

Fighting public corruption

How local media and audits can reduce corruption via electoral accountability
(Online appendix)

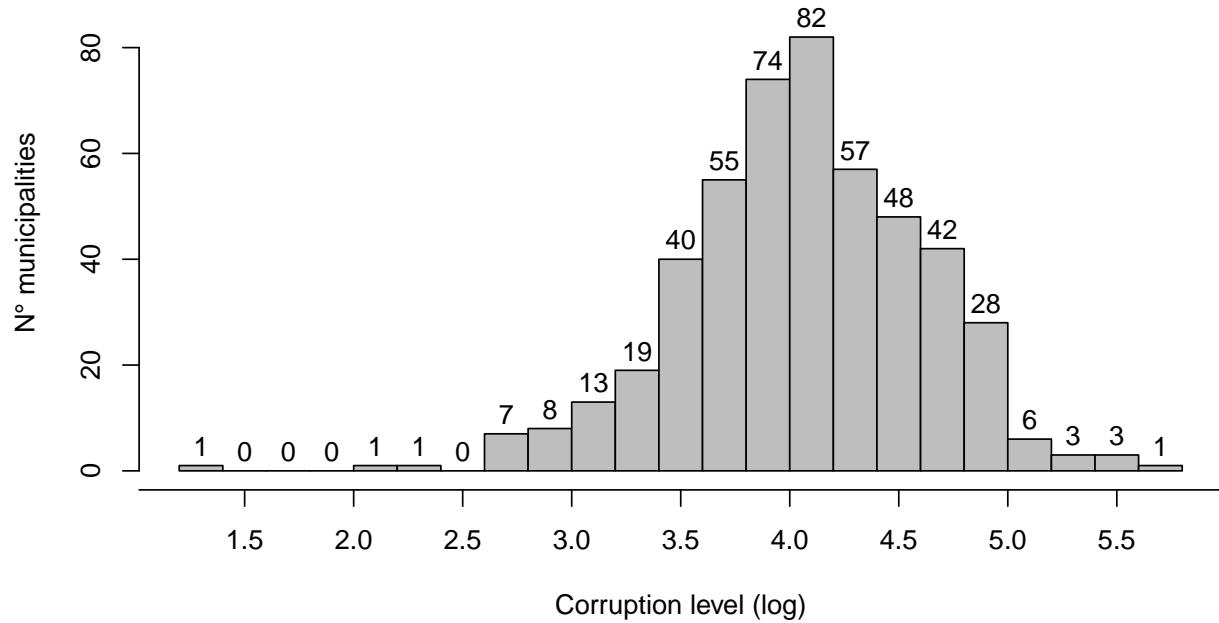
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The replication codes of this appendix and of the original article can be found at [the author GitHub's page](#). Most of the necessary databases to run the previous codes is also available in the previous page. However, the database identifying the radio waves covering voting precincts is private. It can be accessed otherwise after approval and prior contact with this author.

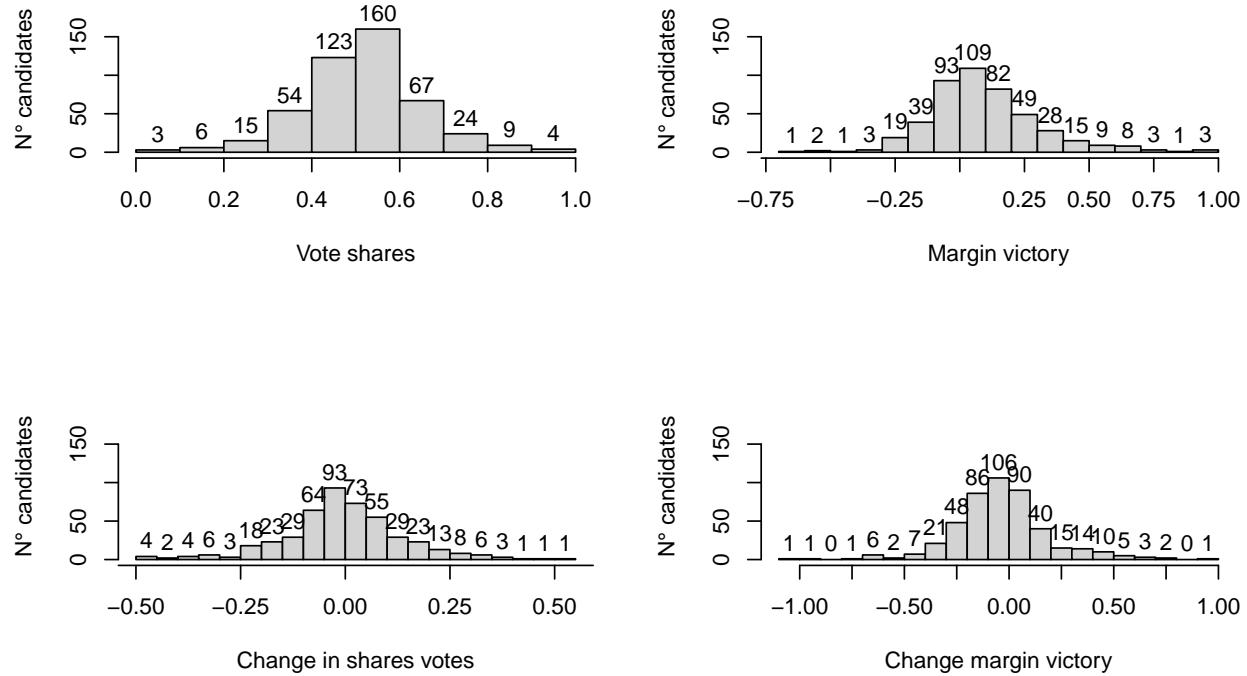
1 Variables' distributions

Figure 1: Distribution of the log number of corruption acts detected by audits performed in Brazilian municipalities between 2006-13



This histogram counts with 489 municipalities (as illustrated by figure 2 in the original paper). Out of them, 458 had log numbers of corruption below 5 and higher than 3.

Figure 2: Distribution of alternative dependent variables: candidates vote shares, margin of victory and their respective changes in relation to previous elections.



Their normal distribution motivated linear estimations of the different model specifications

2 Municipal level analysis

Table 1 repeats the estimation of *table 5* from the original article but utilize alternative dependent variables.

Table 1: Estimated coefficients of equation 1 using different sample specifications and including control variables (coefficients not displayed)

	<i>Dependent variable:</i>							
	Vote share		Margin victory		Changes in vote shares		Changes in win margin	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pre elections	0.010 (0.013)	0.005 (0.014)	0.014 (0.021)	0.007 (0.023)	0.015 (0.014)	0.013 (0.015)	0.011 (0.022)	0.003 (0.025)
Observations	464	380	464	380	458	376	458	376
R ²	0.207	0.227	0.195	0.204	0.166	0.206	0.171	0.201
Adjusted R ²	0.091	0.090	0.077	0.064	0.043	0.064	0.048	0.057

Note:

*p<0.1; **p<0.05; ***p<0.01

All dependent variables are percentages normally distributed, justifying the usage of a linear model, instead of a logit, probit or beta regression. Dependent variable Vote share (which ranges from 0-100) for incumbent reelection candidates. Dependent variable Margin victory (which ranges from -75 to 75) from the incumbent reelection candidates and the winner. If the incumbent wins the election this margin will be positive, but if he/she loses it will be negative. For example, if an incumbent running for reelection receives 60% changes in vote share (which ranges from -50 to 50) measures in relation to these same measures respectively in the previous election. All the models include only the dummy indicating whether the municipality was audited before or after the elections as the only independent variable. All models exclude all candidates receiving 0 or 100% a candidature rejected by the electoral tribunal or having its opponent(s) candidature rejected respectively)- this is why less observations are used than the full sample of 489 municipalities (figure 2). Such phenomena did not represent an issue when using the dependent variable Election results dummy which indicates if incumbents running for their re-election were elected or not. Some models had one observation less due to missing values. (2),(4),(6) and (8) exclude observations after 2011. Therefore only the 2008 election was considered in these models. The remaining models consider all years (2006-2013).

Table 2 adds a variable indicating the year when the municipalities were audited. Therefore the equation 1 from the original article becomes

$$Y_{m,s} = \beta_0 + \beta_1 audited_{m,s} + \beta_2 factor(year) + \beta_3 X_{m,s} + v_s + \varepsilon_{m,s} \quad (1)$$

The results from table 1 below are in line with the estimates from the original paper (presented in table 5 there). Although not presented here, estimations without the inclusion of covariates and using a *Probit* estimations had similar results to table 5 from the original article.

However table 2 presents now statistical significance regarding the included time fixed effects. This suggests that the audit timing had different impact on electoral performance in different years. This was especially true in 2008 in some extent in 2012, years of the elections.

Table 2: Estimated coefficients of equation 1 using different sample specifications including control variables and a factor variable indicating the year when the audits were conducted.

	Dependent variable:							
	Vote share		Margin victory		Changes in vote shares		Changes in win margin	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pre elections	0.057*	0.060*	0.085*	0.088	0.055*	0.061*	0.065	0.073
	(0.029)	(0.035)	(0.047)	(0.057)	(0.032)	(0.037)	(0.051)	(0.060)
factor(year)2007	0.004	0.002	0.041	0.040	0.036	0.035	0.060	0.060
	(0.027)	(0.027)	(0.043)	(0.044)	(0.029)	(0.029)	(0.047)	(0.047)
factor(year)2008	0.067**	0.072**	0.121**	0.128**	0.086**	0.094***	0.143**	0.157***
	(0.032)	(0.034)	(0.051)	(0.055)	(0.035)	(0.036)	(0.056)	(0.058)
factor(year)2009	0.069*	0.072	0.127*	0.130*	0.081*	0.091*	0.124*	0.137*
	(0.040)	(0.045)	(0.065)	(0.073)	(0.044)	(0.047)	(0.070)	(0.078)
factor(year)2010	0.061	0.068	0.120*	0.128*	0.072	0.079*	0.115	0.125
	(0.040)	(0.045)	(0.065)	(0.073)	(0.045)	(0.048)	(0.071)	(0.078)
factor(year)2011	0.036		0.062		0.032		0.070	
	(0.033)		(0.053)		(0.036)		(0.058)	
factor(year)2012	0.072*		0.123*		0.094**		0.121	
	(0.043)		(0.070)		(0.047)		(0.075)	
factor(year)2013	0.088*		0.125		0.063		0.086	
	(0.050)		(0.081)		(0.055)		(0.087)	
educ_years_candidate	-0.001	0.0002	-0.001	0.003	-0.003	0.002	-0.001	0.009
	(0.004)	(0.005)	(0.007)	(0.008)	(0.005)	(0.005)	(0.007)	(0.008)
Observations	464	380	464	380	458	376	458	376
R ²	0.223	0.243	0.207	0.219	0.182	0.225	0.187	0.220

Note:

*p<0.1; **p<0.05; ***p<0.01

The only difference from this table to the previous one is the inclusion of the independent variable factor(year) which indicates in each year the audits were conducted.

Similarly, table 3 also adds the year time fixed effects and the years of 2008, 2009, 2010 and 2012 persisted with statistical significance in most of the specifications. Nevertheless, the interaction term $audited_{m,s} \times corruption_{m,s}^2$ presents negative effects of the order of -16% to -37%, in line with Table 7 from the original article.¹ Table 4 repeat the latter estimation but restricts the sample to municipalities audited two years before or after the 2008 elections.

Figure 3 summarizes the linear models presented in table 4 but using the level of corruption acts

¹These same year fixed effects are statistically significant when included in the equation containing the dummy indicating the presence of AM radio in the interaction term $audited_{m,s} \times corruption_{m,s}$ (equation 3 from the original paper).

instead of its logarithms. The graphs are in overall aligned with the top panel of *Figure 6* from the original paper. Therefore using a linear form, the results are counter-intuitive as explained in the *Results* section in the original article.

Table 3: Estimated coefficients of equation 2 including factor year variable as well as control variables (coefficients not displayed)

	Dependent variable:							
	Vote share		Margin victory		Changes in shares		Changes in margins	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
treatpre-elections	-0.015 (0.102)		-0.139 (0.165)		0.016 (0.112)		-0.092 (0.178)	
corruption	-0.011 (0.020)		-0.041 (0.032)		-0.023 (0.022)		-0.046 (0.034)	
factor(year)2007	0.004 (0.027)	0.002 (0.027)	0.041 (0.043)	0.038 (0.043)	0.036 (0.029)	0.035 (0.029)	0.057 (0.047)	0.054 (0.047)
factor(year)2008	0.069** (0.032)	0.067** (0.032)	0.123** (0.051)	0.120** (0.051)	0.085** (0.035)	0.083** (0.035)	0.139** (0.056)	0.136** (0.056)
factor(year)2009	0.073* (0.040)	0.064 (0.040)	0.137** (0.065)	0.124* (0.065)	0.084* (0.044)	0.078* (0.044)	0.127* (0.070)	0.118* (0.070)
factor(year)2010	0.064 (0.040)	0.057 (0.040)	0.127* (0.065)	0.116* (0.065)	0.072 (0.044)	0.067 (0.045)	0.114 (0.071)	0.105 (0.071)
factor(year)2011	0.040 (0.033)	0.040 (0.033)	0.067 (0.054)	0.066 (0.053)	0.028 (0.037)	0.028 (0.037)	0.062 (0.059)	0.063 (0.059)
factor(year)2012	0.074* (0.043)	0.069 (0.043)	0.122* (0.070)	0.112 (0.070)	0.089* (0.048)	0.086* (0.048)	0.111 (0.076)	0.103 (0.076)
factor(year)2013	0.084* (0.051)	0.067 (0.051)	0.108 (0.082)	0.081 (0.082)	0.052 (0.056)	0.039 (0.056)	0.061 (0.089)	0.042 (0.089)
educ_years_candidate	-0.001 (0.004)	-0.001 (0.004)	-0.001 (0.007)	-0.001 (0.007)	-0.004 (0.005)	-0.004 (0.005)	-0.002 (0.007)	-0.002 (0.007)
treatpost-elections:corruption		-0.223** (0.101)		-0.349** (0.164)		-0.172 (0.112)		-0.197 (0.177)
treatpre-elections:corruption	0.018 (0.024)	-0.220** (0.102)	0.056 (0.039)	-0.375** (0.166)	0.009 (0.027)	-0.160 (0.113)	0.038 (0.043)	-0.223 (0.179)
treatpost-elections:I(corruption^2)		0.027** (0.013)		0.040* (0.021)		0.019 (0.015)		0.019 (0.023)
treatpre-elections:I(corruption^2)		0.030** (0.013)		0.051** (0.022)		0.019 (0.015)		0.029 (0.024)
Observations	464	464	464	464	458	458	458	458
R ²	0.221	0.230	0.209	0.219	0.177	0.181	0.183	0.187
Adjusted R ²	0.093	0.102	0.079	0.089	0.041	0.043	0.048	0.049

Note:

*p<0.1; **p<0.05; ***p<0.01

These estimations are the same of table 7 from the original article except from the inclusion of the independent variable factor(year) which indicates in what year the audits were conducted.

Table 4: Estimated coefficients of equation 2 including factor year variable, control variables (coefficients not displayed) and restricting the sample to municipalities audited two years before and after 2008.

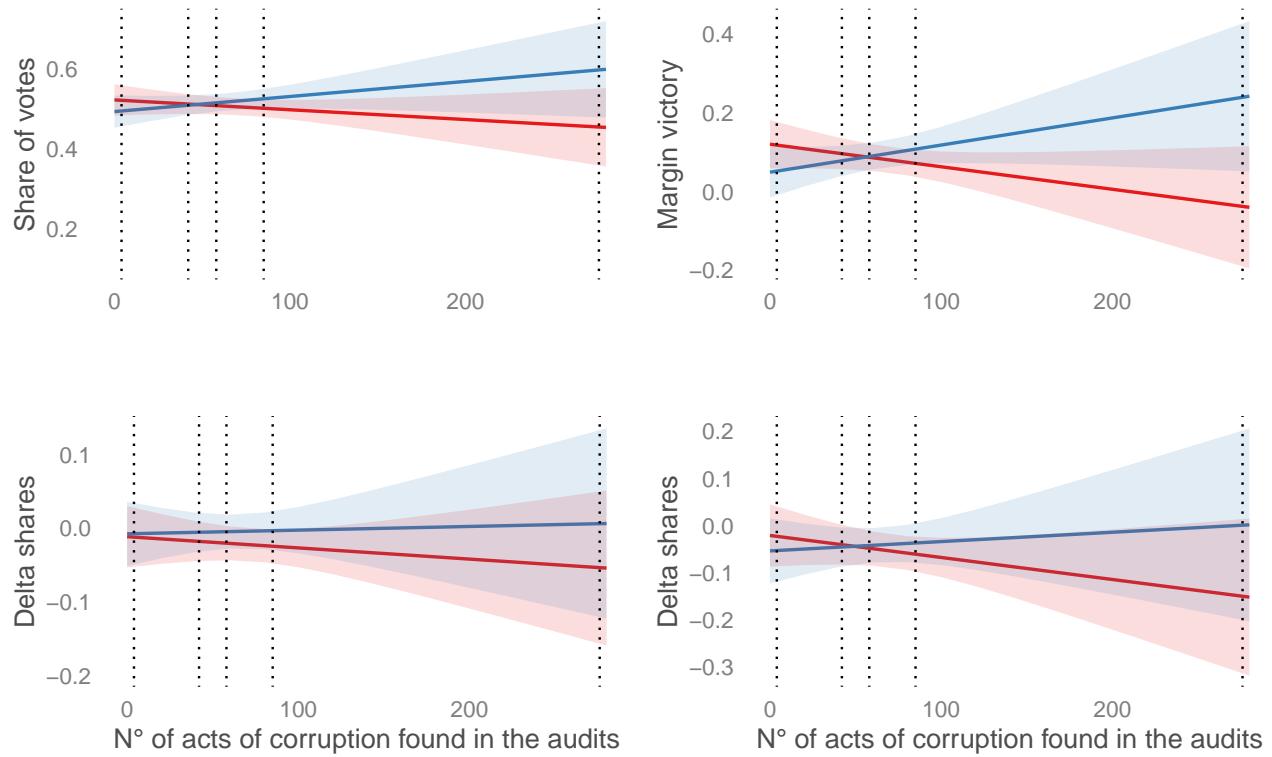
	<i>Dependent variable:</i>							
	Vote share		Margin victory		Changes in shares		Changes in margins	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
treatpre-elections	-0.008 (0.126)		-0.169 (0.205)		0.076 (0.133)		-0.056 (0.218)	
corruption	0.013 (0.023)		-0.014 (0.037)		-0.007 (0.024)		-0.039 (0.040)	
factor(year)2007	0.001 (0.027)	-0.0005 (0.027)	0.038 (0.044)	0.035 (0.044)	0.035 (0.029)	0.033 (0.029)	0.057 (0.047)	0.054 (0.047)
factor(year)2008	0.073** (0.034)	0.071** (0.033)	0.128** (0.054)	0.125** (0.054)	0.091** (0.036)	0.091** (0.035)	0.150** (0.058)	0.148** (0.058)
factor(year)2009	0.072 (0.045)	0.066 (0.045)	0.129* (0.073)	0.119 (0.072)	0.087* (0.047)	0.081* (0.047)	0.129* (0.077)	0.119 (0.077)
factor(year)2010	0.066 (0.045)	0.061 (0.045)	0.124* (0.073)	0.116 (0.073)	0.074 (0.047)	0.071 (0.047)	0.115 (0.078)	0.107 (0.077)
educ_years_candidate	0.001 (0.005)	0.001 (0.005)	0.003 (0.008)	0.003 (0.007)	0.001 (0.005)	0.002 (0.005)	0.008 (0.008)	0.009 (0.008)
treatpost-elections:corruption		-0.225 (0.148)		-0.336 (0.240)		-0.309** (0.156)		-0.433* (0.255)
treatpre-elections:corruption	0.017 (0.029)	-0.224 (0.148)	0.063 (0.048)	-0.376 (0.240)	-0.005 (0.031)	-0.283* (0.156)	0.029 (0.051)	-0.450* (0.255)
treatpost-elections:I(corruption^2)		0.029 (0.019)		0.039 (0.030)		0.037* (0.020)		0.048 (0.032)
treatpre-elections:I(corruption^2)		0.032* (0.019)		0.054* (0.030)		0.035* (0.020)		0.056* (0.032)
Observations	380	380	380	380	376	376	376	376
R ²	0.246	0.253	0.223	0.230	0.222	0.230	0.219	0.227
Adjusted R ²	0.104	0.110	0.076	0.083	0.074	0.080	0.070	0.076

Note:

*p<0.1; **p<0.05; ***p<0.01

These estimations are the same as the previous 3 except the sample size which is now restricted to municipalities audited either two years before or after the 2008 elections.

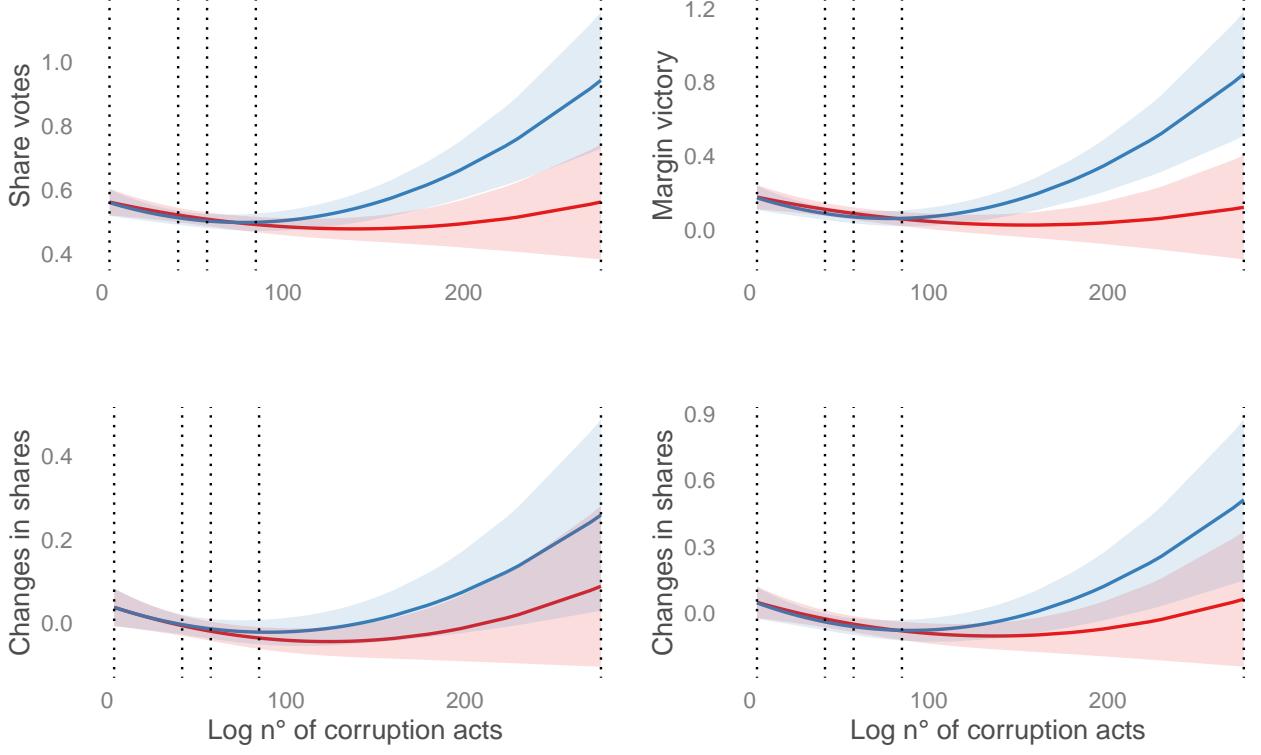
Figure 3: Illustration of the linear models from table 4 without including factor(year) and using the levels of corruption instead of its logarithms



The graphs are in overall aligned with the top panel of *Figure 6* from the original paper.

Figure 4 illustrates the models including quadratic terms from table 4.

Figure 4: Illustration of the quadratic models from table 4 without including factor(year) and using the levels of corruption instead of its logarithms



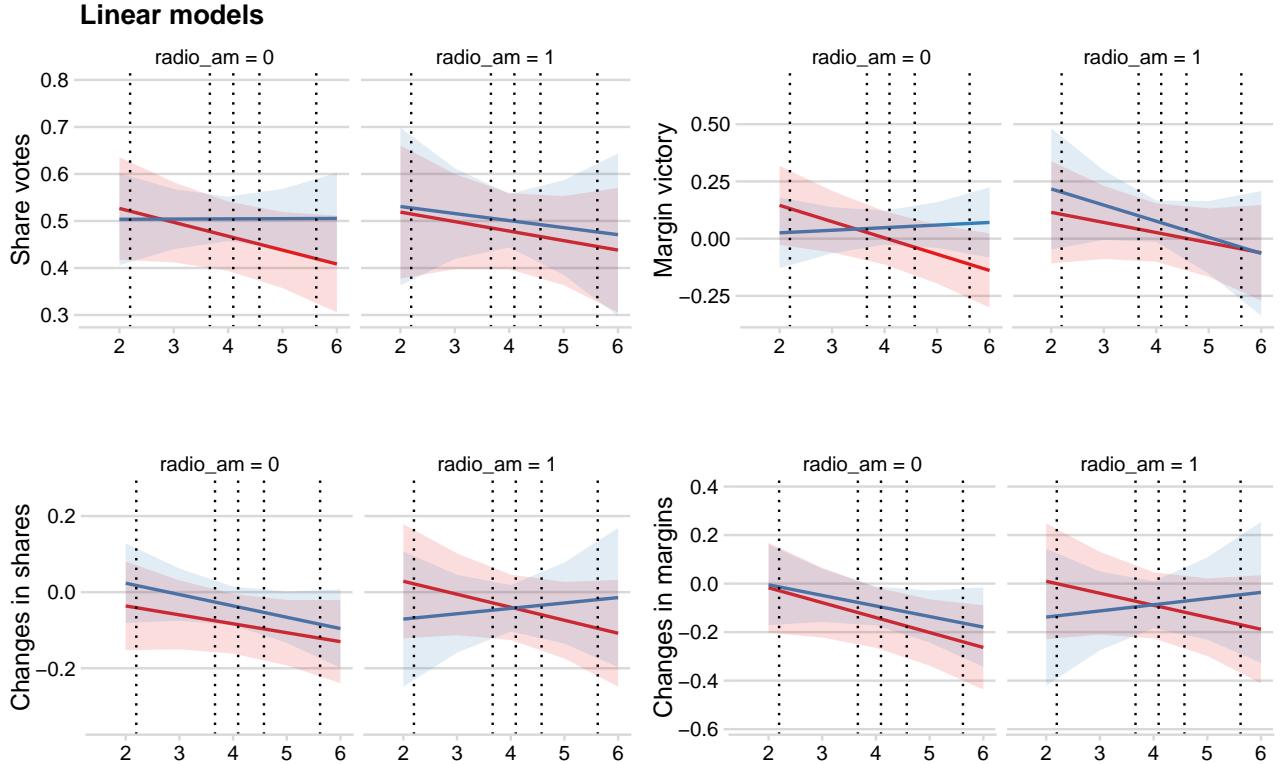
The graphs highlights the counter-intuitive effects of the audit policy at higher levels of registered corruption. Therefore, with mayors from municipalities presenting high levels of corruption registered by audits conducted pre-elections having relatively better electoral performance.

Finally, figure 5 illustrates the estimations of the equation

$$\begin{aligned}
 Y_{m,s} = & \beta_0 + \beta_1 audited_{m,s} + \beta_2 corruption_{m,s} + \beta_3 media_{m,s} + \beta_4 (audited_{m,s} \times corruption_{m,s}) + \\
 & \beta_5 (audited_{m,s} \times media_{m,s}) + \beta_6 (media_{m,s} \times corruption_{m,s}) + \beta_7 (audited_{m,s} \times corruption_{m,s} \times media_{m,s}) + \\
 & \beta_8 X_{m,s} + v_s + \varepsilon_{m,s}
 \end{aligned} \tag{2}$$

using alternative dependent variables. Notably, candidates' shares of votes, margins of victory and the changes in both latter measures in relation to previous elections. Figure 6 illustrates the estimation of the previous equation with the inclusion of the following quadratic form, $(audited_{m,s} \times corruption_{m,s}^2 \times media_{m,s})$ respectively. The captions of figures 5 and 6 show that when employing these other dependent variable some conclusions change in relation to the usage of the logit model in the original article.

Figure 5: Illustration of the linear models from equation 2 without including state and political party fixed effects. Blue curves represent municipalities audited before the elections and red otherwise.



The graphs are roughly in line with *figure 7* from the original paper. The latter shows that in municipalities with the presence of local radio the predicted probabilities of reelection decreases gradually with higher levels of corruption detected by the audits. The slope of such decrease is higher among municipalities audited before the elections than the slope of those audited post-elections. In the absence of local media, the inverse trend was observed in *figure 7* from the paper. Thus, mayors audited before the elections had a relatively stable predicted electoral performance regardless the level of corruption found (actually a slightly better performance with the increase of corruption found). On the other hand, mayors audited post-elections had better performance at lower levels of registered corruption and worst performance otherwise.

The graphs above are not entirely in line with the description above of figure *figure 7*. Therefore, in the presence of radio in the municipalities and in the occurrence of low levels of corruption registered by the auditors, mayors audited pre-elections had relatively higher margins of victory and shares of votes. It would be expected a higher decreasing slopes of the blue curves (audited pre-elections) than the red curves (audited post-elections). But, such a pattern is observed only in the graph regarding the margins of victory. The variations of mayors shares of votes and margins of victory in relation to their previous elections behaved counter-intuitively and differently from *figure 7*. This is counter-intuitive.

When it comes to municipalities without the presence of local radios, the relatively electoral performance stability of the pre-elections audited mayors is observed in the top panel graphs. Equally, the decreasing slope of the red curves is observed in the top panel. In the bottom panel, the red curves behave similarly, but not the blue ones.

Figure 6: Illustration of the quadratic models from equation 2 without including state and political party fixed effects. Blue curves represent municipalities audited before the elections and red otherwise.

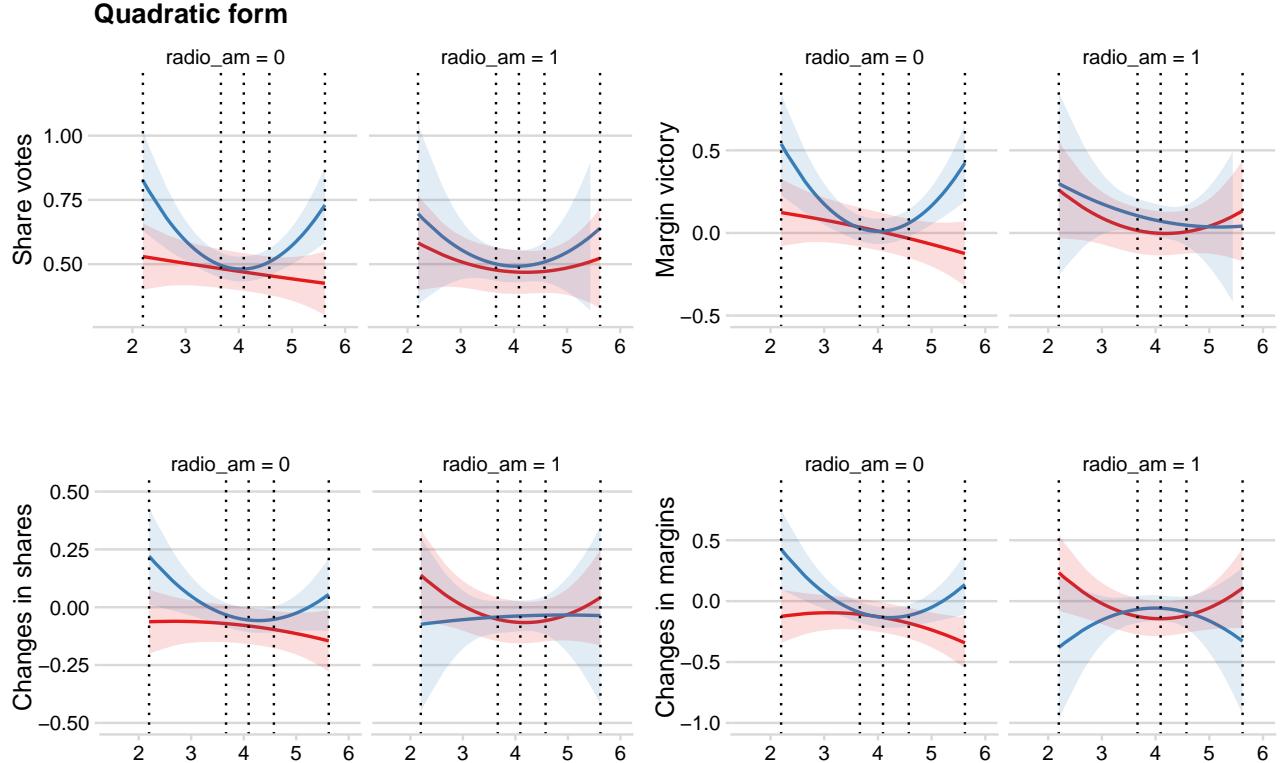


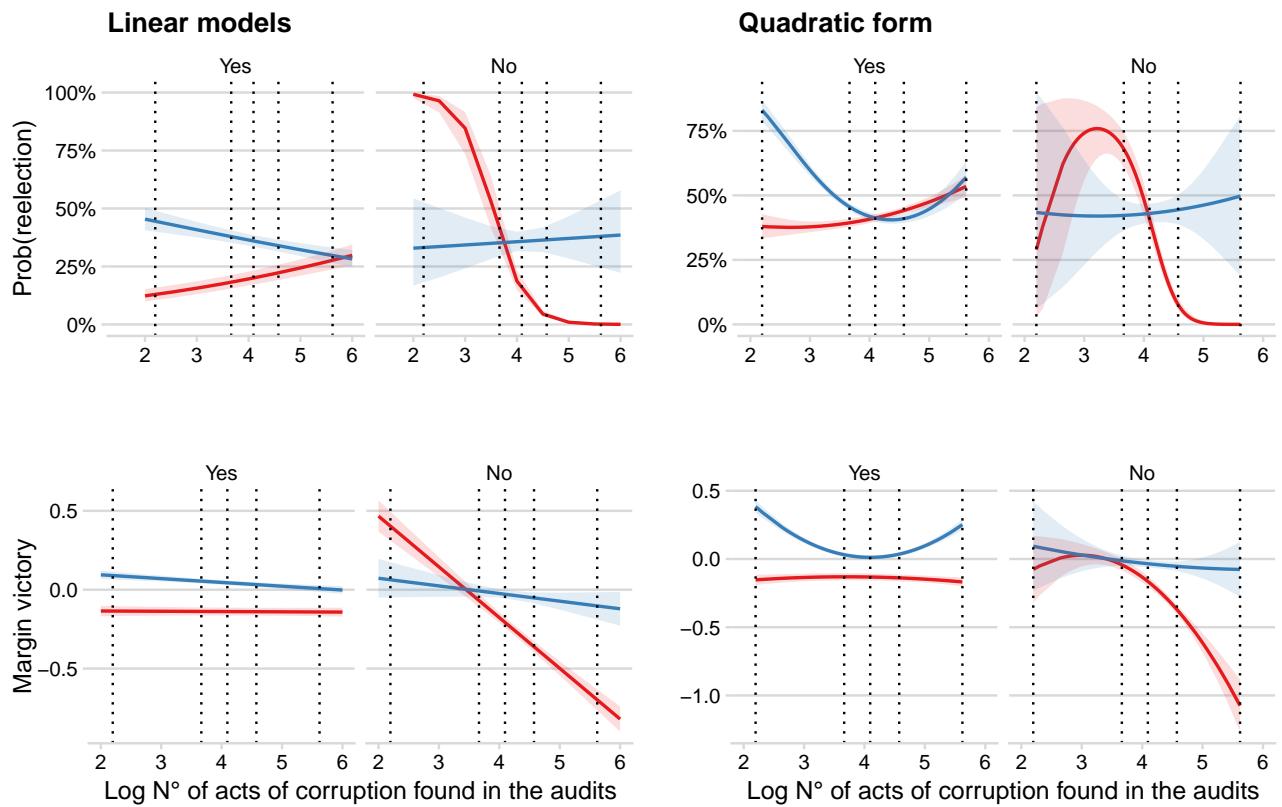
Figure 8 from the original article shows different patterns in municipalities with and without local media. Among the ones with radio, mayors audited pre-elections out-perform the ones audited post-elections only at the middle range of the detected corruption distribution. However, at high levels of registered corruption they unperformed the mayors audited after the elections. The latter group of mayors had a relatively constant electoral performance at very and high levels of corruption found in their municipalities and a relatively lower performance at the middle range of the distribution of the number of corruption acts. In the absence of radios, municipalities audited pre-elections had their mayors with good performance at high and low levels of detected corruption, but not at the middle range. Those audited post-elections had a relatively better performance if low degrees of corruption were found in the administration but were electorally punished otherwise.

The graphs from the figure above shows a similar pattern. Among the municipalities with radio presence and audited before the elections (blue curves), only the bottom right graph behaves respectively as *figure 8* from the original paper. The chart illustrating the changes in shares show a stable electoral performance of the with radio pre-elections audited mayors. Still in the presence of local media, a U-shaped red curve would be in line with *figure 8*. Such pattern is observed in all four charts. On the other hand, in the absence of radio a U-shaped blue curve would be expected, which is also observed in all graphs. Finally, regarding the municipalities audited post-elections (red curves) and without local media, a negative slope would be expected to be in line with the findings from *figure 8*. Such a pattern is also observed.

3 Voting precinct level analysis

Figure 14 from the original article shows the predicted share of votes from mayors audited pre or post elections and conditional on the findings of these audits as well as on voting precincts local news coverage. The figure 7 repeats the respective estimation with other dependent variables and adds time fixed effects (variable year). Overall, the curves patterns are pretty similar to the original figure 14 presented in the article.

Figure 7: Illustration of the linear and quadratic models from equation 2 excluding state and political party fixed effects but including year fixed effects. Blue curves represent municipalities audited before the elections and red otherwise. Yes stands for precincts covered by local news and No otherwise



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