Natural disasters and electoral support: an investigation of the channels driving vote decisions*

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Abstract

Natural disasters are catastrophic events that may change vote decisions of affected voters. In this study, we analyze how the occurrence of earthquakes changes voters' behavior at municipal elections and which channels drive this change. To analyze the impact of earthquake occurrence on electoral outcomes, we exploit data from 11,966 municipal electoral cycles where incumbents seek reelection between 1993 and 2015 in Italy and apply an empirical strategy that combines propensity score matching and regression adjustment. We use probit regressions of incumbent mayor reelection probability and OLS regressions of and a difference-in-differences strategy for incumbent mayor vote share. We find that the occurrence of destructive earthquakes significantly increases the incumbent mayors' chance of being reelected and vote share. We argue that this result is driven by incumbent mayor performance in recovery from disaster damages combined with a higher visibility on the media in the aftermath of the disaster. However, the higher visibility on the media may bias voters towards incumbent mayors just for the mediatic relevance of earthquake occurrence.

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1 Introduction

Democracy in modern society allows voters to express their preferences on representatives and policies. Vote choice is the result of policy preferences, retrospective evaluation of and future expectations on politician performance. The occurrence of negative shocks, such as natural disasters or terrorist attacks, likely affect voters' evaluations because the shock allows to update preferences and expectations (Ashworth et al., 2018). Indeed, politicians are pushed into the center of the storm because they need to provide a response to unexpected damages and needs. Voters can use information on politicians' response to assess incumbent politicians' competences and evaluate whether they deserve maintaining their position and punish or reward them at the following elections. Several studies address the question of voter behavior at elections when disasters occur. However, findings are mixed and evidence on the alignment between variations in electoral support in local-level elections and incumbent mayor performance is lacking.

In this study, we investigate how the occurrence of natural disasters (earthquakes) affects electoral outcomes. To this aim, we use data from 11,966 municipal elections where incumbent mayors run for reelection between 1993 and 2015 in Italy and exploit a rich dataset of all earthquake events occurred within the same period. In particular, we analyze how the reelection probability and vote share of incumbent mayors differ between struck and unaffected municipalities in local elections. Our empirical strategy to identify the causal impact of earthquake occurrence on electoral outcomes is based on propensity score matching (PSM) combined with regression adjustment. We use probit regressions of incumbent mayor reelection probability and OLS regressions of vote share weighted by the reciprocal of normalized propensity scores. Moreover, we employ a difference-in-difference strategy, combined with PSM, to estimate the impact of earthquake shocks on vote share. We find that the occurrence of destructive earthquakes raises the support for the incumbent mayor by increasing both the reelection probability and the share of votes gained. The result is robust to the use of alternative matching procedures and placebo tests. Then we analyze possible channels through which earthquake occurrence changes vote decisions. In particular, we focus on politician performance and visibility on the main Italian press agency (ANSA). While data for the measurement of performance (local government financial indicators) are available from institutional sources, we collected data on political visibility using a search strategy on Factiva to identify the frequency of news mentioning incumbent mayors and competing candidates. We find that both incumbent mayor performance and visibility on the media increase after the occurrence of an earthquake which explains improved electoral outcomes for incumbent mayors since voters reward good performance and the mediatic exposure of incumbent mayors relative to their competitors biases voters' choice at elections towards incumbents.

Previous studies tend to suggest that the occurrence of natural disasters reduces the support for the incumbent politician if his/her response is perceived as inadequate (Eriksson, 2016; Lay, 2009) or if he/she takes actions which go to the detriment of voters welfare (Akarca and Tansel, 2016). Conversely, an appropriate response, generally measured by the size of financial transfers from the central government, raises the support for the incumbent government (e.g. Healy and Malhotra, 2009), although incumbents may use these tools to attract votes in an opportunistic manner (Bechtel and Hainmueller, 2011). Belloc et al. (2016) show that between 1000 and 1300, political and religious leaders (bishops) in autocratic Italian cities exploited the occurrence of earthquakes to maintain their power leveraging on fear and the religious sphere of individuals. However, whether voters are able to identify the politicians who are responsible for a positive (negative) response to disasters and reward (punish) them at elections is an under-investigated question and provides mixed evidence. Gasper and Reeves (2011) analyze the impact of extreme rainfalls in the US on electoral outcomes at county and federal level and find that voters are able to identify the politicians who are responsible for a good (or bad) response to disaster occurrence and reward (or punish) these politicians accordingly. Conversely, Achen and Bartels (2016) argue that voters express their frustration at elections when disasters strike and blame incumbents as long as there is some reason to believe that they are accountable for disaster occurrence.

However, investigation of other channels driving vote decisions when natural disasters occur is still lacking. Studies investigating on incumbent government response generally focus on spending levels but neglect the performance in recovery from damages. Moreover, a large strand of the literature analyzes the role of media in biasing vote decisions showing that the influence of media can shift votes towards a specific party or shape the evaluation of politicians' competences (e.g. DellaVigna and Kaplan, 2007; Hetherington, 1996) but, to our knowledge, there are no studies that relate variations in political visibility following a disaster and electoral outcomes.

Our contribution to this literature is twofold. First, we use a unique and very detailed data set on earthquake occurrences to capture the impact of these shocks on municipal electoral outcomes, an institutional level that has been neglected in previous studies.[1] Second, we extend the understanding of channels driving vote decisions and take into account factors that have been neglected in past studies.

The remainder of this paper is structured as follows. Section 2 provides an overview of electoral rules in local elections. Section 3 describes the data and presents some preliminary evidence on the relationship between votes and earthquake occurrences. Section 4 presents our identification strategy, while Section 5 discusses the main results of the analysis. Finally, in Section 6 we provide evidence on possible channels driving our results. Section 7 concludes.

2 Institutional setting

2.1 Municipal elections

Italy is a parliamentary republic with a multiparty system organized in 20 regions, 110 provinces and almost 8000 municipalities.[2] Substantial power is delegated by the central government to sub-national governments and each institutional level has a government with executive power and a council with legislative power. Local (municipal) governments have the task to provide a number of services to the resident population. The main services are primary education, waste disposal, urban road maintenance, public residential buildings and social protection.[3] The mayor is the head of the Executive Committee (*Giunta Comunale*), which holds executive power, and the Municipal Council (*Consiglio Comunale*) exercises legislative power.

In this study, we focus on municipal elections. At local level, the mayor and the Council members are elected directly by the electorate, while the Executive Committee is proposed by the mayor and approved by the Council. Local government elections are ruled by two electoral systems (majoritarian and proportional) which are assigned based on the population size of the most recent population census. Municipalities with less than 15,000 inhabitants adopt a single-ballot majoritarian system and each mayor candidate

[1] Exceptions are Nikolova and Marinov (2017) who focus on corruption determined by flood-driven relief funds and incumbent reelection, and Bodet et al. (2016) who analyze the effect of a flood on electoral outcomes in one town and for one electoral period.

[2] These numbers refer to 2015. Since 1993, provinces increased from 103 to 110 and municipalities have followed a consolidation process from 8100 to 7997 jurisdictions.

[3] See Decree Law 267/2000 (*Testo unico delle leggi sull'ordinamento degli enti locali*).

can be supported by a single party/list. Municipalities with more than 15,000 inhabitants adopt a two-ballot proportional electoral system and each mayor candidate is supported by a coalition of parties. The second ballot takes place if no candidate wins the absolute majority in the first ballot. Therefore, voters express their preference for one of the two candidates who obtained the largest shares of votes in the first ballot.[4]

Until 2000, each term lasted 4 years. Afterwards, the term was extended to 5 years and a term limit was introduced for mayors.[5] In municipalities with less than 3,000 inhabitants a mayor is allowed to rule for not more than three consecutive mandates, while in municipalities with more than 3,000 inhabitants only two consecutive mandates are allowed. Elections do not take place at the same time in each municipality. Anticipation is possible if a mayor loses the support of the Council or resigns, or the central government replaces the elected officials because of connections with the mafia. Between 1993 and 2015, the *regular* election years are 1995, 1999 and every 5 years afterwards. Less than 50% of municipalities have governments that reach the end of their mandates in every electoral cycle.

2.2 Response to earthquake shocks

Between 1993 and 2015, 397 municipalities were struck at least once by a destructive earthquake (i.e. an earthquake with Mercalli scale intensity greater than 5). In addition, 1524 municipalities registered an intensity equal to 5 and many other jurisdictions below that threshold. Following the shocks, the central government intervenes through the Civil Protection, a department administered by the Presidency of the Council of Ministers with the task to manage prevention, response and forecast of natural and man-made disasters, and through delegates who can act notwithstanding the regulation in order to face the state of emergency. Large amounts of financial resources are transferred to local governments from both central and regional governments.[6]

The response of local governments to the occurrence of an earthquake is generally immediate. Evidence suggests that local governments in struck municipalities increase expenditure by about 100 Euro per capita for 11 years after the shock (Masiero and Santarossa, 2019). This expenditure variation is allowed by a higher availability of transfers

[4]See Law 81/1993 for further details on municipal elections in Italy.

[5]Law 120/1999, Art. 7.

[6]See for example Barone and Mocetti (2014), Di Giacomo (2014) and Masiero and Santarossa (2019) for a discussion on public transfers and expenditure in the aftermath of earthquake shocks in Italy.

from the central and regional governments. Moreover, local governments adjust the spending composition to face the consequences of the disaster. Local governments increase the share of resources for housing, Civil Protection, waste disposal, water services and services for environmental protection, and reduce the expenditure share of minor services such as justice, culture and sports.

3 Data and descriptive evidence

3.1 Sample and variables

To analyze the impact of earthquake occurrence on electoral outcomes, we merge a number of data sources with information aggregated at municipality level. Data on municipal electoral outcomes are provided by the Italian Ministry of Interior and are available on the online historical election archive (*Archivio storico delle elezioni*). These data include information on election dates, candidates, lists/coalitions, vote participation and preferences for elections taking place between 1993 and 2015.[7] Since these data lack some information on municipal elections, we supplement the information with a second data set (*Anagrafe degli amministratori locali*) which includes yearly information on gender, age and education for all elected officials. Between 1993 and 2015, 41,361 municipal elections (about 5 per municipality) took place.

The municipal election data set includes 16,266 observations relative to incumbent mayors running for reelection. Using these data, we define two electoral outcome measures. The first is a dummy variable equal to one if an incumbent mayor is reelected. The second is the share of votes received by the incumbent computed as the proportion of preferences relative to the total number of valid votes. The reelection dummy is a dichotomous measure that allows to assess the success of the incumbent in the electoral run, but it does not suggest if and how much the incumbent gains or loses support during his mandate. Instead, the vote share, especially if related to the votes received in the previous election, measures how much support an incumbent gains or loses, but looking at the vote share variation does not allow to make inference on electoral success.

Using the sources above, we also compute the number of candidates participating in the electoral run and the political orientation of the incumbent government (center-left,

[7] Data on more recent electoral outcomes are available, but we cannot use them because we lack data on earthquake occurrences.

center-right, independent or *Movimento 5 Stelle*).[8] In municipalities with more than 15,000 inhabitants, we classify governments according to the political orientation of the parties forming the winning coalition.

We use several other data sources to complete our data set. Data on earthquake occurrence are provided by the Italian Institute for Geophysics and Volcanology (INGV) and these data are discussed in detail in the next section. We use population data for the period 1993-2015 provided by the Italian Institute for Statistics (ISTAT) to define sociodemographic indicators (percentage variation of population and variation in the share of elderly people), and population census data for the years 1991, 2001 and 2011 to classify municipalities by electoral system (proportional or majoritarian). Local government balance sheet data are provided by the Italian Ministry of Interior. Total expenditure and revenue data are available for the period 1993-2015, and detailed data (spending categories and revenue sources) for the period 1998-2015. All monetary values are deflated using the consumer price index to obtain real values at 2010 prices.

We exclude elections taking place in autonomous regions (Valle D'Aosta, Friuli Venezia Giulia, Sicily and Sardinia) and provinces (Bolzano and Trento) because the institutional setting is not comparable to the setting in regions with ordinary statute (including the electoral system), and drop observations with incomplete data. Thus, our final sample is composed of 11,966 observations.

3.2 Measurement of earthquake occurrence

We use data on earthquake occurrences from the Italian Macroseismic Database DBMI15 (Locati et al., 2016) provided by INGV aggregated by municipality and electoral period. The INGV institute is managed by the Civil Protection and has the purpose to increase the knowledge of natural phenomena in terms of occurrence and relevance, with a particular focus on seismic and volcanic events. The DBMI15 database includes detailed information on earthquakes occurred in Italy between 1000 AD and 2014.[9] We are interested in the Mercalli scale intensity (I), which measures observable effects caused by an earthquake on humans, animals, buildings and objects. This is plausibly the best measure of exposure

[8]About 60% of the lists supporting mayors are reported as *civic lists*, i.e. lists which do not have an explicit political orientation and generally are independent from national parties.

[9]Data for 2015 are not available. Note, however, that in 2015 only a few earthquakes occurred and none of them was destructive.

to earthquake risk.[10]

Following Belloc et al. (2016), we classify earthquakes into destructive earthquakes ($I > 5$) and weak earthquakes ($2 < I \leqslant 5$). Belloc et al. (2016) exploit both types of shocks since religious authorities in medieval times leveraged on the intense sentiment of fear to keep their power. However, voters in modern economies are unlikely to reward or punish incumbent governments without any visible consequence. Therefore, in our baseline analysis we use destructive earthquakes to distinguish between struck and unaffected municipalities.[11] We define a dummy variable (EQ_i) equal to one if at least one destructive earthquake occurred in the municipality area (i) between two consecutive electoral periods ($t-1$ and t), and zero otherwise.

Between 1993 and 2015, there are 397 struck municipalities with 406 occurrences of destructive earthquakes between two electoral cycles (see Figure 1 for an illustration of earthquake occurrence across Italian municipalities). Our final sample includes 170 municipalities struck once by a destructive earthquake.[12] 57% of these municipalities are located in 4 regions: Emilia Romagna, Umbria, Marche and Abruzzo.

3.3 Preliminary evidence on electoral outcomes

Before analyzing electoral outcomes, it is worth to observe that mayors decision to run for reelection is not significantly related to earthquake occurrence, since it does not differ between municipalities struck by an earthquake between two electoral cycles and unaffected municipalities. The first line of Table 1 shows that the average probability of observing a mayor who decides to run for reelection is almost identical and not significantly different between the two groups of municipalities.[13] This suggests that the unconditional probability of reelection is not confounded by running decisions of incumbent mayors.

The remainder of Table 1 reports mean characteristics of municipalities struck between two electoral cycles (column 2) and unaffected municipalities (column 1). The reelection probability when an earthquake occurs is on average 7% higher, and the vote share grows by an additional 3.3% compared to unaffected municipalities between two electoral cy-

[10] The alternative Richter scale measures the energy released by an earthquake. Although this is probably a more objective measure of earthquake strength, it is also less suitable to capture damages, and, therefore, risk perception, in the area.

[11] We extend the analysis to include non-destructive earthquakes ($I = 5$) in Section 5.3.

[12] In the full sample, we observe 216 earthquake occurrences after which an incumbent mayor seeks for reelection. We drop 13 shocks because they occur in regions and provinces with special statute and 33 shocks because of missing data.

[13] To test mean differences, we use data from 29,901 municipal elections where an incumbent mayor has the possibility to decide whether or not to seek for reelection.

cles. Results of t-tests on mean differences (reported with stars in column 2) show that differences are statistically significant for both variables.

Vote participation is not significantly affected by the occurrence of earthquakes, which suggests that shocks do not affect the willingness to express preferences for political representatives. Also, the number of candidates participating in elections is not significantly different when an earthquake occurs and decreases slightly less between two electoral cycles in municipalities struck by an earthquake. This suggests that earthquakes do not affect the decision to run for election by alternative candidates and, therefore, the electoral competition is apparently unchanged. Also characteristics of incumbent mayors are not significantly different between the two groups of municipalities, except for age, which is more than one year lower in struck municipalities on average. Finally, the two groups are composed of a non-significantly different share of municipalities with a proportional electoral system.

4 Methodology

4.1 Identification strategy

Even if earthquake occurrence is random over time, the assignment of a municipality to the group of struck municipalities may not be random because of heterogeneous exposure to earthquake risk due to characteristics of the ground. This issue is amplified if we believe that risk preferences shape vote decisions and voters living in areas with high seismic risk have different risk preferences as compared to voters in low-risk areas. Moreover, we observe earthquake occurrence only in 170 of the 11,966 observations (1.4%) and comparing struck municipalities with the universe of the unaffected municipalities risks to further confound our analysis due to heterogeneity between municipalities and electoral cycles. Therefore, we use the propensity score matching (PSM) method to reduce unobserved heterogeneity between struck (*treatment group*) and unaffected municipalities (*control group*) and identify the causal impact of earthquake occurrence on electoral outcomes (e.g. Caliendo and Kopeinig, 2008; Heckman et al., 1997; Imbens, 2004; Rosenbaum and Rubin, 1983). PSM allows to address sample selection bias and obtain a comparable counterfactual group of unaffected municipalities because the matching procedure identifies a sub-sample of unaffected municipalities that is identical to the treatment group, on average, and, therefore, achieves pseudo-randomization.

We want to estimate the average treatment effect on the treated (ATT) of earthquake occurrence on electoral outcomes:

$$\tau_{ATT} = E[Y_1 - Y_0 \mid EQ = 1] = E[Y_1 \mid EQ = 1] - E[Y_0 \mid EQ = 1] \quad (1)$$

where Y_1 and Y_0 are measures of electoral outcomes (incumbent reelection or vote share) when an earthquake strikes (treatment group) and if it would not have occurred (control group), respectively, and EQ assigns municipalities to the treatment group. The limitation of observational data is that we do not observe $E[Y_0 \mid EQ = 1]$. If we assume $E[Y_0 \mid EQ = 1] = E[Y_0 \mid EQ = 0]$, then:

$$\tau_{ATT} = E[Y_1 \mid EQ = 1] - E[Y_0 \mid EQ = 0] \quad (2)$$

If assignment to treatment is random, Equation 2 provides a consistent estimate of τ_{ATT}. Otherwise, as in our case, the consistent estimation of τ_{ATT} builds on the assumptions of unconfoundedness and common support. The first assumption requires that outcomes in control municipalities are independent of assignment to treatment conditional on observable characteristics of municipalities ($Y_0 \perp EQ \mid X$). The second assumption requires that, conditional on observable characteristics, earthquake occurrence is not perfectly predictable ($P(EQ = 1 \mid X) < 1$).[14]

Since conditioning on a large set of covariates makes it difficult to identify suitable matches, Rosenbaum and Rubin (1983) suggest to use balancing scores. This scores can be defined as:

$$P(X) = P(EQ = 1 \mid X) \quad (3)$$

with X being observable characteristics of municipalities predicting earthquake occurrence. $P(X)$ measures the probability that a municipality is assigned to the treatment group. If the assumption of unconfoundedness holds conditional on X, it holds also conditional on $P(X)$ (Imbens, 2004). Therefore, we can reformulate the identifying assumption:

$$E[Y_0 \mid EQ = 1, P(X)] = E[Y_0 \mid EQ = 0, P(X)] \quad (4)$$

[14]Note that the assumptions of unconfoundedness and common support as presented here are valid only for the estimation of ATT and are weaker than the assumptions that allow to consistently estimate the average treatment effect (ATE)(Caliendo and Kopeinig, 2008).

and define the following matching estimator:

$$\tau_{ATT}^{PSM} = E[Y_1 \mid EQ = 1, P(X)] - E[Y_0 \mid EQ = 0, P(X)] \tag{5}$$

Since we observe the vote share of an incumbent mayor both before (when he/she is elected for the first time) and after the occurrence of an earthquake (when he/she seeks for reelection), we can combine the matching approach with a difference-in-difference (DD) strategy (Heckman et al., 1998). This approach has the advantage that the assumption of unconfoundedness is relaxed because it is possible to account for unobserved factors. The identifying assumption is:

$$E[Y_{0,t} - Y_{0,t-1} \mid EQ = 1, P(X)] = E[Y_{0,t} - Y_{0,t-1} \mid EQ = 0, P(X)] \tag{6}$$

with $Y_{0,t}$ being the electoral outcome after the occurrence of treatment if treatment has not occurred, and $Y_{0,t-1}$ the electoral outcome before treatment. Thus, the PSM-DD estimator can be written as:

$$\tau_{ATT}^{DD-PSM} = E[Y_{1,t} - Y_{0,t-1} \mid EQ = 1, P(X)] - E[Y_{0,t} - Y_{0,t-1} \mid EQ = 0, P(X)] \tag{7}$$

4.2 Matching method

To estimate propensity scores as described in Equation 3, we regress earthquake occurrence against a set of time-variant variables observed in the electoral period before earthquake occurrence and time-invariant variables using the following probit regression model:

$$PS_i = Pr[EQ_i = 1 \mid X_i] = \Phi(\alpha + X_i'\gamma) \tag{8}$$

Time-variant variables include the election year and per capita local government expenditure, and time-invariant variables are seismic zones, which are zones defined by the Italian Institute of Geophysics and Volcanology (INGV) and classify municipalities according to the probability of facing earthquakes in the future (zone 1 has the highest and zone 4 the lowest probability), and geo-institutional characteristics (mountain jurisdiction, coastal jurisdiction and geographic location).[15]

[15] We tried to include political factors and characteristics of incumbent mayors on the right-hand side of Equation 8, but coefficients were not significant and this would increase the variance of propensity scores (Caliendo and Kopeinig, 2008). Moreover, political characteristics likely do not determine earthquake occurrence and do not significantly differ between treated and control municipalities even without matching,

Various matching algorithms can be adopted to identify a comparison group for treated municipalities. In this paper, we use radius matching (Dehejia and Wahba, 2002). This approach is described by the following expression:

$$PS_j^C \mid ||PS_i^{EQ} - PS_j^C|| < R \tag{9}$$

with PS_i^{EQ} and PS_j^C being the propensity scores of treated municipality i and comparison municipality j, respectively, and R a radius (or caliper). In words, each treated municipality is matched with the unaffected municipalities with propensity scores falling within the specified radius R. Compared to other algorithms, the advantage of this procedure is that it allows to match treated municipalities with additional or less units when good or bad matches are available, respectively. Since our donor pool is large, we prefer this method because it allows for oversampling but avoids the risk of including bad matches into the control group. The radius we use is $R = 0.01$.

While the treatment group is composed of the 170 struck municipalities identified in Section 3.2, the donor pool is composed of the remaining *municipality* × *election* observations, but with some exceptions. We exclude observations of treated municipalities in electoral periods when no earthquake occurs to avoid that treated municipalities are matched with themselves. Moreover, we exclude municipalities struck by destructive earthquakes in unobserved periods (i.e. when an incumbent mayor does not run for reelection) and nearby municipalities struck by weak earthquakes (intensity equal to 5) because their inclusion may confound or dim our results due to temporal and spatial spillover effects, respectively. Hence, the donor pool is composed of 10,679 observations.

4.3 Estimation of the ATT

To estimate τ_{ATT}^{PSM}, we follow Hirano and Imbens (2001) and combine propensity score weighting and regression adjustment. The advantage of this approach is that propensity score weighting ensures that regressors are not correlated with earthquake occurrence and we can adjust the PSM estimator for outstanding bias if matching is not exact. When the dependent variable is incumbent mayor reelection, we use the following probit regression

except for incumbent mayor age (see Section 3.3). However, after matching, we control balancing properties also for political characteristics to ensure that these characteristics are balanced since they determine electoral outcomes.

model weighted by the reciprocal of the normalized propensity scores:[16]

$$p_i = Pr[Y_i = 1|EQ_i, X_i] = \Phi(\alpha + \tau_{ATT}^{PSM} EQ_i + X_i'\gamma_1 + Z_i'\gamma_2) \tag{10}$$

where EQ_i is the treatment dummy variable, α is the intercept term, X_i' is the vector of variables used to predict propensity scores and Z_i' is a set of political characteristics (characteristics of the incumbent mayor, political orientation of the local government and electoral system). τ_{ATT}^{PSM} and the γs are parameters to be estimated. Instead, when the dependent variable is incumbent vote share, we use the following OLS regression model weighted by the reciprocal of the normalized propensity scores:

$$Y_i = \alpha + \tau_{ATT}^{PSM} EQ_i + X_i'\gamma_1 + Z_i'\gamma_2 + \varepsilon_i \tag{11}$$

where ε is an *iid* error term. The inclusion of regressors (X_i' and Z_i') allows us to adjust estimates of the ATT for outstanding bias if matching is inexact and to correlate political characteristics with electoral outcomes since PSM does not account for that. On the other hand, the drawback is that a parametric estimation of τ_{ATT}^{PSM} requires assumptions on the functional form, but this issue is offset by the fact that combining different approaches to estimate ATT (matching and regressions adjustment) allows to obtain a consistent estimate even if either the earthquake probability model (Equation 8) or the electoral outcome model (Equations 10 and 11) is not correctly specified (Imbens, 2004). We use robust standard errors to account for possible heteroskedasticity.

Then, we estimate the DD-PSM estimator using the following equation weighted by the reciprocal of the normalized propensity scores:

$$Y_{it} = \tau_{ATT}^{DD-PSM} EQ_i \times post_t + \delta\, post_t + \alpha_i + Z_{it}'\gamma_2 + \varepsilon_{it} \tag{12}$$

with $post_t$ being a dummy variable equal to 1 in the period after earthquake occurrence. Time-invariant differences between the treatment and control groups are absorbed by municipality fixed effects (α_i) and time-specific shocks common to both groups are absorbed by time-specific effects (δ). Moreover, municipality fixed effects adjust estimates for outstanding bias if matching is not exact and absorb time-invariant political characteristics

[16] Since weights do not necessarily add up to one, we normalize them to unity. Thus, each treated observation has a weight equal to one and the sum of weights of matched observations equals one.

(i.e. Z'_{it} is composed of time-variant variables) and fixed unobserved characteristics.[17]

Before estimating Equations 10, 11 and 12, we verify that the treatment and matched control samples are balanced on covariates conditional on propensity scores, which ensures the independence between assignment to treatment and observed covariates. Moreover, we impose common support and drop observations that cannot be matched to similar unaffected municipalities (Becker and Ichino, 2002).

To ensure that our estimates are independent from the selection of the radius matching algorithm, we repeat matching using alternative algorithms. As sample size grows, the matching estimator should yield the same estimates independently from the adopted matching algorithm because estimates reach asymptotically the true value of τ_{ATT}^{PSM} (Smith, 2000). However, if estimates vary with the adopted matching procedure, then it is necessary to disentangle the sources of the differences (Bryson, 2002). Then, we perform a set of placebo tests and assign treatment to alternative control groups where the treatment is expected to have no effect. If we find that the placebo treatment has a significant effect, then the assumption of unconfoundedness is not valid. Conversely, not significant estimates of the ATT do not imply the validity of the unconfoundedness assumption, but this finding would increase the plausibility of validity (Imbens, 2004).

5 Results

5.1 PSM results

First, we perform radius PSM using the procedure described in Section 4.2. Table 2 reports probit regression results of earthquake occurrence probability using Equation 8. Except for per capital local government expenditure, all variables have significant coefficients. The three seismic-zone variables have positive coefficients indicating that the probability of facing an earthquake is the lowest in the lowest risk zone 4 (the baseline). Moreover, seismic zones 1 and 2 have coefficients similar in magnitude and larger than the coefficient of zone 3. Mountain municipalities have a higher chance of facing an earthquake and coastal jurisdictions are less exposed to seismic risk because earthquakes mainly occur along the Appenine mountain range, i.e. in the hinterland of the country. Moreover,

[17] Note that X'_i is absorbed by municipality fixed effects because the variables it is composed of are time-invariant. Moreover, we do not include X'_{it} for time-variant variables used to predict propensity scores because they may be determined by earthquake occurrence (e.g. local government expenditure) and, thus, their inclusion risks to bias our estimates.

municipalities in the Center of Italy have a higher probability of facing an earthquake than municipalities in the North, while the opposite happens for municipalities in the South.

Using the estimates in Table 2, we predict propensity scores and perform matching. The radius matching algorithm is able to match 169 municipalities with all observations of the donor pool. One observation of the treatment group is off support because no similar comparison municipality can be identified. Figure 2 illustrates distributions of balanced propensity scores for treated municipalities (red/dark bars) and matched control municipalities (blue/light bars). The overlapping of the two distributions highlights that the common support assumption holds.

Panel A of Table 3 reports balancing properties of covariates used to predict propensity scores before (U) and after matching (M). The matching procedure is effective in reducing bias between the treatment and the control group. Indeed, variables showing significant mean differences between treated and unaffected municipalities before matching do not show significant differences after matching.

Since the matching procedure does not account for political characteristics that determine electoral outcomes, we verify that PSM does not introduce imbalance in these characteristics. Balancing properties for political characteristics (incumbent mayor vote share before earthquake occurrence and characteristics, political orientation of the local government, electoral system) are reported in Panel B of Table 3. The means of all variables, except for incumbent mayor age, were not significantly different before matching. After matching, all of the variables have means that do not significantly differ between treated and control municipalities. In particular, note that the bias of incumbent mayor vote share slightly decreases after matching.[18] Therefore, the matching procedure does not affect or even reduces bias of political characteristics.

5.2 Impact of earthquakes on electoral outcomes

Using the samples of treated and matched control observations and the predicted propensity scores, we estimate the ATT of incumbent mayor reelection probability and vote share using Equations 10, 11 and 12. Results are summarized in Table 4. Columns 1 and 2 report probit regression results of reelection probability (Equation 10). We report

[18]Even if, for some of the variables, bias is slightly larger after matching, note that mean differences between the treatment and control groups remain not significant. Moreover, our empirical strategy takes into account outstanding bias for these variables (see Section 4.3).

marginal effects computed at the mean using the delta method for dummy treatment variables in order to interpret coefficients as percentage variations in reelection probability. Regression results of incumbent mayor vote share are reported in columns 3 and 4 for OLS regressions (Equation 11), and columns 5 and 6 for the DD strategy (Equation 12). Columns 1, 3 and 5 control only for earthquake occurrence, and columns 2 and 4 include the full set of variables used to predict treatment and political characteristics. Column 6 controls only for time-variant political characteristics. All regressions are weighted by the reciprocal of the normalized propensity scores.

All of the coefficients are positive and significant at the 5% level, while coefficients of DD models are significant at the 1% level. Models controlling for the outstanding bias of inexact matching and political characteristics (columns 2, 4 and 6) provide larger coefficients and lower standard errors, except for the DD model of vote share which provides identical results since municipality fixed effects account for most of the bias. Even if the bias is relatively small (0.02% for reelection probability and 0.73% for vote share), this correction further improves the accuracy of our estimates. Moreover, the explanatory power of the models increases with the inclusion of controls. In probit regression models, the pseudo R^2 is almost 7 times larger when covariates are included and the log-likelihood is lower in absolute value. Similarly, the explained variance is almost 21 times larger when covariates are included in the vote share model. Clearly, the DD models have the largest explanatory power with almost 62% of explained variance in both models with and without control variables since they account for municipality-specific time-invariant heterogeneity.

The results show that the occurrence of a destructive earthquake raises a mayor's probability of being reelected by 6.32%-6.34%. Moreover, the mayor's vote share increases by 2.54%-3.18%. Thus, earthquake occurrence raises both the incumbent mayors' chance of being reelected and his/her strength in the municipal council, *ceteris paribus*. This result is in contrast with Achen and Bartels (2016) who argue that incumbent politicians are punished at elections when disasters occur, but is in line with other studies showing that incumbent politicians gain support if the response to disasters meets voters expectations and needs (e.g. Gasper and Reeves, 2011; Healy and Malhotra, 2009). However, results presented here do not allow to draw conclusions on the effectiveness of the response provided by incumbent mayors, but we further investigate this aspect in Section 6. Moreover, note that our results are in line with Belloc et al. (2016) who find that earthquake occurrence delays political transition in the Middle Ages. However, fear from God is not a credible channel explaining our results in the modern context where voters are aware that earthquakes are natural phenomena.

Note that the results presented in this section provide valid estimates of τ_{ATT} conditional on the assumptions of unconfoundedness and common support. While we showed that the assumption of common support is satisfied (see Section 5.1), it is worth to further investigate the validity of unconfoundedness.[19] We address this issue in Section 5.3.2.

5.3 Robustness checks

5.3.1 Alternative matching algorithms

To test whether the results shown in Table 4 depend on the choice of the matching algorithm, we perform both nearest-neighbor and kernel matching. Then, for each procedure, we estimate Equations 10, 11 and 12 using the new control groups and propensity score weights.

We perform kernel matching with bandwidth 0.01 and nearest-neighbor (NN) matching with 10 neighbors. With kernel matching, we are able to match 169 treated municipalities, and with NN matching all of the 170 treated municipalities. In the case of kernel matching, the control group is composed of 10,679 observations, while for NN matching the control group is composed of 1,037 observations.[20] As in our baseline approach, we impose common support and balancing properties are satisfying (see Tables A.1 and A.2 in the Appendix for kernel and NN matching, respectively).

Estimates of the ATT based on the kernel matching procedure show negligible differences relative to our baseline estimates for all of the models (see Table A.3, columns 1-3). When we base our estimates on NN matching, resulting coefficients are slightly lower in magnitude and less significant. This is due to the fact that NN matching attaches the same weight to all matched control municipalities but the control group may include bad matches since no caliper is set to filter them out. Still, the results point into the same direction of our baseline results, but radius and kernel matching procedures are more precise in selecting and weighting municipalities of the control.

[19]Note that repeating the analysis with the inclusion of the observation of the treatment group that is off support provides results that are almost identical to those presented in this section.

[20]The control group obtained from NN matching is not composed of 1,700 observations (170 treated × 10 neighbors) because matching occurs with replacement and, thus, treated municipalities can share the neighbors. Weights account for the frequency with which a neighbor is matched with treated municipalities.

5.3.2 Placebo tests

We perform a set of placebo tests to assess whether our estimates are sensitive to unobserved confounding factors. We estimate the effect of the placebo treatment on electoral outcomes using Equation 10 for incumbent reelection probability and Equations 11 and 12 for incumbent vote share, respectively.

We run two tests. First, we assign treatment to election periods of treated municipalities when no earthquake occurs (i.e. before and after earthquake occurrence). This implies that we measure the impact of placebo shocks on electoral support for incumbent mayors who are different from those in charge when earthquakes strike and in electoral periods taking place at least 5 years before or after earthquake occurrence. We do not find significant estimates for both incumbent reelection and vote share models (see Table A.4, columns 4-6, in the Appendix).[21]

Then, following Heckman et al. (1997), we assign treatment to an alternative sample of municipalities (not used in our baseline matching procedure) exposed to earthquake occurrence, but where earthquakes were not destructive and, hence, treatment was not assigned. These municipalities are those hit with an intensity equal to 5 and represent 658 observations. Since the treatment group for this placebo test is composed of different municipalities, we repeat the matching procedure described in Section 4.2 to predict propensity scores and identify the control group. Also in this case, we do not find significant estimates in all of the models (see Table A.4, columns 4-6). This suggests that weak earthquakes are not sufficiently strong to trigger a significant variation in electoral outcomes. Therefore, we argue that our identification strategy is robust to unobserved confounders.

6 Channels driving vote decision

6.1 Post-disaster relief and incumbent mayor performance

A channel that may explain the change in electoral outcomes following the occurrence of an earthquake is politicians' ability to recover from earthquake damages through the use of additional public resources. Previous studies argue that public financial windfalls

[21] We aggregate elections taking place before earthquake occurrence with elections taking place afterwards because, before earthquake occurrence, we do not observe electoral periods in which an incumbent mayor runs for reelection for all of the treated municipalities, and vice versa. However, note that distinguishing between electoral periods before and after earthquake occurrence does not provide evidence of significant heterogeneous effects.

from the central government increase the support for the incumbent party in national elections (Bechtel and Hainmueller, 2011; Healy and Malhotra, 2009) and that voters are able to identify how incumbent politicians perform in recovery from disaster (Gasper and Reeves, 2011). Thus, even incumbent mayors may benefit from the response to disaster occurrence at elections if they perform well.

Since performance indicators for local politicians are not available, we follow Gagliarducci and Nannicini (2013) and exploit balance sheet data to build performance measures. Indeed, pre-electoral expenditure could signal incumbent politicians' ability to expand the availability of public goods (Rogoff, 1990; Rogoff and Sibert, 1988). We investigate how per capita expenditure, transfers from regional and central governments, deficit (the differences between per capita expenditure and revenues) and tax revenues, and the ratio between budget allocation to investments (capital expenditure) and goods and services (current expenditure) observed in the year before elections vary after earthquake occurrence.[22] Moreover, we investigate variations in personal income as a proxy for local economic growth. We express all monetary values in real values at 2010 prices. For each variable, we apply the DD strategy described in Section 4.3 (Equation 12, excluding controls Z'_{it}) to estimate the impact of earthquake occurrence.

Results are summarized in Table 5. Incumbent mayors provide a remarkable response after earthquake occurrence. Expenditure significantly increases by 695 Euro per capita (column 1). This outcome is expected since governments in developed countries generally provide aid to disaster areas (Noy and Nualsri, 2011). The additional resources spent by local governments are allocated to investments which significantly grow by almost 20% relative to expenditure on services and goods (column 2). The sharp increase in spending levels is driven by the intervention of upper-tier governments which significantly increase transfers to municipalities struck by earthquakes by 1,100 Euro per capita (column 3). Conversely, deficit significantly decreases by 419.2 Euro per capita (column 4). However, this variation is the result of the partial use of additional transfers for disaster relief given that it is almost equal to the gap between the increases in expenditure and transfers (404.8 Euro per individual). Finally, tax revenues slightly decrease and personal income slightly increases. However, neither of these two variations are significant.

[22]Since data for expenditure components, transfers and tax revenues are available only for the period 1998-2015 (see Section 3), we exclude observations for 3962 electoral cycles, including 99 treated observations, to improve comparability across the results presented here. Note, however, that baseline estimates of the impact of earthquake occurrence on electoral outcomes presented in Table 4 hold also using this sub-sample of observations.

These results suggest that, on average, incumbent mayors perform well in recovery from earthquake damages. They expand spending levels and foster investments to reconstruct damaged infrastructures (e.g. streets and public buildings) to allow local economic activities to start operating again without laying the burden of reconstruction on voters' fiscal contributions. In line with Gasper and Reeves (2011), we find that, on average, voters are able to identify that incumbent mayors perform well in responding to earthquake occurrence which allows to limit voters' wealth losses (no variation in personal income) and, therefore, incumbents are rewarded at elections. Moreover, the electorate rewards improved fiscal performance (lower deficit) which is achieved despite disaster occurrence (Brender and Drazen, 2008). Thus, voters do not express their frustration at elections as suggested by Achen and Bartels (2016), but rather express their gratitude to well-performing politicians.

Clearly, incumbents are not accountable for the increase in resources available for recovery, which are sent by upper-tier governments, but this is due to local government budget constraints. However, mayors are accountable for the use of the resources and our results highlight that incumbent mayors are rewarded for an appropriate response to disasters.

A criticism that may arise is that voters act under bounded rationality because they do not have access to complete information on the fiscal performance of local governments. If this is the case, then voters may reward incumbents just for the fact of providing a response which we know being driven by upper-tier government transfers. However, we argue that, due to the mediatic exposure of earthquake occurrences (see Section 6.2), voters are aware that upper-tier governments intervene by means of earthquake-specific transfers and are informed on the response provided by incumbent mayors. Moreover, it is likely that voters are able to observe the response provided since incumbent mayors favor expenditure on investments at the expense of goods and services, and the former spending component is characterized by a higher visibility as compared to the latter (Drazen and Eslava, 2010; Kneebone and McKenzie, 2001).

6.2 Political visibility

Natural disasters receive extensive media coverage that provides information on the impact of these events. Both local politicians and representatives in upper-tier governments are frequently cited and interviewed by the media. Therefore, catastrophic events increase the visibility of politicians allowing them, either opportunistically or not, to send a signal of reassurance to the electorate.

To what extent higher visibility of incumbent politicians in earthquake areas affects electoral outcomes is worth to be explored. We measure political visibility using frequencies of news reporting the name of incumbent mayors geolocalized in the ruling municipality and issued while they are in charge.[23] We apply this search strategy on the *Factiva* database and collect information from the main Italian press agency (*ANSA*).[24] Since our access is limited to news issued after 2001, we exclude electoral cycles before or overlapping with 2001. The sub-sample of electoral runs for which we collect news frequencies is composed of 4,659 observations (52 treated). To control for media exposure of other political competitors, we apply a similar search strategy and build a competitor visibility measure using frequencies of news relative to the main challenger (most mentioned competitor).[25]

On average, we collected 33.51 and 18.15 press-agency news per municipality on incumbent mayors and main challengers, respectively. The proportion of press agency news on incumbents exceeds news on the main challenger by almost 67% in municipalities treated by an earthquake, whereas the difference in control municipalities, weighted by the reciprocal of normalized propensity scores, is significantly lower and equal to 52% (see Figure 3). The different distribution of news in treated municipalities is determined by a sharp increase of news on the incumbent (64.36 news on average), while news frequencies of competitors are just slightly higher (4.79 news on average). These results suggest that, after the occurrence of an earthquake, the incumbent mayor benefits not only from a higher visibility on the media, but also from a higher visibility relative to his main challenger. Indeed, media coverage can influence citizens' opinion about politicians and parties (e.g. Arceneaux et al., 2012; Druckman and Parkin, 2005; Ladd and Lenz, 2009).

Different from DellaVigna and Kaplan (2007) and Clinton and Enamorado (2014) who find that media can bias voters towards a specific party coalition, our results seem to suggest that the media bias voters towards politicians under the spotlight, namely

[23]This search strategy is an adaptation of the strategy used by Giommoni (2017).

[24]Factiva is a research tool which provides access to news from all over the world. Along with *ANSA*, several other Italian local and national news providers are accessible. We limit the search to the main press agency because it covers information over the entire country and for the longest period (since 2001). Indeed, data from the second most frequent sources, *Corriere della Sera* and *Il Sole 24 Ore*, are available since 2005 for about 2,500 observations and only 25 of them belong to the treatment group.

[25]Other measures of competitor's visibility, such as the average news frequencies of all competitors, can be used. However, the share of news issued on the incumbent and the main challenger is on average 96.85% of the total news issued on candidates, suggesting that the remaining candidates have a marginal role in the electoral run.

incumbent mayors. Moreover, visibility of incumbent mayors likely is the channel through which voters get informed on his/her performance, as described in Section 6.1, and, thus, leads to higher electoral support for incumbents. Note, however, that our data do not allow us to exclude that other factors, such as the content of the news or the opportunistic behavior by incumbents who seeks the media, play a relevant role in shaping vote choices after the occurrence of an earthquake.

7 Conclusions

The occurrence of natural disasters requires politicians to provide a response to recover from damages which reveals information on their competences. Since the occurrence of natural disasters and the response provided by national-level governments affects vote decisions (e.g. Eriksson, 2016; Gasper and Reeves, 2011), also local-level incumbent politicians may gain (or lose) support at elections taking place after the occurrence of these shocks. We provide evidence that communities struck by natural disasters are more likely to offer support to incumbent mayors at elections taking place after the occurrence of the shock.

We exploit data on municipal electoral outcomes from 11,966 municipal electoral cycles where incumbent mayors seek for reelection and taking place between 1993 and 2015, and the register of all seismic events for the same period. We compare electoral outcomes in municipalities struck by an earthquake with unaffected municipalities using propensity score matching combined with regression adjustment and a difference-in-difference strategy. We find that the occurrence of an earthquake increases incumbent mayor reelection probability by 6.3% and vote share by more than 3%. This result is driven by higher performance of incumbent politicians who increase spending levels and investments to recover from damages, and are able to reduce deficit without affecting the level of wealth. This signal sent to the electorate allows voters to update their expectations on incumbent mayor performance and competences and leads to higher support for the incumbent at the following elections (Ashworth et al., 2018).

Moreover, incumbents benefit from a higher visibility on the media, both in news frequency and relative to their competitors. This allows incumbent mayors to inform the electorate about the implemented measures to foster recovery from earthquake damages. On the other hand, the increased disproportion between news covering incumbent mayors as compared to their competing challengers likely biases voters in favor of incumbent politicians (Clinton and Enamorado, 2014; DellaVigna and Kaplan, 2007), even if higher visibility is just the result of the mediatic relevance of earthquake occurrences. Future research could further investigate the role of media coverage in shaping vote decisions in the aftermath of natural disasters to understand whether it is the content of the news (e.g. politician performance) or just the disproportionate visibility of incumbents as compared to competing candidates that drive vote decisions.

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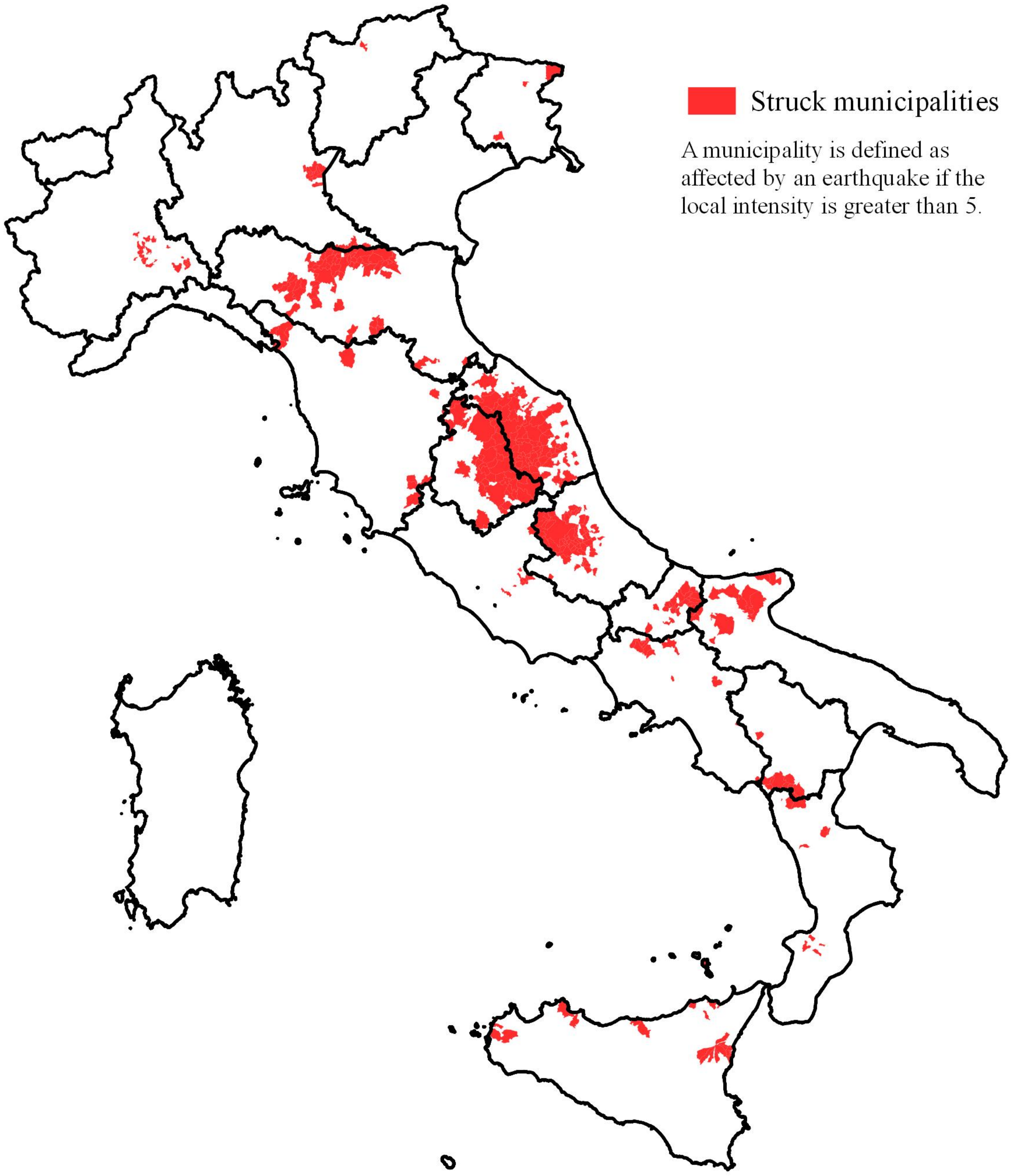
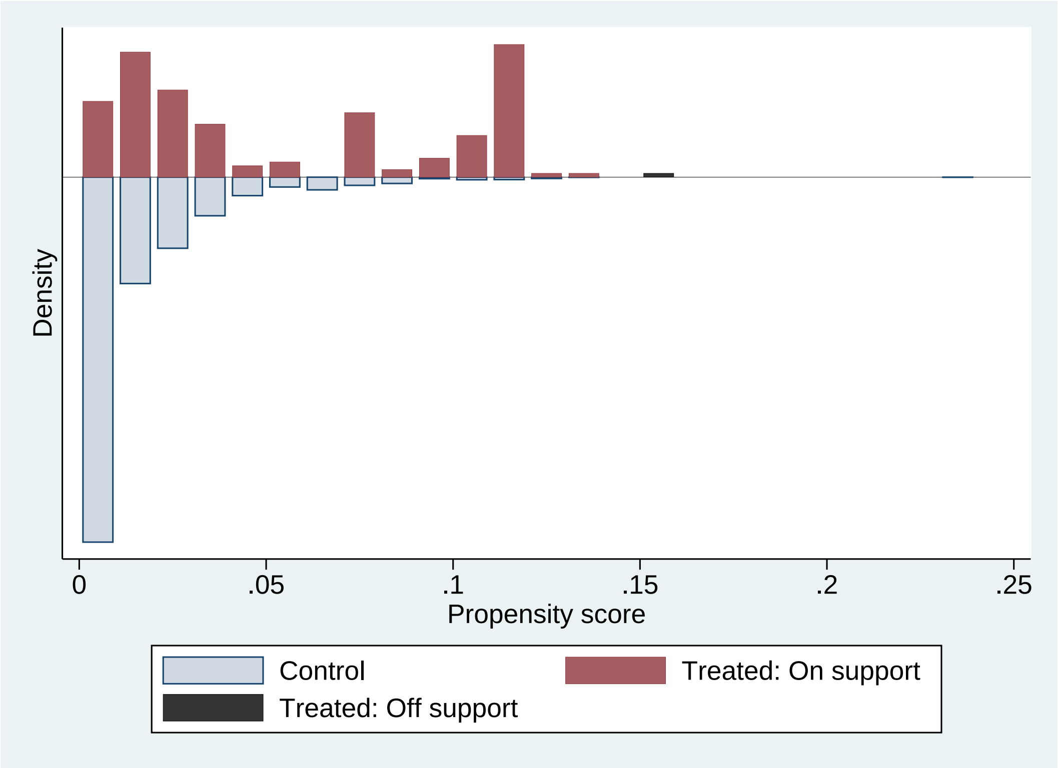
Figure 1: A map of earthquake occurrence in Italy (1993-2015).



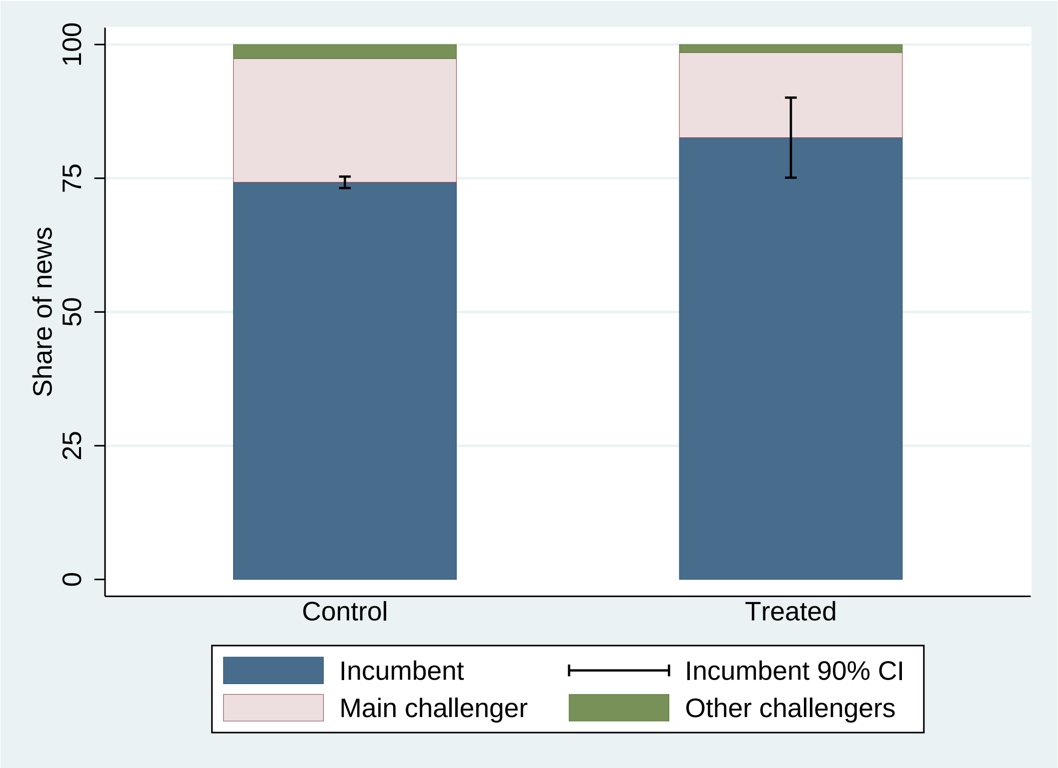
Notes - The map represents municipalities struck by a destructive earthquake (with intensity >5) between 1993 and 2015. Red areas represent struck municipalities.
Source: Our elaboration on data from the DBMI15 database of INGV (Locati et al., 2016). The shape map of the administrative borders is provided by ISTAT.

Figure 2: Balanced propensity scores.



Notes - The figure represents the distribution of propensity scores obtained from a radius matching algorithm with caliper 0.01. Red/dark bars represent the distribution for treated municipalities (on support), and blue/light bars matched unaffected municipalities. The black bar represents the single treated municipality off support.
Source: Our elaboration on data provided by the Italian Ministry of the Interior.

Figure 3: Political visibility.



Notes - The figure illustrates average proportions of news on the incumbent mayor (blue bars) and on competing candidates (red bars for the main challenger and green bars for other challengers) over an electoral cycle. Bars denoted by *Treated* refer to municipalities struck by a destructive earthquake (with intensity >5) between two elections and bars denoted by *Control* refer to matched unaffected municipalities identified with radius PSM. Shares are weighted by the inverse of normalized propensity scores. *Press agency* includes news issued by *ANSA*. *Newspapers* includes news issued by the Italian national newspapers *Corriere della Sera* and *Il Sole 24 Ore*.
Source: Our elaboration on data collected from the *Factiva* database.

Table 1: Descriptive statistics.

	(1) No earthquake	(2) Earthquake
Runs for reelection (=1)	0.487	0.486
Reelected (= 1)	0.783	0.853**
Δ Vote share of the incumbent	1.869	5.169**
Vote participation (%)	76.47	76.86
Δ candidates	-0.114	-0.0118
Inumbent education years	14.40	14.25
Incumbent is man (=1)	0.926	0.918
Incumbent age	46.59	45.26**
Proportional electoral system (=1)	0.0827	0.100
Obs.	11796	170

Notes - The table reports mean characteristics of unaffected municipalities (column 1) and municipalities struck by a destructive earthquake (with intensity >5) between two electoral cycles (column 2). The reported statistics are related to municipal elections where a mayor runs for reelection (except for *Runs for reelection* which exploits the universe of municipal elections). Stars in column 2 indicate significance levels that result from one-side t-tests on mean differences between the two groups of municipalities. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 2: Probit regression model of earthquake occurrence probability.

	(1)
Dependent variable	Earthquake
Election year$_{t-1}$	-0.0261***
	(0.00595)
Seismic zone 1	1.270***
	(0.194)
Seismic zone 2	1.287***
	(0.166)
Seismic zone 3	0.882***
	(0.152)
Mountain municipality	0.187**
	(0.0701)
Coastal municipality	-0.951**
	(0.329)
Center (=1)	0.288**
	(0.105)
South (=1)	-0.277*
	(0.117)
Per captia local government expenditure $_{t-1}$	0.0213
	(0.0114)
Obs.	10858
No. of treated	170
Pseudo R-sq.	0.163
Log-likelihood	-732.7

Notes - The table reports probit regression results of earthquake occurrence probability. The dependent variable is a dummy variable equal to 1 if an destructive earthquake occurred between two electoral cycles (between $t-1$ and t). Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors are in parentheses.

Table 3: Balancing properties

Variable	U/M	Treated	Control	% bias	t	p> |t|
Panel A: Predictors of earthquake occurrence						
Election year$_{t-1}$	U	2003.4	2005.6	-38.4	-4.87	0.000
	M	2003.4	2003.1	5.0	0.47	0.638
Seismic zone 1	U	.15294	.08963	19.4	2.85	0.004
	M	.15385	.13443	6.0	0.51	0.613
Seismic zone 2	U	.61765	.2457	80.9	11.15	0.000
	M	.61538	.57548	8.7	0.75	0.456
Seismic zone 3	U	.2	.21828	-4.5	-0.57	0.567
	M	.20118	.1948	1.6	0.15	0.883
Mountain municipality	U	.61176	.38716	46.0	5.96	0.000
	M	.60947	.63109	-4.4	-0.41	0.683
Coastal municipality	U	.00588	.06933	-33.8	-3.25	0.001
	M	.00592	.01584	-5.3	-0.88	0.381
Center (=1)	U	.46471	.11948	81.9	13.62	0.000
	M	.46154	.49128	-7.1	-0.55	0.585
South (=1)	U	.27647	.26609	2.3	0.30	0.761
	M	.27811	.22597	11.7	1.10	0.271
Per captia local government expenditure $_{t-1}$	U	1.8244	1.5285	19.6	2.27	0.023
	M	1.7681	1.6067	10.7	1.27	0.204
Panel B: Political characteristics						
Incumbent vote share$_{t-1}$	U	55.438	56.483	-7.5	-0.84	0.400
	M	55.415	56.063	-4.7	-0.46	0.643
Incumbent is man (=1)	U	.91765	.92496	-2.7	-0.36	0.720
	M	.92308	.94668	-8.8	-0.88	0.381
Incumbent age	U	45.259	46.727	-16.1	-1.99	0.046
	M	45.367	46.125	-8.3	-0.78	0.434
Inumbent education years	U	14.253	14.369	-3.2	-0.42	0.672
	M	14.231	14.416	-5.1	-0.47	0.637
Center-right local government	U	.10588	.12622	-6.3	-0.79	0.428
	M	.10651	.10357	0.9	0.09	0.930
Civic-list local government	U	.00588	.00281	4.7	0.75	0.456
	M	.00592	.00173	6.4	0.62	0.534
Proportional electoral system (=1)	U	.1	.08243	6.1	0.83	0.409
	M	.10059	.06796	11.3	1.08	0.282

Notes - Panel A reports balancing properties of covariates used to predict propensity scores using radius PSM with caliper 0.01. Panel B reports balancing properties for political variables. *U* represents the full (unmatched) sample and *M* the matched sample of municipalities.

Table 4: PSM regression results.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Incumbent reelection		Incumbent vote share			
Model	Probit (marginal effects)		OLS	OLS	DD	DD
Earthquake (× Post)	0.0632**	0.0634**	2.535*	3.247**	3.183***	3.183***
	(0.0301)	(0.0288)	(1.401)	(1.364)	(1.105)	(1.105)
Municipality fixed effects	No	No	No	No	Yes	Yes
Time fixed effects	No	No	No	No	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes
Obs.	10848	10848	10848	10848	21696	21696
(Pseudo) R-sq.	0.00724	0.0498	0.00541	0.112	0.615	0.616
Log-likelihood	-157.9	-151.2				

Notes - The table reports regression results of electoral outcomes weighted by the reciprocal of normalized propensity scores. Columns 1 and 2 report marginal effects computed at the mean from probit regression results of incumbent mayor reelection probability. Columns 3 and 4 report OLS regression results of incumbent mayor vote share, and columns 5 and 6 report results using a difference-in-difference strategy. *Earthquake* is a dummy variable equal to 1 if a municipality was struck by an earthquake since the previous electoral period. In columns 5 and 6, *Earthquake* × *Post* is a dummy variable equal to 1 for struck municipalities in the electoral period after earthquake occurrence. Columns 2, 4 and 6 control for political variables (election year and electoral system), characteristic of the incumbent (education years, age and gender) and geo-institutional characteristics (seismic zones, mountain or coastal jurisdiction, and geographic location). Columns 5 and 6 further control for municipality and time fixed effects (post-earthquake electoral cycle). Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors clustered by municipality are in parentheses.

Table 5: Incumbent mayor fiscal performance after an earthquake.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Expenditure	Inv./Cur.	Transfers	Deficit	Tax revenues	Personal income
Earthquake × Post	695.3***	0.196**	1100.1***	-419.2***	-12.21	66.66
	(153.4)	(0.0771)	(222.2)	(150.0)	(26.27)	(131.0)
Municipality fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	13772	13772	13772	13772	13772	12551
R-sq.	0.814	0.629	0.660	0.483	0.823	0.971

Notes - The table reports regression results from a DD strategy applied on a set of incumbent mayor performance indicators. Performance indicators are per capita local government expenditure, the ratio between investments and current expenditure, per capita transfers and deficit (expenditure - revenues), tax revenues and personal income. *Earthquake × Post* is a dummy variable equal to 1 for struck municipalities in the electoral period after earthquake occurrence. All models control for municipality and time fixed effects (post-earthquake electoral cycle). Monetary values are expressed in 2010 prices. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors clustered by municipality are in parentheses.

Appendix

Table A.1: Balancing properties: Kernel matching

Variable	U/M	Treated	Control	% bias	t	p> |t|
Panel A: Predictors of earthquake occurrence						
Election year$_{t-1}$	U	2003.4	2005.6	-38.4	-4.87	0.000
	M	2003.4	2002.9	7.5	0.72	0.473
Seismic zone 1	U	.15294	.08963	19.4	2.85	0.004
	M	.15385	.14174	3.7	0.31	0.755
Seismic zone 2	U	.61765	.2457	80.9	11.15	0.000
	M	.61538	.57898	7.9	0.68	0.497
Seismic zone 3	U	.2	.21828	-4.5	-0.57	0.567
	M	.20118	.19214	2.2	0.21	0.835
Mountain municipality	U	.61176	.38716	46.0	5.96	0.000
	M	.60947	.62078	-2.3	-0.21	0.831
Coastal municipality	U	.00588	.06933	-33.8	-3.25	0.001
	M	.00592	.01442	-4.5	-0.78	0.437
Center (=1)	U	.46471	.11948	81.9	13.62	0.000
	M	.46154	.49478	-7.9	-0.61	0.542
South (=1)	U	.27647	.26609	2.3	0.30	0.761
	M	.27811	.23532	9.6	0.90	0.369
Per captia local government expenditure $_{t-1}$	U	1.8244	1.5285	19.6	2.27	0.023
	M	1.7681	1.598	11.3	1.32	0.186
Panel B: Political characteristics						
Incumbent vote share$_{t-1}$	U	55.438	56.483	-7.5	-0.84	0.400
	M	55.415	55.871	-3.3	-0.33	0.743
Incumbent is man (=1)	U	.91765	.92496	-2.7	-0.36	0.720
	M	.92308	.94723	-9.0	-0.90	0.369
Incumbent age	U	45.259	46.727	-16.1	-1.99	0.046
	M	45.367	46.028	-7.2	-0.69	0.491
Inumbent education years	U	14.253	14.369	-3.2	-0.42	0.672
	M	14.231	14.466	-6.5	-0.60	0.547
Center-right local government	U	.10588	.12622	-6.3	-0.79	0.428
	M	.10651	.10445	0.6	0.06	0.951
Civic-list local government	U	.00588	.00281	4.7	0.75	0.456
	M	.00592	.00188	6.1	0.59	0.552
Proportional electoral system (=1)	U	.1	.08243	6.1	0.83	0.409
	M	.10059	.0711	10.2	0.97	0.335

Notes - The table reports balancing properties of kernel PSM using the Epanechnikov kernel function with bandwidth 0.01. *U* represents the full (unmatched) sample and *M* the matched sample of municipalities.

Table A.2: Balancing properties: Nearest-neighbor matching (n=10)

Variable	U/M	Treated	Control	% bias	t	p> |t|
Panel A: Predictors of earthquake occurrence						
Election year$_{t-1}$	U	2003.4	2005.6	-38.4	-4.87	0.000
	M	2003.4	2003.2	3.1	0.29	0.771
Seismic zone 1	U	.15294	.08963	19.4	2.85	0.004
	M	.15294	.14529	2.3	0.20	0.844
Seismic zone 2	U	.61765	.2457	80.9	11.15	0.000
	M	.61765	.58235	7.7	0.66	0.508
Seismic zone 3	U	.2	.21828	-4.5	-0.57	0.567
	M	.2	.24118	-10.1	-0.91	0.361
Mountain municipality	U	.61176	.38716	46.0	5.96	0.000
	M	.61176	.59706	3.0	0.28	0.782
Coastal municipality	U	.00588	.06933	-33.8	-3.25	0.001
	M	.00588	.00824	-1.3	-0.26	0.796
Center (=1)	U	.46471	.11948	81.9	13.62	0.000
	M	.46471	.50235	-8.9	-0.69	0.489
South (=1)	U	.27647	.26609	2.3	0.30	0.761
	M	.27647	.23353	9.6	0.91	0.365
Per captia local government expenditure $_{t-1}$	U	1.8244	1.5285	19.6	2.27	0.023
	M	1.8244	1.6063	14.5	1.74	0.082
Panel B: Political characteristics						
Incumbent vote share$_{t-1}$	U	55.438	56.483	-7.5	-0.84	0.400
	M	55.438	55.589	-1.1	-0.11	0.912
Incumbent is man (=1)	U	.91765	.92496	-2.7	-0.36	0.720
	M	.91765	.94706	-10.9	-1.08	0.282
Incumbent age	U	45.259	46.727	-16.1	-1.99	0.046
	M	45.259	45.918	-7.2	-0.70	0.484
Inumbent education years	U	14.253	14.369	-3.2	-0.42	0.672
	M	14.253	14.578	-9.0	-0.86	0.393
Center-right local government	U	.10588	.12622	-6.3	-0.79	0.428
	M	.10588	.11353	-2.4	-0.22	0.822
Civic-list local government	U	.00588	.00281	4.7	0.75	0.456
	M	.00588	.00118	7.1	0.73	0.466
Proportional electoral system (=1)	U	.1	.08243	6.1	0.83	0.409
	M	.1	.07647	8.2	0.76	0.446

Notes - The table reports balancing properties of nearest-neighbor matching with 10 neighbors. *U* represents the full (unmatched) sample and *M* the matched sample of municipalities.

Table A.3: PSM regression results using alternative matching algorithms.

	(1)	(2)	(3)	(4)	(5)	(6)
Matching algorithm	Kernel			Nearest-neighbor (n=10)		
Dependent variable	Reelected	Vote share	Vote share (DD)	Reelected	Vote share	Vote share (DD)
Earthquake (× Post)	0.0598**	3.198**	3.054***	0.0549*	2.380	2.688*
	(0.0291)	(1.361)	(1.109)	(0.0322)	(1.452)	(1.444)
Municipality fixed effects	No	No	Yes	No	No	Yes
Time fixed effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	10848	10848	21696	1207	1207	2414
(Pseudo) R-sq.	0.0490	0.109	0.618	0.0450	0.109	0.669
Log-likelihood	-150.8			-150.1		

Notes - The table reports regression results of electoral outcomes weighted by the reciprocal of normalized propensity scores. Columns 1-3 are based on kernel matching with bandwith 0.01 and columns 4-6 on nearest-neighbor matching with 10 neighbors. Columns 1 and 4 report marginal effects computed at the mean from probit regression results of incumbent mayor reelection probability. Columns 2 and 5 report OLS regression results of incumbent mayor vote share, and columns 3 and 6 report results using a difference-in-difference strategy. *Earthquake* is a dummy variable equal to 1 if a municipality was struck by an earthquake since the previous electoral period. In columns 5 and 6, *Earthquake* × *Post* is a dummy variable equal to 1 for struck municipalities in the electoral period after earthquake occurrence. All models control for political variables (election year and electoral system), characteristic of the incumbent (education years, age and gender) and geo-institutional characteristics (seismic zones, mountain or coastal jurisdiction, and geographic location). Columns 3 and 6 further control for municipality and time fixed effects (post-earthquake electoral cycle). Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors clustered by municipality are in parentheses.

Table A.4: Placebo tests.

	(1)	(2)	(3)	(4)	(5)	(6)
	Unaffected election periods			Intensity = 5		
Dependent variable	Reelection	Vote share	Vote share (DD)	Reelection	Vote share	Vote share (DD)
Placebo earthquake (× Post)	-0.000243	0.156	-0.216	0.00441	0.187	-0.404
	(0.0293)	(1.208)	(1.198)	(0.0208)	(0.780)	(0.685)
Municipality fixed effects	No	No	No	No	No	Yes
Time fixed effects	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	10939	10939	21878	11381	11381	22762
(Pseudo) R-sq.	0.0508	0.101	0.504	0.0516	0.108	0.635
Log-likelihood	-207.5			-423.0		

Notes - The table reports regression results of electoral outcomes weighted by the reciprocal of normalized propensity scores using placebo earthquakes to assign treatment. In columns 1-3, the placebo is assigned to struck by earthquakes in electoral periods when no earthquake occurs (before and after the occurrence of the shock). In columns 4-6, the placebo is assigned to municipalities struck by weak earthquakes (intensity equal to 5). Columns 1 and 4 report marginal effects computed at the mean from probit regression results of incumbent mayor reelection probability. Columns 2 and 5 report OLS regression results of incumbent mayor vote share, and columns 3 and 6 report results using a difference-in-difference strategy. *Placebo earthquake* is a dummy variable equal to 1 for municipalities to which placebo treatments are assigned. In columns 3 and 6, *Placebo earthquake* × *Post* is a dummy variable equal to 1 for struck municipalities in the electoral period after earthquake occurrence. All models control for political variables (election year and electoral system), characteristic of the incumbent (education years, age and gender) and geo-institutional characteristics (seismic zones, mountain or coastal jurisdiction, and geographic location). Columns 3 and 6 further control for municipality and time fixed effects (post-earthquake electoral cycle). Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors clustered by municipality are in parentheses.