption that parties that are not formally allied with the mayor in the election coalitions are against him or her, and are considered the political opposition.

I drop observations from the analysis if they meet any of the following criteria:

- The residual quotient and the lowest winning quotient are from the same coalition, and thus the concept of 'being on the margin' is no longer valid. This happens when the marginal seat is passing from one anti-mayor coalition to another, or from one pro-mayor coalition to another. (25% of obs)

- The municipal legislatures seem to have disregarded the standard election procedure (following the D'Hondt Method). This is seen in the data when the quotients I calculate from vote totals do not acurately predict the amount of seats awarded to each party. This could also happen due to a gap in coalition data or an electoral tie (1.5% of obs)

- Coalitions are such that two parties are allied in the election for city councillors but not in the election for mayor. (1.5% of obs)

The key assumption for RD to be valid is the smoothness or 'no precise manipulation' assumption. I test for manipulation of the running variable using the test outlined in McCrary (2008) and using the local polynomial methods put forth in Cattaneo, Jansson, and Ma (2017). I find no evidence of manipulation, failing to reject the null hypothesis of no manipulation with a p-value of 0.97. Figure 1 presents visual evidence of this.

As additional evidence for the validity of the RD design, in table 4 I present results from placebo tests, estimating the effect of treatment on a variety of municipal characteristics where no treatment should be found. Consistent with the validity of the RD design, there are no significant effects found.

4.2 Effect on Corruption

With this running variable I estimate a series of sharp RD models. The first model, which estimates the effect of political opposition on various measures of corruption,

Table 4: Placebo Tests

	2nd Term Mayor	City Council Wage	AM Radio	TV Station
T	-0.0588	131.9	-0.00603	-0.0298
	(0.0532)	(107.4)	(0.0406)	(0.0342)
Observations	2688	3577	3256	2791
	Judiciary District	Avg. Monthly Inc.	Illiteracy Rate	Urb. Rate
T	-0.0449	10.29	0.0672	-3.352
	(0.0552)	(22.86)	(1.091)	(2.124)
Observations	2632	2529	2643	3287
	Pop. 2010	City Council Size	Tot. Votes Cast	Audited Before
T	6176.6	-0.155	3986.0	0.0170
	(25633.0)	(0.223)	(13201.7)	(0.0530)
Observations	3125	3167	3172	2652

Effect of the marginal opposing legislator using a cross section of all municipalities from the 2004 election year. CCT optimal bandwidth, uniform kernel, standard errors in parenthesis.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

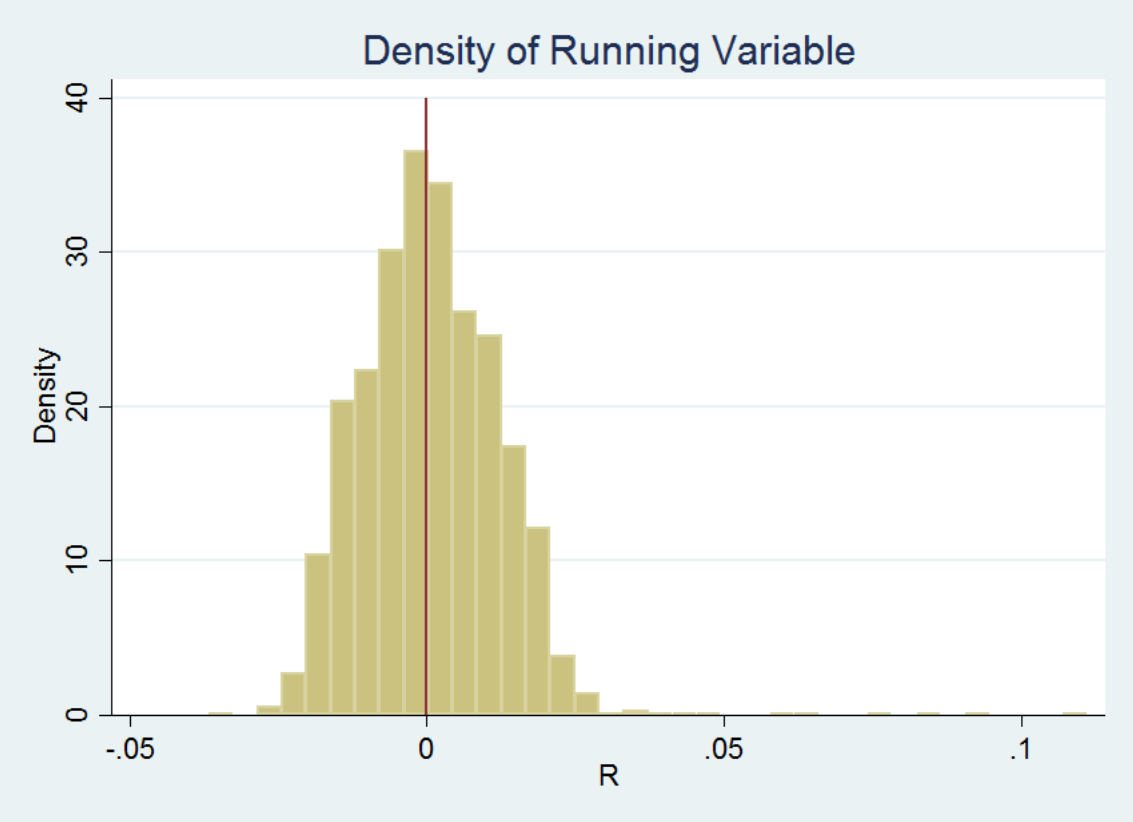

Figure 1: Density of the running variable (margin of victory/loss for the marginal legislator politically opposed to the mayor). Using McCrary's (2006) density test, I find no evidence of manipulation of the running variable.

can be written

$$c_{m,t} = \alpha_1 + \alpha_2 T_{m,t} + \alpha_3 f(R_{m,t}) + \alpha_4 f(R_{m,t}) * T_{m,t} + \varepsilon_{m,t} \tag{4.1}$$

for municipality m during term t.[13] Where $c_{m,t}$ is the amount of corrupt violations found in the municipality, the function $f(*)$ is a polynomial specification for the running variable, and $T_{m,t} = I[R_{m,t} > 0]$ denotes treatment status. Thus, α_2 is the main parameter of interest. For each outcome, I report in section 5 my preferred specification in tables (using the CCT optimal bandwidth from Calonico, Cattaneo, and Titiunik (2014) and a quadratic polynomial specification), and in section 8.4 in the appendix as a robustness check, I report a number of alternate RD specifications, varying the bandwidth and polynomial order. In the appendix I also report CCT's bias-corrected and robust variance estimates from Calonico, Cattaneo, and Titiunik (2014).

In the framework of Cattaneo et al. (2016), who provide conditions for interpreting regression discontinuity designs with multiple cutoffs, I have a pooled sharp RD with cumulative cutoffs. Cutoffs are cumulative in the sense that depending on opponent coalition's total vote share, units receive different treatments (different amounts of opposition legislators). Due to the cumulative nature of the cutoffs, while Cattaneo et al.'s score ignorability assumption may hold, it is unlikely that cutoff ignorability will hold. Becuase of this, my estimator can be interpreted as a weighted average of the treatment effect at various cutoffs (and hence at various marginal opposing legislator levels).[14]

Figure 2 illustrates somewhat the variation from which I am identifying the treatment effect. Particularly, it shows how this estimator can be seen as a weighted average at various levels of voter preference, becasue I have data close to the cutoff for a variety of total anti-mayor coalition vote shares.

4.3 Effect on Public Service Provision

The second model estimates the effect of political opposition on the quality of public service provision. This model differs from the first model in that I now observe data at the individual level rather than the municipality level, also it is done as a linear

[13] A small number of municipalities were audited twice in the same term. In this case I only consider the first audit report.

[14] To visualize what the weights roughly are, see figure 3 in the appendix.

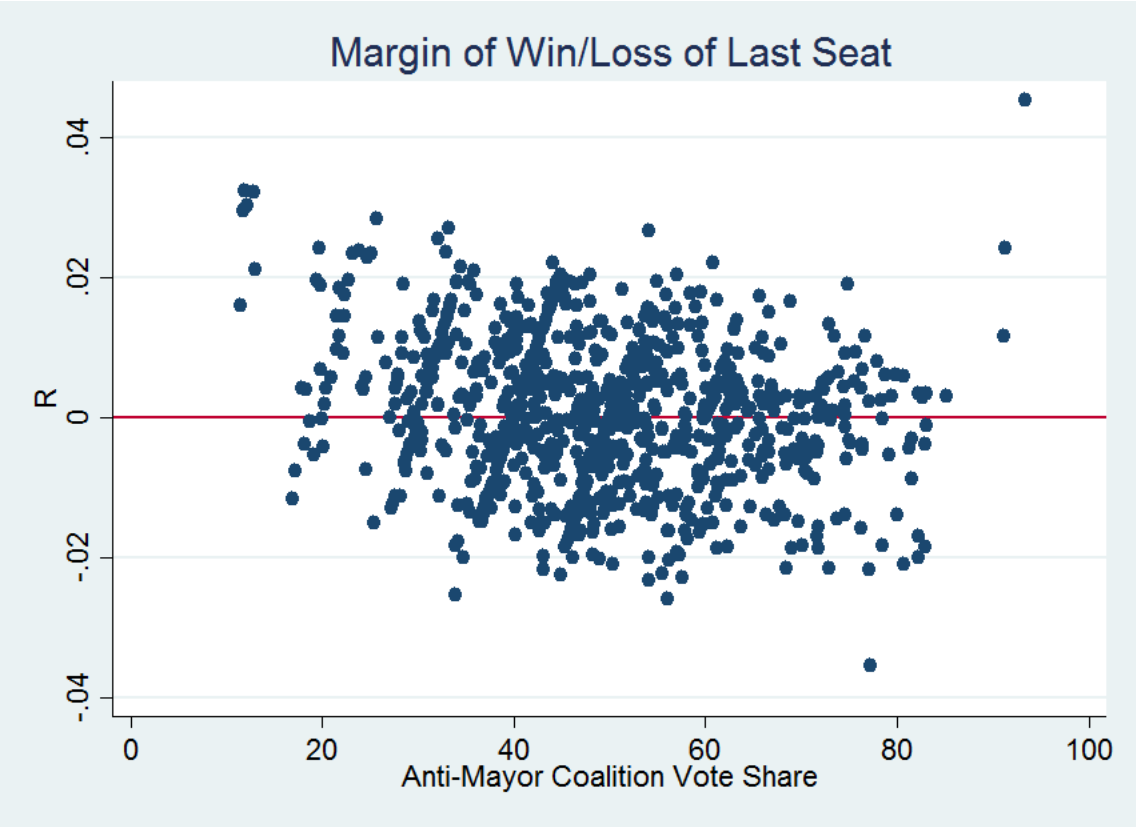

Figure 2: This figure illustrates that the estimator is a weighted average of the treatment effect at a variety of thresholds (voter preference levels). The faint pattern of upward-sloping lines comes from municipalities where there were only 2 coalitions, in which case vote share maps 1-to-1 into the running variable for a given disputed seat in the legislature.

probability model, since survey answers are yes/no answers. The model can be written

$$ps_{i,m,t} = \beta_1 + \beta_2 T_{i,m,t} + \beta_3 f(R_{i,m,t}) + \beta_4 f(R_{i,m,t}) * T_{i,m,t} + \epsilon_{i,m,t} \tag{4.2}$$

for individual i in municipality m during term t. Where $ps_{i,m,t}$ is an indicator for the respondent answering 'yes' to a given question relating to public service provision, and now β_2 is the main parameter of interest. In this model standard errors are clustered at the municipality level. Once again, I report in tables my preferred specification and the appendix contains a variety of robustness checks. It should be noted that this model does not limit the channel through which political opposition may affect public service provision. Political opposition may improve public service provision by a decrease in corruption, an increase in politician effort, or by other means, but based on my estimates of equation 4.1, it seems likely that corruption is at least a major channel.

4.4 Effect on Health Outcomes

The third model estimates the effect of the marginal politicaly opposed legislator on various health outcomes. In this model I again observe municipalities, though this model differs from the first model in that now I observe data for each year within an electoral term. The model can be written

$$h_{y,m,t} = \gamma_1 + \gamma_2 T_{y,m,t} + \gamma_3 f(R_{y,m,t}) + \gamma_4 f(R_{y,m,t}) * T_{y,m,t} + u_{y,m,t} \tag{4.3}$$

for municipality m in year y during term t. Where $h_{y,m,t}$ is a health outcome measure and now γ_2 is the main parameter of interest. In this model standard errors are also clustered at the municipality level. Tables contain my preferred specification and the appendix contains alternate specifications to test robustness.

4.5 Alternate IV Model

Because not all municipalities have the same size of city council, this presents a potential problem for my RD model, because this means that not all municipalities are receiving exactly the same marginal treatment. For municipalities with 9 seats on the city council (82% of all municipalities), they are recieving a $1/9th$ change in the composition of the city council, but for large municipalities with larger city councils,

they are recieving a 'diluted' marginal treatment. For example, the municipality of São Paulo has 55 seats on the city council. Thus, São Paulo would receive only a $1/55th$ change in the composition of the city council.

In order to address this issue, for the latter two models (for which I have high sample sizes)[15] I also estimate an alternate IV model where I regress outcomes on the share of city council seats that the opposition holds, using the RD equation to instrument for opposition share, and using the CCT optimal bandwidth from the first stage RD model.

$$y_{m,t} = b_1 + b_2 OppositionShare_{m,t} + \eta_{y,m,t} \tag{4.4}$$

$$OppositionShare_{m,t} = \delta_1 + \delta_2 T_{m,t} + \delta_3 f(R_{y,m,t}) + \delta_4 f(R_{y,m,t}) * T_{y,m,t} + \xi_{y,m,t} \tag{4.5}$$

5 Results

5.1 Effect on Corruption

My estimates for the treatment effect in equation 4.1 are reported in table 5. In panel A we see that the marginal politically opposed legislator can decrease the amount of items audited found to have a major embezzlement opportunity by approximately 0.642 items, which amounts to a 0.84 decrease in standard deviation units. This is a sizable effect given that the average municipality only has 1.6 items audited found to be involved in some type of corruption.[16] Note that there is no significant effect on 'Other Irregularities', evidence that my embezzlement variable is indeed measuring cases of embezzlement and not mere procedural errors.

In panel B we see that the coefficient for minor violations involving embezzlement is positive and significant at a 10% level. This provides some evidence for the intuitively appealing idea that when monitoring is tighter, there will be substitution from larger money-stealing schemes to smaller ones. Note that despite this substitution, the net effect is less corruption, especially since 'Major Violations' refers to violations with larger amounts of monetary losses to government accounts.

There is no discernible effect of treatment on either fraud in procurement or overinvoicing. Going back to the discussion in section 2, this is evidence that the legislative

[15] Due to the IV estimator's poor finite sample properties and my low sample size, I find no statistically significant results applying this model to my corruption data.

[16] For municipalities where corruption was found, the average is 2.8 items found to be involved with some type of corruption.

branch can restrain the executive branch's rent-seeking through its auditing responsibilities, but not through its lawmaking responsibilities. Restraining the executive from transferring money from government bank accounts to his or her own private bank account is fairly straightforward as long as the city council requires that the mayor and his secretaries provide receipts and other documentation for all expenditures they make. However, knowing which public projects proposed by the mayor are likely to be fraudulent may be more difficult. These findings also run contrary to the idea that corruption in Brazil is completely institutionalized, independent of party affiliation.

Next I examine the extensive versus intensive margin for major violations. As a simple way to do this, I examine the extensive margin by defining indicators for whether or not different types of corruption were found in the muncipality (or any corruption at all), and I look at the intensive margin by running the same model as panel A, but only for municipalities where corruption was found. I find that the effect is entirely on the intensive margin. Results for the extensive and intensive margins are respectively in panels C and D of table 5. These findings indicate that the marginal opposing legislator does not affect the decision of whether or not to *be* corrupt, but rather *how much* corruption to engage in.

These results are robust to a variety of alternate specifications as shown in table 21 in section 8.4.

5.2 Effect on Healthcare Provision

If the marginal politically opposed city councillor can decrease the amount of money potentially embezzled by the executive branch, we may hope that the money not being stolen is finding its way to the programs it is meant for. Complementary to this, there may be some direct effect of higher politician effort on public service provision. For the remainder of the paper I examine the pass-through effects on public service provision, particularly healthcare. In Brazil a large amount of healthcare is provided by the government, with local health clinics staffed by physicians, dentists, and nurses. If money is being stolen from public coffers, local governments will be cash-constrained and may be unable to hire the adequate amount of healthcare professionals, or unable to pay the professionals they have already hired. Approximately 51% of physicians in

Table 5: Corruption Outcomes

	Embezzlement	Fraud	Overinvoicing	Other Irregularities
Panel A: Major Violations				
T	-0.642**	-0.271	-0.106	0.235
	(0.256)	(0.259)	(0.293)	(0.911)
Observations	342	402	399	505
Panel B: Minor Violations				
T	0.368*	0.0370	0.0793	-2.072
	(0.206)	(0.264)	(0.177)	(1.777)
Observations	423	445	418	404
Panel C: Major Violations, Extensive Margin (0/1)				
T	-0.0728	-0.0645	-0.0535	-0.0870
	(0.108)	(0.0988)	(0.114)	(0.100)
Observations	348	455	396	455
Panel D: Major Violations, Intensive Margin (Given non-zero corruption)				
T	-1.208***	-0.254	-0.292	-0.872
	(0.392)	(0.460)	(0.478)	(1.386)
Observations	199	174	224	226

Treatment effect of the marginal opposing legislator on corruption, using the CCT optimal bandwidth and a uniform kernel. Standard errors in parenthesis. Outcomes are the count of items audited with a violation. Other irregularities captures all other irregularities found by auditors that were not classified as embezzlement, fraud, or overinvoicing, and includes a host of procedural and other errors.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Brazil work in both the public and private sectors.[17] If these physicians are unpaid for their public work because of missing funds, they will likely substitute towards their private practice, leaving the public clinics understaffed and unable to provide care to those who depend on Brazil's public healthcare. On the other hand it may be that mayors with more opposition in the city council exert higher effort in assuring that health clinics are adequately staffed. I examine this effect on public service provision in table 6, which contains my estimates for the treatment effect from equation 4.2.

As we can see in panel A of table 6, the marginal politically opposed city councillor increases the probability that a physician or dentist will be present to tend to patients by 27.7 and 33.9 percentage points, respectively. In table 7 I present results from the IV specification. Technically, the interpretation of these coefficients is the effect from a switch from 0% opposition to 100% opposition in the city council, though since the majority of my data comes from municipalities with between 30% to 60% opposition, I would be cautious about such a global interpretation, as there are likely to be nonlinearities. Nevertheless, it is clear that opposition in the city council plays a very large role in assuring that healthcare professionals are present to see patients.

Going to panel B of table 6, we see that the marginal opposing legislator also significantly decreases the probability of irregular hiring practices for Community Health Agents, and decreases the probability that patients have to wait in lines to receive care.

In recent years, Brazil has experienced a significant shortage of physicians at public health clinics. As evidence of this, see various news articles (Falcão and Amorim; 'Postos de saúde') as well as Brazil's ongoing federal program which started in 2013, *Mais Médicos* (More Doctors), which is aimed at recruiting more physicians for public health clinics, including importing them from other countries. Experts cited in these news articles suggest that this public sector shortage of physicians could be due to underfinancing of the public health system. My results confirm this and suggest that a significant share of the physician shortage in the public sector could explained by missing funds due to corruption, and that much of this corruption could be stopped by legislators who will fulfil their oversight responsibilities.

[17] Meanwhile 27% work exclusively in private medicine and 22% work only in public medicine (Scheffer M. et al. 2015).

Table 6: Public Service Provision

Panel A: Presence of Healthcare Professionals			
	Nurse Present	Dentist Present	Physician Present
T	0.150	0.339**	0.277**
	(0.128)	(0.139)	(0.128)
Observations	2711	2233	2751
Clusters	127	121	130
Panel B: Community Health Agents and Lines			
	Irregular Hiring	Lines at Health Unit	Healthcare Visits
T	-1.055***	-0.402**	-0.0369
	(0.256)	(0.170)	(0.0487)
Observations	243	2439	2482
Clusters	74	119	117

Treatment effect of the marginal opposing legislator on public service provision outcomes, using the CCT optimal bandwidth and a uniform kernel. Clustered standard errors in parenthesis.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Public Service Provision: IV Model

Panel A: Presence of Healthcare Professionals			
	Nurse Present	Dentist Present	Physician Present
Opposition Seat Share	0.306	1.266**	0.729
	(0.330)	(0.578)	(0.456)
Observations	2473	2040	2489
Clusters	116	110	116
Panel B: Community Health Agents and Lines			
	Irregular Hiring	Lines at Health Unit	Healthcare Visits
Opposition Seat Share	-1.085	0.293	0.167
	(0.984)	(0.617)	(0.172)
Observations	243	2439	3119
Clusters	74	119	147

Effect of political opposition on public service provision. Opposition Share is the percentage of seats occupied by legislators not allied with the mayor. This is instrumented by the RD equation, using the CCT optimal bandwidth that was calculated for the first stage. Clustered standard errors in parenthesis.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.3 Effect on Health Outcomes

Going further down the causal chain, I now estimate the effect that the marginal opposing legislator has on actual health outcomes, particularly infant health. If physicians are missing from local health clinics due to missing funds or low politician effort, it is natural to expect to see negative health outcomes for the population, especially for infants, who are among the most vulnerable.[18] Table 8 contains my estimates for the treatment effect from equation 4.3.

The most interesting finding from this section is that in panel A of table 8 we see that the marginal opposing legislator can improve executive performance to the extent that on average it lowers the infant mortality rate by 2.32 deaths per 1000 live births for uneducated mothers. This estimate is robust to a variety of specifications as shown in table 22. Given that the overall infant mortality rate in Brazil is approximately 15 per 1000 live births, this is a sizable effect for only a single city councillor to have. The results from the IV model in table 9 corroborate these results, indicating that more opposition in the city council also decreases the fraction of babies born preterm, preterm birth being a leading cause of child deaths (*Preterm Birth* 2016). No effect is found on infant health outcomes for educated mothers.

Table 8: Public Health Outcomes

Panel A: Uneducated Mothers		
	Preterm	Infant Mort. Rate
T	-0.547	-2.324**
	(0.340)	(0.983)
Observations	25297	27702
Clusters	4259	4278
Panel B: Educated Mothers		
	Preterm	Infant Mort. Rate
T	-0.275	-0.346
	(0.250)	(0.538)
Observations	25403	25673
Clusters	4259	4278

Treatment effect of the marginal opposing legislator on public health outcomes, using the CCT optimal bandwidth and a uniform kernel. Clustered standard errors in parenthesis.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[18] Indeed, many researchers use infant mortality rate as a proxy measure for the overall health of a population.

Table 9: Public Health Outcomes: IV Model

Panel A: Uneducated Mothers		
	Preterm	Infant Mort. Rate
Opposition Share	-4.056**	-11.23*
	(1.921)	(6.338)
Observations	17258	17258
Clusters	3345	3345
Panel B: Educated Mothers		
	Preterm	Infant Mort. Rate
Opposition Share	-1.608	-4.043
	(1.468)	(3.447)
Observations	17282	17283
Clusters	3346	3346

Effect of political opposition on public health outcomes. Opposition Share is the percentage of seats occupied by legislators not allied with the mayor. This is instrumented by the RD equation, using the CCT optimal bandwidth that was calculated for the first stage. Clustered standard errors in parenthesis.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Discussion and Conclusion

Because of my new method of measuring corruption using regular expressions, it is difficult to directly compare my estimates of the effect of the marginal opposing legislator to other treatments already considered in the corruption literature; however, it is quite straightforward to compare my estimates of the effect on public service quality and public health to those in the existing literature. Litschig and Zamboni (2017) examine the effect that increased audit risk from Brazil's central audit program has on corruption as well as the same survey measures of public service provision that I use. While Litschig and Zamboni find that increased audit risk significantly decreases corruption, they find that it has no significant effect on measures of public service provision, including the probability that physicians and dentists will be at local health clinics to see patients. In contrast, I find that the marginal opposing legislator can increase the probability that these healthcare professionals will be present to see patients by 28 and 34 percentage points, respectively.

My work contrasts Lichand et al. (2016) which finds that though Brazil's centralized audit program decreased corruption, it also worsened some health outcomes such as hospital beds and immunization coverage. Overall, this seems to indicate that auditing by the legislative branch may be more effective than top-down auditing

by the federal government. This is also interesting in comparison to Olken (2007), who finds that top-down monitoring is more effective than grassroots monitoring in decreasing corruption.

My estimates of the sizable effect of the marginal opposing legislator on corruption, public service delivery, and health outcomes, coupled with the fact that the typical mayor has 5 city councillors in his or her coalition (table 15) suggests that mayors depend significantly on having city councillors on their side in order to extract rents or exert low effort.

This suggests that it may be favorable to have more legislators politically opposed to the mayor, but legislators are chosen by voters, not economists, so what can be done? It so happens that the D'Hondt Method used in Brazil (and many other countries) to apportion seats is known to disproportionately favor larger parties. As can be seen in table 17, the typical mayor's coalition in Brazil is the largest coalition in terms of vote share. Thus, using an alternative method that does not disproportionately favor larger parties may almost costlessly increase political opposition, decrease corruption, and improve public service provision.

I conduct counterfactual simulations using the Webster Method, the Danish Method, and the Huntington-Hill Method on Brazil's municipal electoral data from 2004 to 2016, and report results in tables 23 through 25 in appendix 8.5. The three methods only differ in the way that quotients are calculated.[19]

In the Huntington-Hill case for example, 83% of elections have no change in the size of the mayor's coalition and in 4.4% of elections the mayor's coalition gains a member, but in 12.4% of cases the mayor loses a coalition member. So on net, 8% of municipalities would have an additional legislator politically opposed to the mayor.

Beyond the possible benefits of alternative methods of allocating seats, this work emphasizes the importance of strengthening legislative oversight to combate corruption and promote the good use of public resources. Stapenhurst, Pelizzo, Olson, and von Trapp (2008) document that various tools of legislative oversight are common throughout the world, but they are not universal.[20] For example, in a sample of 39 countries— 25 of which are OECD countries— only 28% have a specialized budget research organization attached to the legislature.[21] The number is likely much lower

[19]The formulas for the three alternate methods are respectively $Q_s = \frac{V}{2s+1}$, $Q_s = \frac{V}{3s+1}$, and $Q_s = \frac{V}{\sqrt{s*(s+1)}}$.

[20]See table 1.1 specifically.

[21]Table 6.6

in a sample of only developing countries. My estimates suggest that strengthening legislative oversight may be a low-cost alternative to centralized audit programs.

In conclusion, I use a regression discontinuity design to show that the marginal politically opposed legislator can have a large impact in reducing opportunity for embezzlement as well as improving healthcare provision and actual health outcomes. Finally, I address this work's implications for the methods of proportional representation that are most likely to encourage good governance, as well as the importance of legislative oversight to combat corruption.

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8 Appendix

8.1 Additional Summary Statistics

Table 10: Municipal Characteristics

	RD Sample	Non-RD Sample	Diff.
AM Radio	0.213	0.236	-0.023^{*}
	(0.409)	(0.425)	(0.013)
TV Station	0.102	0.127	-0.026^{***}
	(0.302)	(0.334)	(0.01)
Judiciary District	0.472	0.492	-0.019
	(0.499)	(0.5)	(0.016)
Avg. Monthly Income	433.133	446.383	-13.25^{**}
	(196.475)	(202.788)	(6.447)
Illiteracy Rate	16.36	15.69	0.67^{**}
	(9.862)	(9.812)	(0.315)
Urbanization Rate	63.263	65.589	-2.325^{***}
	(21.978)	(22.171)	(0.708)
Population 2010	34135.8	34273.96	-138.153
	(224619.0)	(97499.66)	(4420.171)
Tot. Votes Cast	17692.5	17334.42	358.079
	(116821.2)	(49890.38)	(2282.044)
Observations	4192	1275	.

Full sample for 2004 election year (the year corresponding to most of the audit data). Means are presented in the main row, standard deviations/errors are below in parenthesis.

Table 11: Conditional Summary Statistics

	count	mean	sd	min	max
Total Audit Service Items	432	25.38657	10.13098	9	95
Embezzlement, Maj.	432	.4606481	.984015	0	8
Fraud, Maj.	432	.5324074	1.149545	0	8
Overinvoicing, Maj.	432	.5972222	1.287019	0	12
Other Major Irreg.	432	4.118056	3.786954	0	30
Embezzlement, Min.	432	.5231481	.8930883	0	7
Fraud, Min.	432	.4953704	1.476805	0	18
Overinvoicing, Min.	432	.4074074	.803554	0	7
Other Minor Irreg.	432	15.55093	6.179616	4	60

RD Sample, conditional on corruption being found

Table 12: Public Service Assessment Questions

Variable	Survey Questions
Nurse Present	*When you needed to be seen at the Family Health Unit, was there a nurse there to serve you?*
Dentist Present	*When you needed to be seen at the Family Health Unit that has a dentist, were you served?*
Physician Present	*When you needed to be seen at the Family Health Unit, was there a physician there to serve you?*
Healthcare Visits	*Does the family recieve visits from Community Health Agents?*
Lines at Health Unit	*Have you or someone in your family had to wait in lines to recieve care?*
	Auditor's Assessment
Irregular Hiring	*Are there Community Health Agents that were contracted irregularly?*

	Total City Council Seats	
	freq	pct
9	778	88.41
10	42	4.77
11	28	3.18
12	5	0.57
13	12	1.36
14	4	0.45
15	5	0.57
16	1	0.11
18	2	0.23
19	3	0.34
Total	880	100.00

Table 13

	Num. Coalitions in Municipality	
	freq	pct
2	190	21.59
3	185	21.02
4	142	16.14
5	137	15.57
6	85	9.66
7	54	6.14
8	38	4.32
9	19	2.16
10	8	0.91
11	11	1.25
12	4	0.45
13	4	0.45
15	3	0.34
Total	880	100.00

Table 14

	Mayor's Coalition's Seats	
	freq	pct
0	4	0.45
1	7	0.80
2	39	4.43
3	95	10.80
4	177	20.11
5	273	31.02
6	174	19.77
7	73	8.30
8	25	2.84
9	8	0.91
10	3	0.34
11	1	0.11
12	1	0.11
Total	880	100.00

Table 15

	Num. Coalitions Supporting Mayor	
	freq	pct
1	444	50.45
2	253	28.75
3	124	14.09
4	44	5.00
5	11	1.25
6	3	0.34
7	1	0.11
Total	880	100.00

Table 16

	Mayor's Coalition Rank (In Vote Share)	
	freq	pct
1	591	67.16
2	231	26.25
3	41	4.66
4	11	1.25
5	3	0.34
6	2	0.23
8	1	0.11
Total	880	100.00

Table 17

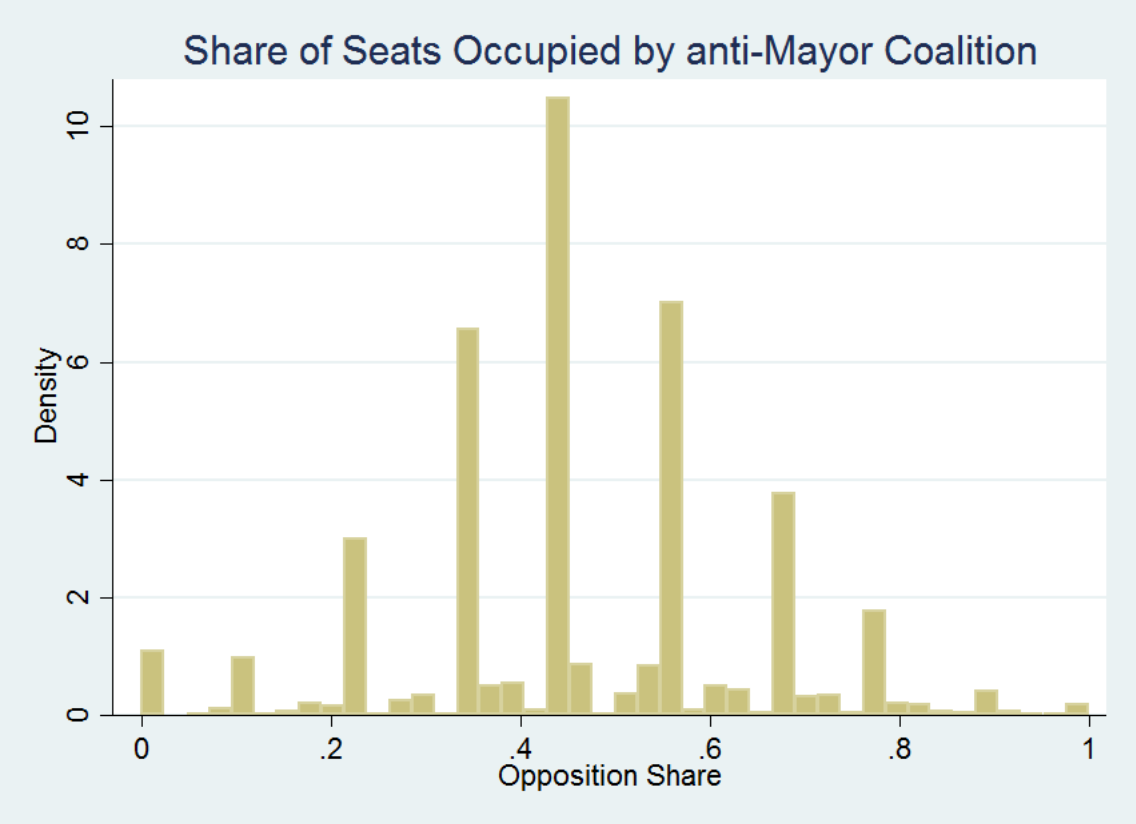

Figure 3: The density of opposition seat shares. The density clusters at levels that are fractions of 9 because the majority of municipalities have 9 seats.

8.2 Additional Results

In the model shown in 4.1 I use conventional standard errors. Heteroskedasticity-robust standard errors are biased in small samples, so I conduct the Breusch-Pagan test to test for possible heteroskedasticity. I fail to reject the null hypothesis of homoskedasticiy for all of my main outcome variables, with all F-statistics arbitrarily close to zero. This is unsurprising, since due to the RD design, we do not expect variance of the error term to be different between municipalities where the anti-mayor coalition barely won an additional seat versus municipalities where they barely didn't win an additional seat. Results available upon request.

Below I report results from Calonico, Cattaneo and Titiunik's RD robust estimator. Their 'conventional' standard errors are heteroskedasticity robust standard errors.

Table 18: CCT Robust Estimation

	Embezzlement	Embezzlement, Ext. Margin
Conventional	-0.642	-1.208**
	(0.397)	(0.602)
Bias-corrected	-0.705*	-1.336**
	(0.397)	(0.602)
Robust	-0.705	-1.336*
	(0.455)	(0.713)
Observations	788	432

Treatment effect using CCT robust confidence intervals.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 19: CCT Robust Estimation

	Physician Present	Dentist Present
Conventional	0.277**	0.339**
	(0.127)	(0.139)
Bias-corrected	0.316**	0.354**
	(0.127)	(0.139)
Robust	0.316**	0.354**
	(0.141)	(0.157)
Observations	2751	2233
Clusters	130	121

Treatment effect using CCT robust confidence intervals.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 20: CCT Robust Estimation

	Inf. Mort. Rate, Uneducated Mothers
Conventional	-2.324**
	(0.984)
Bias-corrected	-2.470**
	(0.984)
Robust	-2.470**
	(1.053)
Observations	27702
Clusters	4438

Treatment effect using CCT robust confidence intervals.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

8.3 RD Plots

Here I present some RD plots for particular outcomes of interest. These plots were made using the algorithm outlined by Calonico et al. (2015), limiting the plot to the data within the CCT optimal bandwidth.

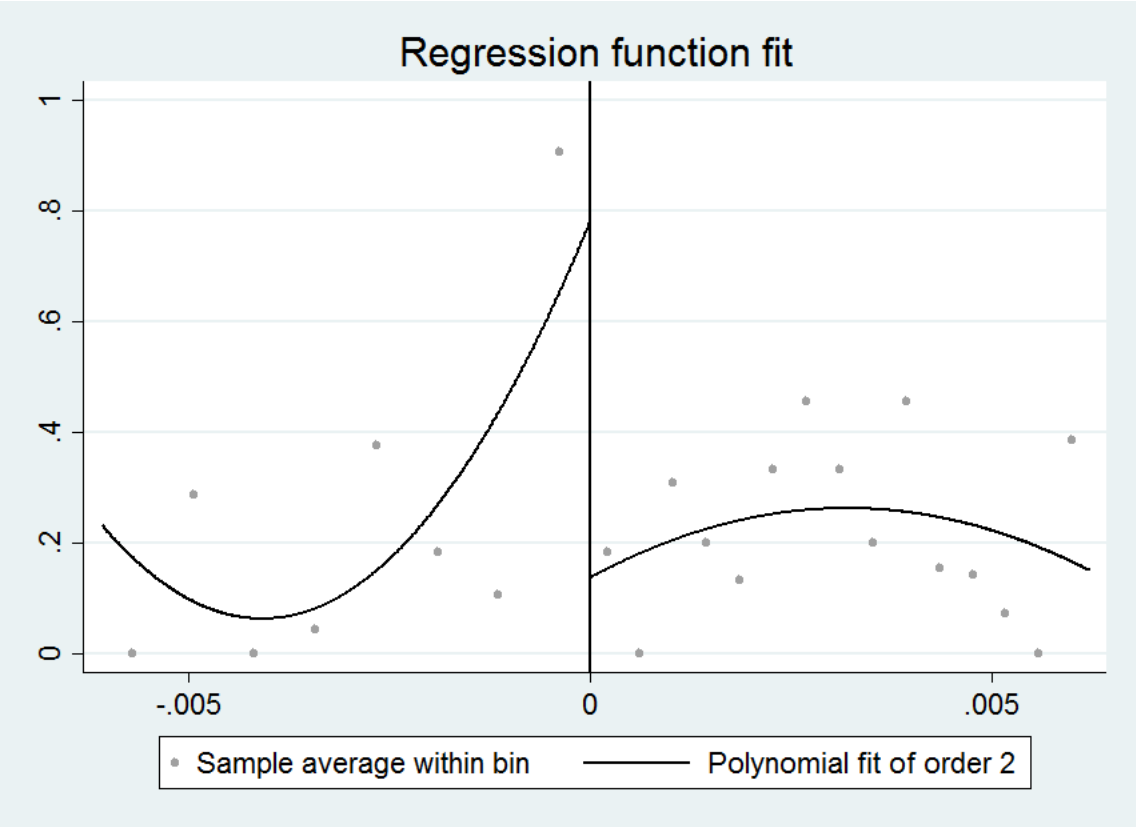

Figure 4: Embezzlement, Major Violations

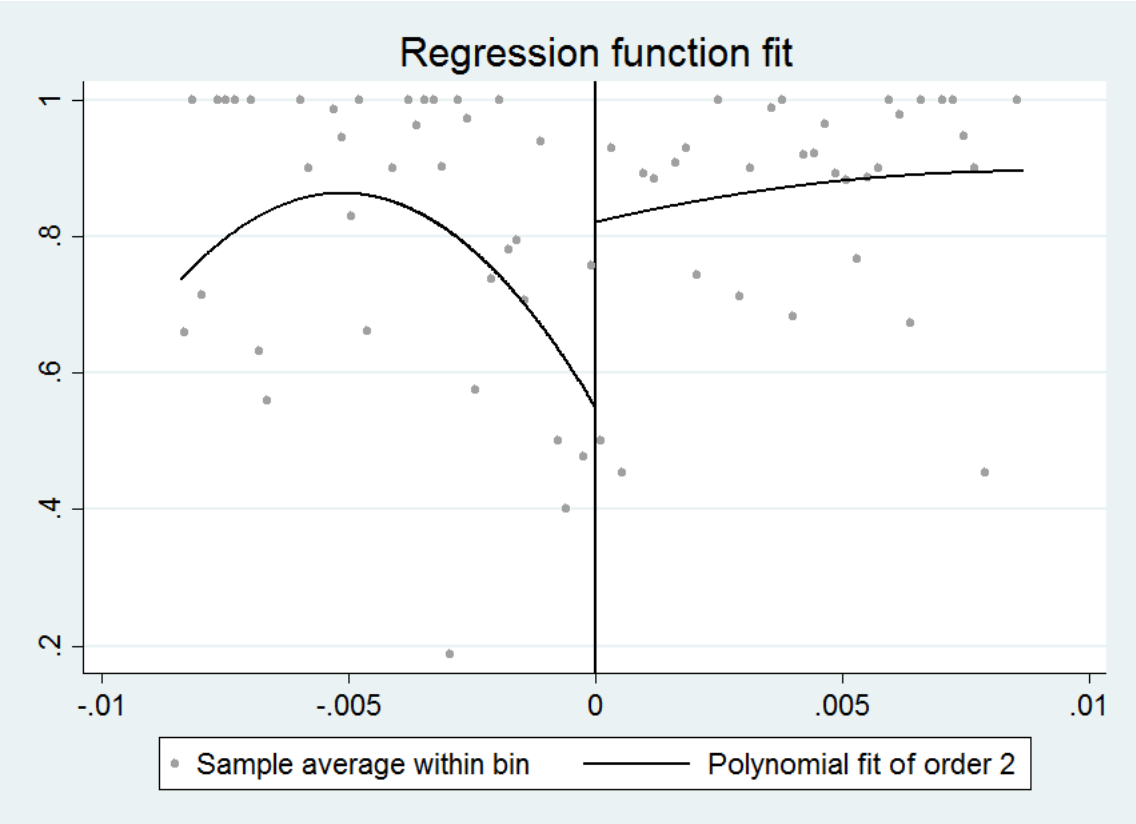

Figure 5: Physician Present

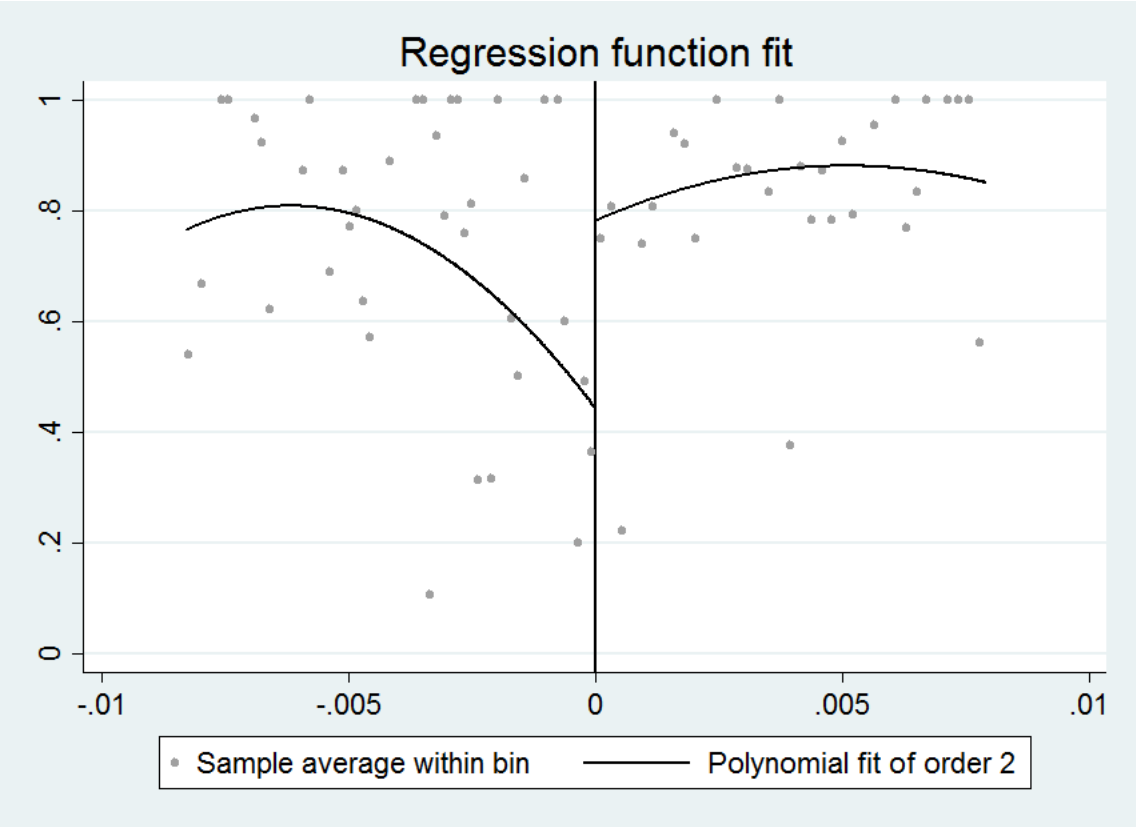

Figure 6: Dentist Present

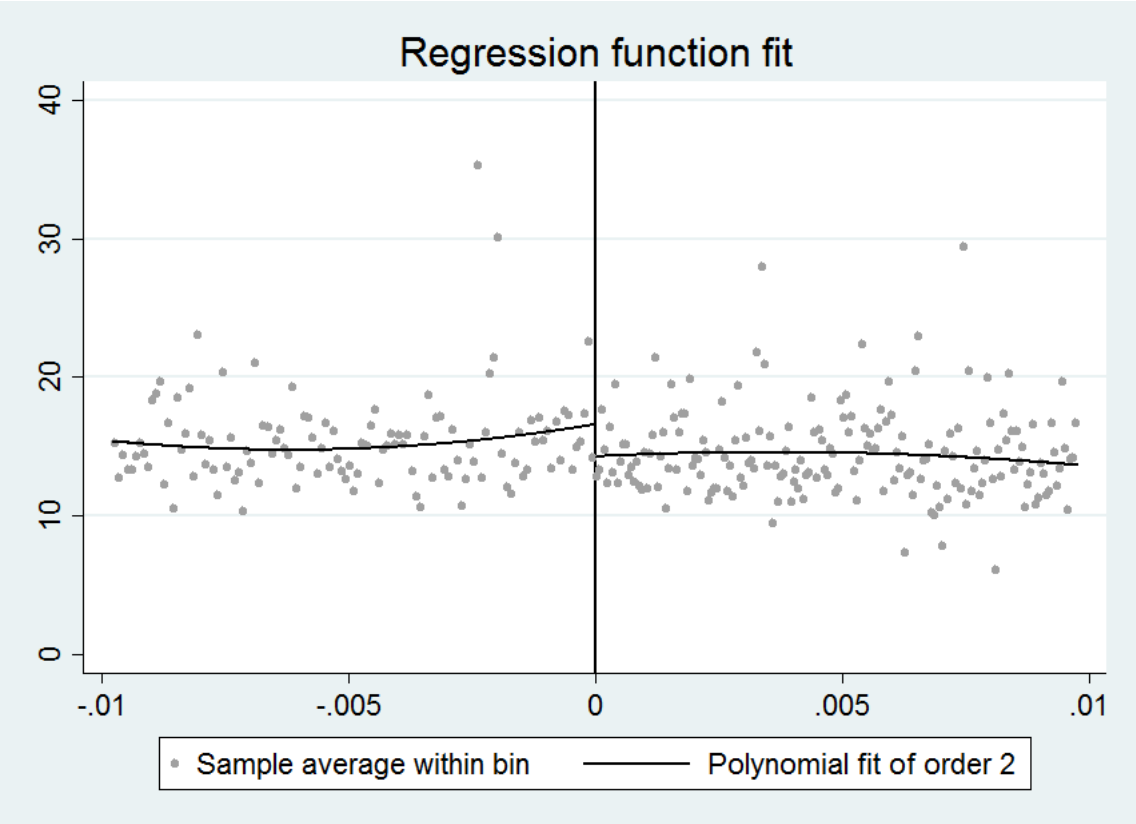

Figure 7: Infant Mort. Rate, Uneducated Mothers

8.4 Robustness Tests

The following tables show the results from a variety of alternate model specifications for outcome variables of interest, including various bandwidth selections and polynomial specifications.

Table 21: Alternate RD Specifications: Embezzlement

	Bandwidth Scale				
	2	1.5	1	.5	.25
Polynomial Spec.	Panel A: Embezzlement, Major				
None	-0.07	-0.169	-0.273	-0.538	-0.92
	(0.127)	(0.165)	(0.204)	(0.406)	(0.658)
Linear	-0.224	-0.284^{*}	-0.512^{**}	-0.786^{**}	-1.071
	(0.145)	(0.168)	(0.233)	(0.375)	(0.728)
Quadratic	-0.253	-0.49^{**}	-0.642^{**}	-0.893^{**}	-0.951
	(0.194)	(0.214)	(0.256)	(0.447)	(0.813)
Cubic	-0.376^{*}	-0.492^{**}	-0.606^{**}	-0.855^{**}	-0.813
	(0.193)	(0.221)	(0.28)	(0.392)	(0.699)
	Panel B: Embezzlement, Major - Intensive Margin				
None	-0.271	-0.46	-0.673	-1.224^{*}	-0.903
	(0.26)	(0.312)	(0.41)	(0.667)	(0.736)
Linear	-0.49^{*}	-0.604^{**}	-1.147^{***}	-1.436^{**}	-1.769
	(0.253)	(0.298)	(0.419)	(0.622)	(1.208)
Quadratic	-0.516^{*}	-1.087^{***}	-1.208^{***}	-1.534^{**}	-1.714
	(0.311)	(0.342)	(0.392)	(0.675)	(1.083)
Cubic	-0.784^{**}	-0.936^{**}	-1.16^{***}	-1.52^{**}	-1.347
	(0.323)	(0.365)	(0.442)	(0.609)	(1.067)

Outome is count of embezzlement cases found by auditors. Each cell contains the RD estimate for the given polynomial specification in the row and uses the CCT optimal bandwidth scaled by the factor denoted in the column. Standard errors reported in parenthesis.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 22: Alternate RD Specifications: Healthcare

	Bandwidth Scale				
	2	1.5	1	.5	.25
Polynomial Spec.	Panel A: Dentist Present				
None	0.21***	0.245***	0.306***	0.234	0.311
	(0.073)	(0.075)	(0.097)	(0.15)	(0.171)
Linear	0.21***	0.208**	0.246**	0.375***	0.215
	(0.068)	(0.08)	(0.099)	(0.141)	(0.184)
Quadratic	0.294***	0.274**	0.339**	0.22	0.353
	(0.11)	(0.124)	(0.139)	(0.191)	(0.222)
Cubic	0.312**	0.338**	0.267	0.182	0.727**
	(0.131)	(0.139)	(0.176)	(0.218)	(0.268)
	Panel B: Physician Present				
None	0.127*	0.18**	0.189*	0.246*	0.23
	(0.065)	(0.077)	(0.093)	(0.133)	(0.181)
Linear	0.07	0.172*	0.198	0.213	0.143
	(0.087)	(0.098)	(0.123)	(0.177)	(0.239)
Quadratic	0.182*	0.123	0.277**	0.157	0.009
	(0.096)	(0.11)	(0.128)	(0.184)	(0.239)
Cubic	0.185	0.206	0.287*	0.1	-0.209
	(0.119)	(0.138)	(0.16)	(0.214)	(0.264)
	Panel C: Infant Mortality Rate, Uneducated Mothers				
None	−0.79*	−1.242**	−1.637**	−1.205*	−2.069**
	(0.463)	(0.567)	(0.748)	(0.672)	(0.994)
Linear	−1.413**	−1.408**	−1.813**	−2.385**	−3.529**
	(0.636)	(0.709)	(0.85)	(0.966)	(1.372)
Quadratic	−1.71**	−1.773*	−2.324**	-1.851	−5.628**
	(0.829)	(0.923)	(0.983)	(1.252)	(2.544)
Cubic	-1.476	-1.522	−2.645**	-2.032	−5.62*
	(0.969)	(1.036)	(1.112)	(1.738)	(3.004)

Outomes are denoted in the panel title. Each cell contains the RD estimate for the given polynomial specification in the row and uses the CCT optimal bandwidth scaled by the factor denoted in the column. Clustered standard errors reported in parenthesis.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

8.5 Counterfactuals

Webster Method		
	Freq.	Pct.
-2	8	0.05
-1	1627	10.15
0	13794	86.02
1	607	3.79
Total	16036	100.00

Difference in mayor's coalition size from using
Webster's Method rather than the D'Hondt Method.

Table 23

Danish Method		
	Freq.	Pct.
-2	19	0.12
-1	2227	13.89
0	13019	81.19
1	769	4.80
2	2	0.01
Total	16036	100.00

Difference in mayor's coalition size from using
the Danish Method rather than the D'Hondt Method.

Table 24

Huntington-Hill Method		
	Freq.	Pct.
-2	16	0.10
-1	1989	12.40
0	13317	83.04
1	712	4.44
2	2	0.01
Total	16036	100.00

Difference in mayor's coalition size from using the
Huntington-Hill Method rather than the D'Hondt Method.

Table 25

8.6 Regular Expressions Used to Measure Corruption

Each violation found by the CGU auditors includes a description of the irregularity. I use regular expressions to search for words and phrases that isolate an irregularity as a certain type of corruption. I arrived at these words and phrases after personally reading through audit reports and taking note of the language used by the auditors. I have inspected a sample of irregularities flagged by these regular expressions and found that they were indeed corruption.

Fraud: Any irregularites containing

- *simulação* OR *simulado(a)* OR *simulações* ['simulation' OR 'simulated' OR 'simulations' (of the bidding process)]
- *montagem* ['assemblage/rigging' (of the bidding process)]
- *fraude* OR *fraudulento* OR *fraudar* ['fraud' OR 'fraudulent']
- *fachada* OR *fantasma* ['façade' OR 'phantom' (referring to fake firms)]

Overinvoicing: Any irregularites containing

- *superfatura* ['overinvoice']
- *sobrepreço* ['overprice']
- *preço superior* OR *preços superiores* ['higher price' OR 'higher prices']

Embezzlement: Any irregularites containing

- *falta de comprovação/comprovante* AND (*pagamento* OR *despesa* OR *aplicação*)

  ['lack of proof/receipt' AND ('payment' OR 'expenditure' OR 'aplication')]

- *não comprovação* AND (*despesa* OR *aplicação*)

  ['no proof/receipt' AND ('expenditure' OR 'aplication')]

- (*pagamento* OR *despesa* OR *aplicação*) AND (*sem comprovação/comprovante* OR *sem documentação comprobatório*)

  [('payment' OR 'expenditure' OR 'application' (of resources)) AND ('without proof/receipt' or 'without supporting documentation')]

- *não apresentação* AND (*documentos comprobatórios* OR *comprovação/comprovante*) AND (*pagamento* OR *despesa* OR *aplicação*)

  ['no presentation' AND ('proving documents' OR 'proof/receipt') AND ('payment' OR 'expenditure' OR 'application')]

- (*pagamento* OR *despesa* OR *aplicação*) AND (*sem documento fiscal* OR *sem suporte documental*)

  [('payment' OR 'expenditure' OR 'application') AND ('without fiscal documents' OR 'without documental support')]

- (*fiscal* OR *fiscais*) AND (*falsa* OR *inidônea* OR *fria*)

  [('fiscal' OR 'fiscals') AND ('false' OR 'disreputable' OR 'cold')] ('cold notes' in portuguese are false fiscal notes)

- *utilização* AND *recursos* AND *sem* AND *comprovação/comprovante* AND *despesa*

  ['utilization' AND 'resources' AND 'without' AND 'proof/receipt' AND 'expenditure']

- *ausência* AND *comprovação/comprovante* AND (*despesa* OR *pagamento*) AND length of description less than 75 characters

  ['absence' AND 'proof/receipt' AND ('expenditure' OR 'payment') AND length of description less than 75 characters]

Note: The character restriction on the last bullet point is because there were some irregularities with very long descriptions that included all of the chosen words, but on inspection, were clearly not corruption.