

Electoral performance after a natural disaster: Empirical evidence from the 2010 Chile earthquake

Andrés A. Acuña-Duarte* and César A. Salazar-Espinoza*

* Departamento de Economía y Finanzas, Facultad de Ciencias Empresariales, Universidad del Bío-Bío
Dirección postal: Avenida Collao 1202, Casilla 5-C, Concepción, Chile. E-mail: aacunad@ubiobio.cl, csalazar@ubiobio.cl

(This is an in-progress work; please, do not cite or quote without permission from the authors)

Abstract

The impact of 2010 Chile earthquake on local authorities' continuity is examined in this paper. County-level data for mayor's electoral outcomes and earthquake activity are gathered from the Chilean Electoral Service and the USGS Earthquake Hazards Program, respectively. The electoral study adopts the program evaluation framework in order to isolate the effect of the natural disaster on the re-election likelihood and the voting share reached by an elected mayor. Main findings suggest that the incumbent's re-election probability and the elected mayor's share of votes are endangered if the county was hit by the earthquake-tsunami. Furthermore, the evidence shows that local electorates are sensitive to adverse economic conditions, which is exacerbated in those counties more damaged by the earthquake. Finally, arguments on the incumbent's leadership in times of crisis and changes in citizen perceptions are discussed.

Key words: electoral engagement, natural disasters, voting behavior

JEL classification: D72, O10, Q54

1. Introduction

Performance assessment of political representatives through systematic mechanisms certainly contributes to the strengthening of institutions and democracy. To a large extent, political actors' capabilities are much more evident during a crisis situation, where the management of resources and citizen perceptions is crucial for a successful process of recovering, reconstruction, and public assistance. On the one hand, an external shock related to a natural disaster could cause huge economic losses and deteriorate the quality of life of the electorate. On the other hand, such a disturbance could have an immediate effect on the perception and preferences of the community regarding to its local authorities and, as a result, modifying its voting behavior.

Furthermore, climate change has increased the rate of occurrence of natural disasters and, in the aftermath, developing countries have reported larger economic loss and death toll (Kahn, 2005). As a significant source of damage and fatalities, seismic activity has intensified and the world has witnessed seven major earthquakes since 2010. Three of them occurred in Chile and their magnitudes exceeded the 8 degrees on the Richter scale: 8.2 degrees in Iquique, 2014, 8.3 degrees in Illapel, 2015, and 8.8 degrees in Cobquecura's offshore, 2010 (USGS, 2016).

This paper examines the impact of 2010 Chilean earthquake on the continuity of local authorities that were elected by universal suffrage in the mayor elections of 2004, 2008, and 2012. The electoral study adopts the program evaluation framework in order to isolate the effect of the natural disaster on the re-election likelihood. County-level data for mayor's electoral outcomes are collected from the Chilean Electoral Service (SERVEL), while seismic data linked to Richter scale intensity, aftershocks, and peak-ground-acceleration (PGA) indicator are gathered from the United States Geological Survey's (USGS) Earthquake Hazards Program. The evidence suggests that the incumbent's re-election probability and the elected mayor's vote share are endangered if the county was hit by the earthquake-tsunami. In addition, the evidence shows that local electorates are sensitive to adverse economic conditions, which is exacerbated in those counties more damaged by the earthquake. Finally, arguments on the incumbent's leadership in times of crisis and changes in citizen perceptions that influence the aforementioned results are discussed.

The rest of the paper is organized as follows. Section 2 reviews the literature on natural disasters and electoral performance. Section 3 outlines the theoretical framework that relates the incumbent's performance in natural disaster relief and election outcomes. Section 4 describes the data and outlines the empirical strategy. Section 5 discusses the main findings. Section 6 concludes.

2. Literature review

Unanticipated natural shocks have shown to cause enormous monetary damages, affecting long run growth rates of countries, and exacerbating territorial disparities (Cavallo et al., 2010; Barone and Mocetti, 2014). Other consequences on migrations have been also reported to be significant (Boustan et al., 2012). The magnitude of these effects depends on the type of natural shocks (geophysical versus meteorological disasters), country's income and quality of institutions (Felbermayr and Gröschl, 2014).

During a natural shock, where economic loss could be substantial, political leaders are constantly under scrutiny and being evaluated for their performance. Along with economic impacts, an external shock can have an immediate effect on population's perception and/or preferences, and then in economic decisions. The latter challenges the standard economic theory that assumes that individual preferences are exogenous and stable across time, suggesting that preferences may actually evolve with changes in the living environment. There is an increasing empirical literature that combines experimental data and information about the occurrence of past shocks to test the stability of preferences. Most of this literature looks at how individual's perception of the riskiness of the environment may be a function of the experience of traumatic events (Malmendier and Nagel, 2011; Callen et al., 2014; Cameron and Shah, 2015). Regarding to a potential association between electoral preferences and past natural shocks, there is some evidence in the work of Fiorina (1981), who stated under the theory of retrospective voting that voters evaluate changes in their own welfare to discern whether their leaders have governed well or bad. The latter may be revealed after random events such as natural disasters that impact strongly the population. In democratic countries, natural disasters reduce the welfare of an important proportion of the winner coalition. Thus, even if these events are naturally exogenous to the leader's influence, winner coalition voters may punish their incumbent political leaders that fail to manage the crisis properly via aid distribution or political leadership. Most of the empirical literature supports the evidence of natural disasters having a negative impact on the probability of a leader re-election (Achen and Bartels, 2004; Quiroz and Smith, 2013), arguing that voters use next election as a mechanism to punish or reward the incumbent based on their performance (Healy and Malhorta, 2009). However, evidence also suggests that natural disasters may be beneficial from an electoral perspective in countries with institutions that favor clientelism. For instance, Gallego (2012) found that political parties governing places more strongly affected by floods and landslides in Colombia were more likely to be re-elected months after these events. The author argued that incumbents may distribute strategically the aid resources to favor groups that allows political leader to remain in power.

The association between political leaders' performance and changes in population's welfare is sometimes difficult to identify due to the existence of many diffuse sources of welfare and information problems. Thus, it is unclear that voters only look at their own welfare to punish or reward political leaders' actions, suggesting a potential indirect effect coming from changes in perception and voters' preferences.

Achen and Bartels (2012) argue that the association between political leaders' performance and subjective well-being is likely to be random, suggesting that voters punish or reward incumbents after events that are beyond political leaders' control even if material changes are not significant. The authors prove this hypothesis by looking at a series of random dramatic shark attacks occurred in New Jersey in 1916 that created much social commotion in the population. They show that voters in the affected communities significantly punished the incumbent president at the polls. In relation to preferences, Visconti (2015) discusses how the occurrence of natural disasters may influence the relative weight that voters assign to ideology in the election. The author found that political preferences measured by ideology changed and were less important in the presidential election coming after the earthquake occurred in 2010 in Chile.

3. Theoretical framework

This section outlines the relationship between natural disasters and election outcomes under a two-candidate framework, where voters comply with the rational voting axiom asserted by Anthony Downs (1957).

Suppose that a democratic society is populated by n rational citizens that have an inclination to certain political ideology and are entitled to vote. Citizens' welfare comes from their own flow of income, W , and government actions, T , that are aligned with platforms explicitly declared during the election campaign by the elected candidate. In addition, assume that voting is costly for citizens, but society has mitigated or eradicated any hurdle or inconvenience from the act of voting. This simplification assumption implies that costs of voting are independent from candidates and have been discounted from citizen's stream of income.

On the other hand, assume that in every election two candidates run for office. That is, the incumbent candidate, denoted by A , runs for re-election, while the challenging candidate B hopes to overcome the incumbency advantage; thus, both candidates will make their best to win the election. Notice that in a multi-party system the challenging and incumbent candidates could be part of the same political coalition or share the very same ideology. For the sake of simplicity, candidates A and B represents opposite political ideologies and offer dissimilar platforms.

Literature suggests that incumbents have an electoral advantage if they have fulfilled their campaign promises and have not deviated from their announced platforms (Bernhardt and Ingberman, 1985). Since incumbents enjoy a better reputation and challenging candidates with unknown background could be considered as riskier by voters, then continuous re-election could be a feasible outcome. In order to address uncertainty about candidates assume that incumbent's platform, T^A , is normally distributed with mean \tilde{T}^A and variance σ_A^2 , while challenging candidate's platform, T^B , is distributed $N(\tilde{T}^B, \sigma_B^2)$. Given that both candidates offer different platforms, then $\tilde{T}^A \neq \tilde{T}^B$. In addition, a riskier candidate is the one that deviates from his or her platform, or "*diverge from his reputation (or previous position(s))*" (Bernhardt and

Ingberman, 1985, p. 48), which exhibits a larger volatility or variance. Thus, riskiness about candidates could be elucidated by voters through comparison between σ_A^2 and σ_B^2 .

Furthermore, suppose that citizen i 's preferences can be represented by a continuous and at least twice differentiable utility function, $u_i(\cdot)$. Given that citizens “*act rationally in politics*”, then they will vote for the incumbent candidate if the following condition holds at time t :

$$(1) \quad E\left[u_i(W_{t+1}^i, T_{t+1}^A) \mid \Omega_t^i\right] - E\left[u_i(W_{t+1}^i, T_{t+1}^B) \mid \Omega_t^i\right] > 0; \quad i = 1, 2, \dots, n.$$

Where $E[\cdot]$ is the expectation operator, $u_i(\cdot)$ the citizen i 's utility function, W_{t+1}^i the future stream of income earned by citizen i , T_{t+1}^A the future policies implemented by the incumbent if he or she is re-elected, T_{t+1}^B the upcoming actions driven by the challenging candidate if he or she is elected, Ω_t^i the information set available at time t , and superscript i individualizes a specific citizen. The above information set is composed by information about candidates and their platforms that was disseminated during the election campaign. That is to say, political parties employ campaign expenditure to finance actions aimed to maximize candidate positioning among electorate.

The turnout decision rule stated by equation (1) can be thought of as the citizen's expected party differential defined by Downs (1957, Ch. 3). That is, citizen i votes for the incumbent if the net expected utility is greater than zero, while he or she votes for the challenging candidate if that differential is negative. Alternatively, abstention takes place if the above comparison is equal to zero.

Now, let us define the following indicator function, v_t^i , in order to compute the incumbent's vote share:

$$(2) \quad v_t^i = \begin{cases} 1 & \text{If } E\left[u_i(W_{t+1}^i, T_{t+1}^A) \mid \Omega_t^i\right] - E\left[u_i(W_{t+1}^i, T_{t+1}^B) \mid \Omega_t^i\right] > 0 \\ 0 & \text{If } E\left[u_i(W_{t+1}^i, T_{t+1}^A) \mid \Omega_t^i\right] - E\left[u_i(W_{t+1}^i, T_{t+1}^B) \mid \Omega_t^i\right] \leq 0 \end{cases}; \quad i = 1, 2, \dots, n$$

Accordingly, the incumbent's vote share at time t , s_t , is given by:

$$(3) \quad s_t = \frac{\sum_{i=1}^n v_t^i}{n}$$

Moreover, equation (3) can be interpreted as re-election probability. Therefore, economic conditions, candidate profiles, and citizens' preferences on political platforms could be decisive to incumbent's re-election and vote share.

In order to address the impact of political authorities' performance in a time of crisis on voting behavior, assume that a natural disaster (e.g., floods, hurricanes, or earthquakes) occurs at time t with probability p . The economic loss that each citizen experienced after the natural shock could be exacerbated

by the political representative's capabilities to handle the crisis. That is to say, more qualified authorities could exercise their leadership to reduce the detriment on people's welfare. In particular, the economic loss will be equal to L_h if a high-quality candidate held office during the crisis, where the proportion of high-quality candidates is equal to θ . Conversely, a larger economic loss, L_l , will be due to a low-quality authority. Thus, it holds that $L_h < L_l$. As a consequence, the elements included in the turnout decision rule (1) are redefined as follows:

$$(4) \quad E[u_i(W_{t+1}^i, T_{t+1}^k) | \hat{\Omega}_t^i] = p[\theta u_i(W_{t+1}^i - L_h, T_{t+1}^k) + (1 - \theta)u_i(W_{t+1}^i - L_l, T_{t+1}^k)] + (1 - p)u_i(W_{t+1}^i, T_{t+1}^k); k = A, B$$

Given equation (4), the indicator function and incumbent's vote share are rewritten as follows:

$$(5) \quad \hat{v}_t^i = \begin{cases} 1 & \text{If } E[u_i(W_{t+1}^i, T_{t+1}^A) | \hat{\Omega}_t^i] - E[u_i(W_{t+1}^i, T_{t+1}^B) | \hat{\Omega}_t^i] > 0 \\ 0 & \text{If } E[u_i(W_{t+1}^i, T_{t+1}^A) | \hat{\Omega}_t^i] - E[u_i(W_{t+1}^i, T_{t+1}^B) | \hat{\Omega}_t^i] \leq 0 \end{cases}; i = 1, 2, \dots, n$$

$$(6) \quad \hat{s}_t = \frac{\sum_{i=1}^n \hat{v}_t^i}{n}$$

In the equations above, $\hat{\Omega}_t^i$ represents an enhanced information set that further includes facts and statistics about natural disaster occurrence and politicians' skills. In this context, public leadership in times of crisis is a desirable skill and a key piece of information that is not always observed by citizens. If the latter is true and candidates are randomly drawn, then the re-election probability is equal to one half. Conversely, a natural disaster can be thought of as an information shock that reveals how qualified is the politician that holds office. Then, the proportion of high-qualified candidates, θ , can be estimated more accurately by citizens. As a matter of fact, if the incumbent exhibited an embarrassing performance after a natural disaster at time t , then the catastrophe will negatively affect the re-election probability and, as a consequence, the incumbent's vote share.

4. Material and methods

4.1 Empirical strategy

In our empirical strategy, we apply a difference-in-difference approach to estimate the Average Treatment Effect (ATE) of the earthquake at the county level. This approach allows us to exploit both the temporal and spatial variation in the data when the 2010 earthquake occurred between two municipal electoral periods, 2008 and 2012. We exploit the exponential decrease of the earthquake intensity to identify a group of counties affected (and not affected) by the shock. In particular, we follow Visconti (2015), and use the peak ground acceleration (PGA) as a measure of earthquake intensity. To distinguish between treated and control counties, we follow Worden et al. (2012) and use the thresholds 12 and 22. Thus, we place the counties with a PGA equal or greater than 12/22 in the treated group, respectively. This threshold is consistent with a scale informing on the perceived shaking and potential damage of an earthquake shock. A PGA equal or greater than 12 means that the perceived shaking was strong and the potential damage was light while a PGA equal or greater than 22 implies that the earthquake was perceived very strong, severe or violent and damages are expected to be moderate, moderate-heavy or heavy in the county (see Figure 1). In brief, the treatment captures potential impacts of the earthquake on the political preferences of people living in a severely affected county. Consequently, counties with a PGA lower than 12/22, respectively, are placed in the control group. However, and particularly when assuming a threshold of 22, this strategy may be wrong since there may have a series of counties partially treated (Visconti, 2015). To address this problem, we alternatively place in the control group all the counties that had a PGA equal or lower than 12. In this case, counties with PGA values between 12 and 22 are not considered in the analysis.

We define the ATE, the expected effect of the earthquake, as $\delta = E[y_{it}^1 - y_{it}^0]$, where y_{it}^1 and y_{it}^0 are the potential outcomes in a county i 's at time t if the county was affected or was not affected by the earthquake, respectively (Blundell and Costa, 2009; Wooldridge, 2010).

Following equation (6), the incumbent's voting share was modeled in two ways. Firstly, we model the probability of a mayor being re-elected and estimate the before and after change between those counties that were affected by the earthquake and counties that did not suffer any significant impact. This gives us the change in the probability of a mayor being re-elected at the average county that gets affected by the earthquake. The primary specification consists of a random non-linear unobserved effects Probit model (Wooldridge, 2010). Based on this approach, and under the difference-in-difference framework, the outcome "re-elected" as our measure of political preference is modeled as follows:

$$(7) \quad P(y_{it} = 1 | T_i, P_{it}, z_{it}, c_i) = \Phi(\alpha T_i + \beta P_{it} + \delta T_i P_{it} + z_{it} \gamma + c_i + \varepsilon_{it}); i = 1, \dots, N; t = 1, \dots, T$$

where: y_{it} is a binary variable that takes the value of one if the mayor was re-elected at county i and time t and zero otherwise; T_i a treatment status indicator that is equal to one if the county was affected by the earthquake, and zero otherwise; P_{it} a post-treatment indicator that is equal to one in 2012, and zero otherwise; are county fixed effects.¹ z_{it} corresponds to a vector of control variables, including campaign expenditure, local government expenditure per-capita, unemployment rate, and ideology measures. We additionally control for party fixed effects in our regressions. The term c_i is the term of the individual unobserved heterogeneity. The random effect probit model assumes that c_i is normally distributed with constant variance, that is, $c_i | x_i \sim N(0, \sigma_c^2)$, implying that c_i and x_i vector of variables are independent. Under this assumption, the effect of the earthquake on the probability of a mayor being re-elected is consistently estimated by the parameter δ .

Secondly, the empirical study addressed the impact of the earthquake on the voting share reached by an elected mayor, which was computed as suggested by equation (6) from the theoretical framework. Since the dependent variable belongs to the interval $[0, 1]$, then it was modeled through the fractional-response approach developed by Papke and Wooldridge (1996, 2008). Under this approach, the unobserved heterogeneity, c_i , is correlated with the average of time-varying regressors in the form suggested by Mundlak (1978) and Chamberlain (1980). Thus, the fractional response probit (FRP) model for the voting share is given by:

$$(8) \quad E[y_{it} | X, c] = \Phi(X\beta + c_i)$$

$$(9) \quad X\beta = \alpha T_i + \beta P_{it} + \delta T_i P_{it} + z_{it}\gamma + \varepsilon_{it}; i = 1, \dots, N; t = 1, \dots, T$$

$$(10) \quad c_i = \psi + \overline{G}_i \xi + a_i$$

where: $\Phi(\cdot)$ is the standard normal cumulative distribution function, T and P are defined as above, ε_{it} the idiosyncratic error, and the unobserved heterogeneity c_i is distributed $c_i | X \sim N(\psi + \overline{G}_i \xi, \sigma_a^2)$, where \overline{G}_i is a stacked vector of time-average variables for time-varying regressors. z_{it} a vector of control variables that includes campaign expenditure, per-capita county government expenditure, unemployment rate at county level, a dummy variable that takes the value of one if the incumbent runs for re-election and zero otherwise, and a dummy variable that takes the value of one if the incumbent is affiliated to a center-left party and zero otherwise. In addition, party fixed effects were included in the vector of control variables. Hence, the effect of the earthquake on the elected mayor's voting share is consistently estimated by the parameter δ .

¹ For instance, they include geographic location, urban status, and market size.

Once the FRP model was estimated, the average partial effects (APE) were computed following Papke and Wooldridge (2008). Namely, if regressor x_j is continuous, then its APE is given by:

$$(11) \quad \frac{\partial E[y|X,c]}{\partial x_j} = \frac{1}{NT} \sum_{i=1}^N \sum_{t=1}^T \hat{\beta}_j \phi(\hat{\psi} + X_{it} \hat{\beta} + \bar{G}_i \hat{\xi})$$

On the other hand, if regressor x_j is a dichotomous variable, then its APE is defined as:

$$(12) \quad \frac{\partial E[y|X,c]}{\partial x_j} = \frac{1}{NT} \sum_{i=1}^N \sum_{t=1}^T \left[\Phi(\hat{\psi} + X_{it} \hat{\beta} + \bar{G}_i \hat{\xi})|_{x_j=1} - \Phi(\hat{\psi} + X_{it} \hat{\beta} + \bar{G}_i \hat{\xi})|_{x_j=0} \right]$$

Where: $\phi(\cdot)$ and $\Phi(\cdot)$ are the standard normal density and cumulative distribution function, respectively, and circumflex accent denotes estimated values. Estimates from the empirical approach are analyzed and discussed in the next section.

4.2 Data

We exploit the variation across counties of the 2010 earthquake occurred in Chile that mainly affected the central-southern regions. Earthquakes in Chile are frequent and have historically affected the entire country, which guarantee exogeneity and improve comparability among counties. This natural disaster reached a magnitude of 8.8 in the Richter scale, being the 4th strongest earthquake in the world in the previous 50 years. The earthquake was followed by a Tsunami. Together killed around 500 people and 12.000 were left wounded. This natural disaster also had significant damages on private and public infrastructure. Economic losses were estimated at US\$30 billion, which was approximately 18% of the Gross Domestic Product (GDP) (EM-DAT, 2010). Effects were still felt years after the shock (UNISDR, 2012). To measure earthquake intensity, we use data from the USGS Earthquake Hazards Program. In particular, we employ the peak ground acceleration (PGA) at the county level. This indicator measures the strength of shaking produced by the earthquake in a given geographic area. Figure 1 shows the counties affected by the earthquake and the uneven intensity of the natural disaster within the country according to the scale proposed by Worden et al. (2012).

[Figure 1 about here.]

The electoral study was focused on the Chilean mayor elections of 2004, 2008, and 2012. We use available information from the Chilean Electoral Service (SERVEL) for those years to construct our dependent variables the elected mayor and its voting share in each county at time t . In addition, this data allows us to compute a measure of campaign expenditure on advertisement for the incumbent. Furthermore, we employ data from the Municipal Information National System (SINIM) to construct local government expenditure per-capita measures and information from the National Socioeconomic Characterization Survey

(CASEN) to estimate county unemployment rates. Descriptive statistics for these variables are shown in Table 1.

[Table 1 about here.]

Finally, SERVEL data from candidates' political party and political coalition was used to proxy the elected mayor ideology by classifying them in rightist and leftist candidates. The right-wing mayors are those affiliated in parties related to mainly the political pacts Alianza and Coalicion.² Analogously, the left-wing mayors are those associated with political parties included in the leftist pacts Concertacion por la Democracia, Concertacion Democratica, Concertacion Progresista, El Cambio Por Ti, Juntos Podemos, Juntos Podemos Mas, Por Un Chile Limpio, Por Un Chile Justo, Mas Humanos, La Fuerza del Norte, Por El Desarrollo del Norte, Nueva Alternativa Independiente, and Regionalistas e Independientes.³ Finally, if a mayor was not attached to a political pact or political party, then it was categorized as purely independent. The resulting ideological classification is shown in Table 2.

[Table 2 about here.]

5. Main findings and discussion

Table 3 reports the estimates by the random-effects probit model after considering mayor's re-election as the dependent variable.⁴

[Table 3 about here.]

Before discussing the impact of the earthquake on electoral outcomes, we highlight the importance of our control variables to explain the probability of a mayor being re-elected. Our results suggest a positive and significant effect of campaign expenditure on mayor re-election (columns 2-4 and 6-8, Table 3). On average, a 1% increase in the campaign expenditure will increase the probability of being re-elected in around 4%. This entails that incumbent local governments may have the possibility to influence voter's

² The main parties are Renovacion Nacional (RN) and Union Demócrata Independiente (UDI).

³ The main political parties are Democracia Cristiana (DC), Partido Socialista de Chile (PS), Partido por la Democracia (PPD), Partido Radical Socialdemócrata (PRSD), Partido Humanista (PH), Movimiento Amplio Social (MAS), Partido Progresista (PRO), Partido Regionalista de los Independientes (PRI) and Partido Comunista de Chile (PC).

⁴ Estimates of fixed-effects models for the impact of earthquake on incumbent's re-election and mayor's voting share are reported in the Appendix.

preferences and electoral results by expending more in their political campaign (see for example Jacobson, 1978; Green and Krasno, 1988; Benoit and Marsh, 2003; Morales and Piñeiro, 2010; Fink, 2012).

Furthermore, local government expenditure also increases the probability of an incumbent mayor being re-elected (columns 2-4 and 6-8, Table 3). On average, a 1% increase in total local expenditure per-capita will increase the likelihood of re-election in around 10%. Government expenditure relates to the provision of local public goods. Thus, we expect that an increase in government expenditure translates into an augment in population's well-being due to a broader provision of public goods. This finding is in line with a series of studies looking at the effect of public expenditures and its allocation on electoral outcomes (see for example Akhmedov and Zhuravskaya, 2004; Drazen and Eslava 2005; Vergne, 2009; Sakurai and Menezes-Filho, 2011)

Moreover, our results indicate that the higher the rate of the county unemployment, the lower the probability of the incumbent being re-elected in that county (columns 3-4 and 7-8, Table 3). A coefficient larger than one implies that the association is elastic, meaning that 1% increase in the county unemployment rate will lead to a decrease larger than 1% in the re-election likelihood. This result suggests that people punish the incumbent based on business and economic cycle variables, which has been previously documented in the Chilean literature focused on electoral outcomes (Engel and Araos, 1987; Panzer and Paredes, 1991; Cerda and Vergara, 2007, 2008). Finally, one characteristic frequently discussed in Chilean politics is its high degree of party ideologization. In order to capture partially for this aspect, we control for a dummy variable informing on whether the incumbent mayor belongs to a center-left party. Nevertheless, this variable is not significant in any of our specifications (columns 4 and 8, Table 3). This result jointly with economic variables affecting significantly re-election suggests that the behavior of the economy matters more than ideology to explain electoral results (Panzer and Paredes, 1991).

Regarding the effect of the earthquake on incumbent mayor's re-election probability, we find a negative and significant effect no matter which PGA thresholds we use to define the treatment groups. This effect is robust and stronger when we added controls (columns 3, 4, and 7, Table 3). On average, this natural disaster reduces the probability of re-election in around 15% conditioned on economic and local expenditure variables which are likely to be affected by the earthquake. The latter suggests that voters react by punishing the incumbent local government in the next election after the occurrence of a natural disaster. A negative perception of voters on incumbent mayors' performance in the affected counties during the crisis may be behind these results. These results are robust to fixed-effects estimations when using a threshold of 12 for the PGA (see Appendix A.1).

As stated in the Empirical Strategy, the study further explored the effect of the 2010 Chile earthquake on the elected mayor's share of votes. Table 4 reports the average partial effects (APE) for the fractional response probit model after considering voting share as the dependent variable.

[Table 4 about here.]

The evidence confirms the role of control variables in estimating the effect of the earthquake on the elected mayor's vote share under both treatment criteria. In particular, there is a positive return of campaign expenditure advocated to increase the candidate's share of votes (columns 2-4 and 6-8, Table 4).

On the other hand, results also suggest that local electorates are sensitive to adverse economic conditions, measured by the unemployment rate, which is exacerbated in those counties more damaged by the earthquake, i.e., $PGA > 22$ (columns 7 and 8, Table 4). That is, if a county increases its unemployment rate in 1%, then the voting share could be reduced, on average, in about 0.42%. Therefore, the Chilean electorate penalizes, in terms of share of votes, the mayor that holds office if the economic performance was inauspicious during his or her term.

Contrary to what was highlighted above, results did not reveal a significant effect of incumbent's ideology and government expenditure on the elected mayor's vote share, especially in counties that experienced a substantial detrimental after the catastrophe, i.e., $PGA > 22$ (columns 4 and 6-8, Table 4).

In addition, the evidence suggests that the "incumbency effect" is slightly above 3% of vote share if a mayor runs for re-election and conditioned on economic and local expenditure variables (columns 4 and 8, Table 4). This electoral advantage does not seem to be profuse, which indicates that Chilean mayor elections turned more competitive after the 2010 earthquake.

Regarding the effect of the earthquake on elected mayor's voting share, the evidence reassert the negative and significant effect of the natural disaster on the electoral performance of local authorities elected by universal suffrage in Chile (columns 3, 7, and 8, Table 4). On average, the 2010 earthquake reduces the elected mayor's vote share in about 2.8% conditioned on economic and local expenditure variables. Hence, the natural disaster could be interpreted as a negative information shock that revealed the incumbent's competence to handle the crisis during the aftermath. In fact, the earthquake effect almost offset the incumbent's electoral advantage in terms of vote share (columns 4 and 8, Table 4). These results are further robust to fixed-effects estimations when using a threshold of 22 for the PGA (see Appendix A.2).

6. Concluding remarks

The existence of systematic mechanisms to assessing the performance of political representatives is a key element for the strengthening of institutions and democracy. In this regard, the performance of political leaders is under significant scrutiny in times of crisis, which becomes critical after the occurrence of a natural disaster. This paper adopted the program evaluation framework in order to examine the impact of 2010 Chile earthquake on local authorities' continuity during the period 2004-2012.

The results from this electoral study suggest four main insights. First, there is strong evidence on the importance of campaign expenditure on mayor election outcomes in Chile. Since it positively affects the incumbent's re-election and vote share, this finding supports the efforts to regulate the financing of political campaigns, which could ensure the competitiveness of a challenging candidate in a mayor election.

Second, the evidence confirms that local electorates are sensitive to adverse economic conditions, which has been reported in Chilean literature (e.g., Engel and Araos, 1987; Panzer and Paredes, 1991; Cerda and Vergara, 2007, 2008). In particular, if a county exhibits a larger unemployment rate, then voters will punish the mayor that runs for re-election by shrinking his or her electorate. Thus, incumbent candidates will face a lower re-election probability and voting share, which indicates that business cycle matters more than political ideology.

Third, there is a negative and significant effect of the 2010 Chile earthquake on the incumbent's re-election probability (about 15% lower) and elected mayor's vote share (around 2.8% smaller), which is in line with the hypothesis stated from our theoretical framework. As a matter of fact, the evidence suggests that the above natural disaster acted as a negative information shock on how competent was the mayor that held office in those counties more damaged by the earthquake.

Finally, no supporting evidence was found on the effect of incumbent's ideology and local expenditure on a larger capture of votes for the elected mayor.

Acknowledgements

This work was carried out within the research-group project GI 160317/EF "Análisis Económico Sectorial Aplicado", Universidad del Bio-Bio, Chile.

References

- Achen, C., and Bartels, L. (2004). Musical Chairs: Pocketbook Voting and the Limits of Democratic Accountability. Prepared for presentation at the Annual Meeting of the American Political Science Association, Chicago.
- Achen, C., and Bartels, L. M. (2012). Blind retrospection: Why shark attacks are bad for democracy. Working Paper. Center for the Study of Democratic Institutions, Vanderbilt University.
- Akhmedov, A., and Zhuravskaya, E. (2004). Opportunistic political cycles: Test in a young democracy setting. *The Quarterly Journal of Economics*, 119(4), 1301-1338.
- Arceneaux, K., Stein, R. M. (2006). Who is held responsible when disaster strikes? The attribution of responsibility for a natural disaster in an urban election. *Journal of Urban Affairs*, 28(1), 43–53.
- Artés, J. (2014). The rain in Spain: Turnout and partisan voting in Spanish elections. *European Journal of Political Economy*, 34, 126–141.
- Barone, G., Mocetti, S. (2014). Natural disasters, growth and institutions: A tale of two earthquakes. *Journal of Urban Economics*, 84, 52–66.
- Benoit, K., and Marsh, M. (2010). Incumbent and challenger campaign spending effects in proportional electoral systems. *Political Research Quarterly*, 63(1), 159-173
- Bernhardt, M. D., Ingerman, D. E. (1985). Candidate reputations and the ‘incumbency effect’. *Journal of Public Economics*, 27(1), pp. 47 – 67.
- Blundell, R., and M. Costa. (2009). Alternative approaches to evaluation in empirical microeconomics. *The Journal of Human Resources* 44(3), 565–640
- Boustan, L. P., Kahn, M. E., and P. W. Rhode (2012). Moving to higher ground: Migration response to natural disasters in the early twentieth century. *American Economic Review*, 102(3), 238–244.

- Callen M., Isaqzadeh, M., Long, J. D., and C. Sprenger (2014). Violence and Risk Preference: Experimental Evidence from Afghanistan. *American Economic Review*, 104(1), 123–148
- Cameron, L., and M. Shah (2013). Risk-taking behavior in the wake of natural disaster. NBER working papers series 19535.
- Cavallo, E., Powell, A., and O. Becerra (2010). Estimating the direct economic damages of the earthquake in Haiti. *The Economic Journal*, 120(546), F298–F312.
- Cerda, R., and R. Vergara (2008). Government Subsidies and Presidential Election Outcomes: Evidence for a Developing Country. *World Development*, 36(11), 2470–2488.
- Cerda, R., and R. Vergara (2007). Business cycle and political election outcomes: Evidence from the Chilean Democracy. *Public Choice*, 132(1), 125–136.
- Chamberlain, G. (1980). Analysis of covariance with qualitative data. *The Review of Economic Studies*, 47(1), 225–238.
- Cole, S., Healy, A., Werker, E. (2012). Do voters demand responsive governments? Evidence from Indian disaster relief. *Journal of Development Economics*, 97(2), 167–181.
- Downs, A. (1957). *An economic theory of democracy*. New York: Harper and Row.
- Drazen, A., and Eslava, M. (2005). Electoral manipulation via expenditure composition: Theory and evidence. National Bureau of Economic Research (NBER) Working Paper No. 11085.
- Eisensee, T., Strömberg, D. (2007). News droughts, news floods, and U. S. disaster relief. *The Quarterly Journal of Economics*, 122(2), 693–728.
- Eisinga, R., Grotenhuis, M. T., Pelzer, B. (2012). Weather conditions and voter turnout in Dutch national parliament elections, 1971–2010. *International Journal of Biometeorology*, 56, 783–786.
- EM-DAT (2010). *The OFDA/CRED - International Disaster Database*. Université Catholique de Louvain Brussels, Belgium. Retrieved from <http://www.emdat.be>.

- Engel, E., and M. R. Araos (1989). Desempleo, Votación Histórica y el Plebiscito de 1988. *Colección de Estudios CIEPLAN*, 27, 5–17.
- Felbermayr, G., and Gröschl, J. (2014). Naturally negative: The growth effects of natural disasters. *Journal of Development Economics*, 111, 92–106.
- Fink, A. (2012). The effects of party campaign spending under proportional representation: Evidence from Germany. *European Journal of Political Economy*, 28(4), 574-592
- Fiorina, M. (1981). *Retrospective Voting in American National Elections*. New Haven: Yale University Press.
- Gallego, J. (2012). *Natural Disasters and Clientelism: the Case of Floods and Landslides in Colombia*. Working paper. Department of Politics, New York University.
- Gaspar, J. T., Reeves, A. (2011). Make it rain? Retrospection and the attentive electorate in the context of natural disasters. *American Journal of Political Science*, 55(2),340-355.
- Green, D. P., and Krasno, J. S. (1988). Salvation for the spendthrift incumbent: Reestimating the effects of campaign spending in House elections. *American Journal of Political Science*, 32(4), 884-907.
- Healy, A., Malhotra, N. (2009). Myopic voters and natural disaster policy. *American Political Science Review*, 103(3), 387–406.
- Jacobson, G. C. (1978). The effect of campaign spending in Congressional elections. *The American Political Science Review*, 72(2), 469-491.
- Kahn, M. E. (2005). The death toll from natural disasters: The role of income, geography, and institutions. *The Review of Economics and Statistics*, 87(2), 271–284.
- Malmendier, U. and S. Nagel (2011). Depression babies. Do Macroeconomic experiences affect risk taking. *The Quarterly Journal of Economics*, 126(1), 373–416.

- Morales, M., and Piñeiro, R. (2010). Gasto en campaña y éxito electoral de los candidatos a diputados en Chile 2005. *Revista de Ciencia Política*, 30(3), 645-667.
- Mundlak, Y. (1978). On the pooling of time series and cross section data. *Econometrica*, 46(1), 69-85.
- Panzer, J. and R.D. Paredes. (1991). The role of economic issues in elections: The case of the 1988 Chilean presidential referendum. *Public Choice*, 71(1), 51-59.
- Papke, L. E., Wooldridge, J. M. (1996). Econometric methods for fractional response variables with an application to 401(K) plan participation rates. *Journal of Applied Econometrics*, 11(6), 619-632.
- Papke, L. E., Wooldridge, J. M. (2008). Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics*, 145(1-2), 121-133.
- Quiroz, A. and A. Smith (2013). Leading survival and natural disaster. *British Journal of Political Science* 43(3), 1-23.
- Sakurai, S. N. and Menezes-Filho, N. (2011). Opportunistic and partisan election cycles in Brazil: New evidence at the municipal level. *Public Choice*, 148(1), 233-247.
- UNISDR (The United Nation Office for Disaster Risk Reduction) (2012). *Chile still living with quake effects*. Retrieved from <http://www.unisdr.org/archive/25366>.
- USGS (2016). *Earthquake Lists, Maps, and Statistics: By year, magnitude 8+*. United States Geological Survey's Earthquake Hazards Program, United States. Retrieved July 7, 2016, from <http://earthquake.usgs.gov/earthquakes/browse/>.
- Vergne, C. (2009). Democracy, elections and allocation of public expenditures in developing countries. *European Journal of Political Economy*, 25(1), 63-77.
- Visconti, G. (2015). The effects of natural disasters on the ideological and non-ideological components of the vote: Evidence from the 2010 Chilean earthquake. Department of Political Science, Columbia University, unpublished manuscript.

Wooldridge, J. (2010). *Econometric analysis of cross section and panel data*. Cambridge, USA: The MIT Press.

Worden, C.B., Gerstenberger, M.C., Rhoades, D.A., and Wald, D.J. (2012). Probabilistic relationships between ground-motion parameters and Modified Mercalli intensity in California. *Bulletin of the Seismological Society of America*. 102(1), 204–221.

Figure 1: Intensity based on peak ground acceleration. *Source: USGS*

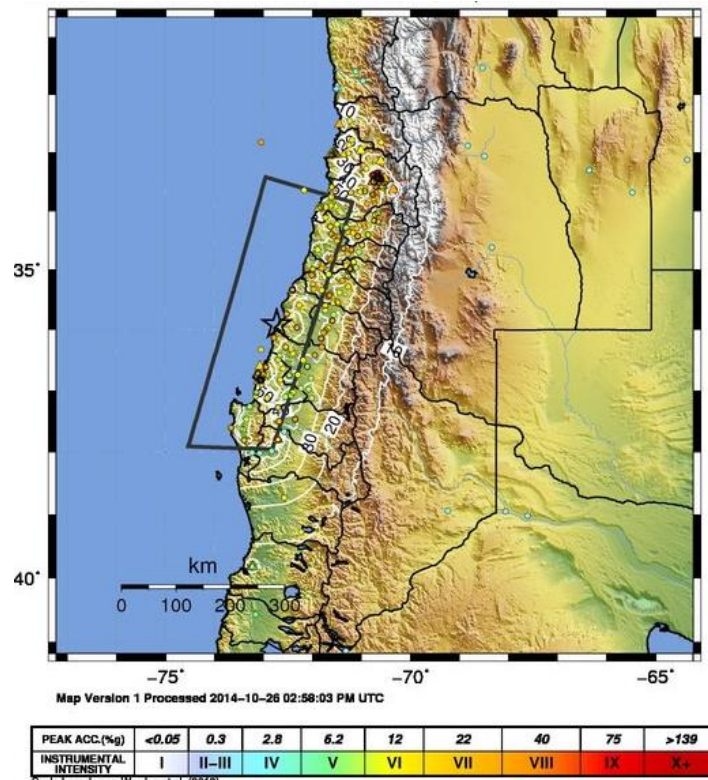


Table 1: Re-election measures by comparison groups.

Treatment criterion:	<i>PGA > 12</i>				<i>PGA > 22</i>			
	Pre-treatment		Post-treatment		Pre-treatment		Post-treatment	
	Treated	Control	Treated	Control	Treated	Control	Treated	Control
Dependent variables:								
Mayor re-election	0.560 (0.498)	0.500 (0.502)	0.485 (0.502)	0.525 (0.501)	0.565 (0.498)	0.500 (0.502)	0.500 (0.502)	0.525 (0.501)
Mayor's voting share	0.491 (0.096)	0.477 (0.101)	0.515 (0.092)	0.523 (0.099)	0.496 (0.093)	0.477 (0.101)	0.522 (0.092)	0.523 (0.099)
Control variables:								
Campaign expenditure	15.316 (1.423)	14.734 (1.290)	15.441 (1.437)	14.993 (1.247)	15.431 (1.403)	14.734 (1.290)	15.541 (1.454)	14.993 (1.247)
Local government expenditure	4.849 (0.494)	4.973 (0.530)	5.139 (0.523)	5.282 (0.586)	4.858 (0.523)	4.973 (0.530)	5.145 (0.555)	5.282 (0.586)
Unemployment rate	0.074 (0.030)	0.063 (0.031)	0.073 (0.048)	0.085 (0.045)	0.070 (0.027)	0.063 (0.031)	0.067 (0.040)	0.085 (0.045)
Center-left ideology	0.687 (0.466)	0.625 (0.486)	0.478 (0.501)	0.583 (0.495)	0.657 (0.477)	0.625 (0.486)	0.463 (0.501)	0.583 (0.495)
Observations	134	120	134	120	108	120	108	120

Source: Own elaboration based on SERVEL data.

Note: Pre-treatment corresponds to the period 2008. Similarly, post-treatment corresponds to the period 2012. Treated counties are those with a $PGA > 12$ and $PGA > 22$. Control group are the remaining counties in each case. Standard deviations are reported in parentheses.

Table 2: Elected mayors by political parties and ideologies.

Political ideologies	Political parties	Mayor elections		
		2004	2008	2012
Rightist	Renovacion Nacional (RN)	38	55	41
	Union Democrata Independiente (UDI)	51	58	47
	Independent	18	35	35
Leftist	Democracia Cristiana (DC)	99	59	56
	Partido Socialista de Chile (PS)	45	30	30
	Partido por la Democracia (PPD)	34	35	37
	Partido Radical Socialdemocrata (PRSD)	12	10	13
	Movimiento Amplio Social (MAS)	0	0	1
	Partido Comunista de Chile (PC)	4	4	4
	Partido Humanista (PH)	0	1	1
	Partido Progresita (PRO)	0	0	3
	Partido Regionalista de los Independientes (PRI)	0	2	2
Independent	Independent	27	30	43
Independent	Independent	17	26	32

Source: SERVEL

Table 3: Random effects probit estimations for the impact of the earthquake on the probability of an incumbent mayor being re-elected.

Treatment criterion:	<i>PGA > 12</i>				<i>PGA > 22</i>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Treatment</i>	-0.111 (0.0843)	-0.121 (0.0833)	-0.150* (0.0826)	-0.147* (0.0831)	-0.108 (0.089)	-0.119 (0.0879)	-0.148* (0.0872)	-0.142 (0.0881)
<i>Post-treatment</i>	0.0438 (0.0624)	0.0129 (0.0647)	0.0415 (0.0656)	0.0413 (0.0656)	0.042 (0.063)	0.0140 (0.0650)	0.0413 (0.0663)	0.0402 (0.0663)
<i>ln(Campaign expenditure)</i>		0.0404** (0.0172)	0.0412** (0.0173)	0.0422** (0.0174)		0.0387** (0.0183)	0.0400** (0.0185)	0.0419** (0.0186)
<i>ln(County expenditure)</i>		0.112** (0.0435)	0.113** (0.0457)	0.116** (0.0460)		0.107** (0.0451)	0.110** (0.0475)	0.114** (0.0479)
<i>Unemployment rate</i>			-1.274** (0.570)	-1.275** (0.570)			-1.246* (0.650)	-1.223* (0.652)
<i>Center-left ideology</i>				0.0180 (0.0466)				0.0358 (0.0494)
County fixed effects	No	No	No	No	No	No	No	No
Party fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Counties partially treated	Yes	Yes	Yes	Yes	No	No	No	No
Observations	506	501	495	495	454	443	454	443
R-squared								
Number of counties	254	254	251	251	228	228	225	225

Note: Campaign expenditure and per capita county expenditure were deflated by the Chilean Consumer Price Index (CPI). Standard errors for partial effects are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4: Fractional response Probit estimations for the impact of the earthquake on elected mayor's voting share.

Treatment criterion:	PGA > 12				PGA > 22			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Treatment</i>	-0.0241*	-0.0189	-0.0280*	-0.0248	-0.0236	-0.0177	-0.0294*	-0.0259*
	(0.014)	(0.014)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.015)
<i>Post-treatment</i>	0.0493***	0.0256*	0.0366**	0.0384**	0.0493***	0.0305*	0.0432***	0.0465***
	(0.010)	(0.015)	(0.016)	(0.016)	(0.011)	(0.017)	(0.016)	(0.016)
<i>ln(Campaign expenditure)</i>		0.0177**	0.0186**	0.0188**		0.0190**	0.0197**	0.0197**
		(0.009)	(0.008)	(0.008)		(0.009)	(0.009)	(0.009)
<i>ln(County expenditure)</i>		0.0558*	0.0476	0.0333		0.0374	0.0282	0.0081
		(0.034)	(0.034)	(0.036)		(0.041)	(0.038)	(0.039)
<i>Unemployment rate</i>			-0.3415*	-0.3396*			-0.4185**	-0.4190**
			(0.191)	(0.189)			(0.189)	(0.188)
<i>Incumbent candidate</i>				0.0310***				0.0336***
				(0.011)				(0.011)
<i>Center-left ideology</i>				0.0023				
				(0.009)				
County fixed effects	No	No	No	No	No	No	No	No
Party fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Counties partially treated	Yes	Yes	Yes	Yes	No	No	No	No
Observations	508	503	497	497	456	451	445	445
R-squared								
Number of counties	254	254	251	251	228	228	225	225

Note: Campaign expenditure and per capita county expenditure were deflated by the Chilean Consumer Price Index (CPI). Standard errors in parentheses were computed from 500 bootstrap replications. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix A.

Table A.1: Fixed-effects estimations for the impact of the earthquake on the probability of an incumbent mayor being re-elected.

Treatment criterion:	PGA > 12				PGA > 22			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Treatment</i>	-0.125 (0.089)	-0.139 (0.0873)	-0.164* (0.0876)	-0.191** (0.0885)	-0.108 (0.094)	-0.121 (0.0934)	-0.135 (0.0949)	-0.151 (0.0951)
<i>Post-treatment</i>	0.073 (0.062)	-0.116 (0.0821)	-0.108 (0.0820)	-0.0909 (0.0826)	0.067 (0.063)	-0.110 (0.0865)	-0.122 (0.0858)	-0.108 (0.0859)
<i>ln(Campaign expenditure)</i>		0.0797 (0.0508)	0.0677 (0.0491)	0.0583 (0.0487)		0.0847* (0.0512)	0.0747 (0.0499)	0.0666 (0.0497)
<i>ln(County expenditure)</i>		0.644*** (0.171)	0.697*** (0.167)	0.626*** (0.171)		0.609*** (0.192)	0.682*** (0.189)	0.626*** (0.192)
<i>Unemployment rate</i>			-1.471 (1.106)	-1.526 (1.088)			-0.771 (1.263)	-0.783 (1.251)
<i>Center-left ideology</i>				-0.162 (0.0990)				-0.122 (0.102)
<i>Constant</i>	0.340*** (0.061)	-4.014*** (1.035)	-3.966*** (1.011)	-3.346*** (1.041)	0.373*** (0.067)	-3.909*** (1.178)	-4.040*** (1.149)	-3.557*** (1.173)
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Party fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Counties partially treated	Yes	Yes	Yes	Yes	No	No	No	No
Observations	508	497	508	497	456	451	445	445
R-squared	0.097	0.158	0.169	0.182	0.085	0.140	0.145	0.153
Number of counties	254	254	251	251	228	228	225	225

Note: Campaign expenditure and per capita county expenditure were deflated by the Chilean Consumer Price Index (CPI). Standard errors in parentheses were clustered at the county level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.2: Fixed-effects estimations for the impact of the earthquake on elected mayor's voting share.

Treatment criterion:	<i>PGA > 12</i>				<i>PGA > 22</i>			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Treatment</i>	-0.022 (0.014)	-0.0160 (0.0143)	-0.0252* (0.0146)	-0.0229 (0.0146)	-0.0231 (0.0149)	-0.0171 (0.0149)	-0.0300** (0.0151)	-0.0270* (0.0148)
<i>Post-treatment</i>	0.045*** (0.010)	0.0184 (0.0148)	0.0288* (0.0149)	0.0300** (0.0151)	0.0443*** (0.0103)	0.0238 (0.0158)	0.0364** (0.0154)	0.0389** (0.0156)
<i>ln(Campaign expenditure)</i>		0.0184** (0.00878)	0.0194** (0.00868)	0.0194** (0.00878)		0.0195** (0.00916)	0.0203** (0.00902)	0.0201** (0.00885)
<i>ln(County expenditure)</i>		0.0635* (0.0326)	0.0573* (0.0323)	0.0470 (0.0348)		0.0415 (0.0367)	0.0353 (0.0357)	0.0188 (0.0373)
<i>Unemployment rate</i>			-0.358** (0.175)	-0.358** (0.175)			-0.460** (0.189)	-0.461** (0.185)
<i>Incumbent candidate</i>				0.0214 (0.0136)				0.0267* (0.0139)
<i>Center-left ideology</i>				0.00156 (0.0147)				
<i>Constant</i>	0.489*** (0.010)	-0.0941 (0.189)	-0.0523 (0.187)	-0.0202 (0.208)	0.496*** (0.0106)	0.000473 (0.217)	0.0508 (0.210)	0.0456 (0.233)
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Party fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Counties partially treated	Yes	Yes	Yes	Yes	No	No	No	No
Observations	508	503	497	497	456	451	445	445
R-squared	0.134	0.164	0.187	0.197	0.144	0.166	0.199	0.221
Number of counties	254	254	251	251	228	228	225	225

Note: Campaign expenditure and per capita county expenditure were deflated by the Chilean Consumer Price Index (CPI). Standard errors in parentheses were clustered at the county level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.