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Abstract

This paper investigates the 2011 Italian referendum on nuclear power as a clean laboratory for recovering information on the spatial pattern of votes about the construction (or restoration) of nuclear facilities. Our results show that voting preferences on building nuclear facilities are sensible to proximity determined by a strong local component. Voters' opposition to nuclear installments tends to be even higher when the effect of both existing and proposed plants is taken into account. The study tracks the changes of risk perception and voting preferences finding a positive correlation between the distance-related perceived nuclear risk and the share of participation against nuclear power. The perceived risk and the consequent voting pattern are even higher in communities close to proposed nuclear plants compared to the existing ones. This holds even after taking into account local, regional and political features and several municipality characteristics which may influence preferences over nuclear power.

KEYWORDS: proximity, nuclear risk, referendum, multiple facilities
JEL Codes: D72, H41, Q48

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1. Introduction

On November 1987, Italy held its first national referendum to decide whether to shut down its nuclear power plants. Italian voters approved a proposal which would have been forced closure of the four nuclear power plants erected in Caorso, Trino Vercellese, Latina and Garigliano. Two decades later, in 2008, Italian government announced its intentions to reactivate the four dormant reactors and to raise other ten by 2013 to reduce its dependence on imported energy. Soon after, a second referendum (held on the 12-13 June 2011) has swept away this possibility confirming an indefinite ban on the nuclear energy option. This last initiative was in large part a consequence of intense public outcry concerning the future of nuclear electrical generations in Italy[4].

The revealed preferences approach may in principle provide information on expected benefits or costs in the same way as proposed in the traditional market setting for consumption (Deacon and Shapiro, 1975; Rushton, 2005). Outcomes originated by referenda have proven to be informative about economic behavior, in particular responses of the ballot generally reflect a process of individuals' welfare maximization in the comparison between expected benefits and carried costs of the proposal (Casella and Gelman, 2008; Kent *et al.*, 2010).

The aim of this paper is to investigate the electoral voting process manifested on the 2011 Italian nuclear referendum. Voting models tend to presume that each community is rather narrowly self-interested regardless of the collective benefit that building new facilities can determine at the national level. In the special case of nuclear issue, an additional determinant of voting outcomes concerns the opposition to facilities perceived as risky. Research on nuclear attitudes focused on proximity as the leading cause of resistance to hazardous facilities (among others Stoffle *et al.*, 1991; Pancs and Vriend, 2007). The general message is that communities in close proximity are brought together in the opposition of new plants although they put aside their differences in beliefs and values in voting choice.

To extend this analysis, we therefore introduce a new measure of distance that takes into account both the existence of nuclear plants and the prospective construction of the new ones. It is defined as the difference between the minimum distance from all *existing* plants and the minimum distance from all *proposed* ones. It captures how much the perceived nuclear risk influences municipality's choice if the referendum would not have success. Intuitively, it allows to recognize potential variations in risk related to different impact of distances between existing and proposed facilities. This indirectly implies that votes for and against the proposal may be affected by different risk perceptions of them. In particular evidence about proximity impact of both existing and proposed plants is highly robust although according to literature on risk communication (Levinson, 1999), perceived risk tends to be lower in communities close to existing nuclear plants, thus expecting reduced protests (in terms of votes) compared to communities close to proposed nuclear plants.

Moreover the existing literature is quite supportive of the notion that perceived changes in own personal and social values hold a great deal of voting behavior. Several factors may influence voters' choice providing information on the pros and cons for each community. Beyond proximity to nuclear facilities, we test several hypotheses regarding the sources of voting at municipality level, such as demographics, political leaning and other community attributes. In particular we model the

[4]The fear of a nuclear disaster appeared to be the public's natural feeling especially in the aftermath of the grievous occurrence in Fukushima, Japan, in March 2011.

municipality voting decision to depend on population characteristics like representativeness of employment categories, unemployment rate, education, share of foreigners, homeowners and elderly population among others. As we are going to see, the debate over nuclear power led by the political parties was one of the key issues that shaped the results of the referendum. This insight (as results suggest) involves political ideology and partisanship as possible contributors in favor (or against) the construction of the facility.

According to the homevoter hypothesis, further, owners are more likely to vote in favor of certain facilities perceived to increase residential property value. In case of referendum on stadium subsidies Carlino and Coulson (2004) discover that the presence of a new stadium increases social benefits for a community. Hosting a professional sport franchise has a positive impact into property values (and this effect is even stronger in proximity to the facility) sufficient to justify subsidies with a rise in higher local taxation. Dehring *et al.* (2008) demonstrate that the effect of public announcements for the subsidization of the Dallas Stadium implies a reduction in the property values close to the stadium while increasing those that were far away. The authors motivate this result in the form of positive externalities (e.g., potential benefits due to new parking and concession) of having the stadium for those living further away and negative externalities (greater congestion and noise) of living close. Precincts with positive variations in price signals were thus more likely to vote for the initiative than if they lived close to the stadium. Analyzing data for 46 states, Hilber and Mayer (2009) establish that school district spending is higher in less developed area. They argue that an increase in the quality of education within districts with lower economic opportunity is directly capitalized in household prices to a greater extent than in area with higher potential development. Brunner *et al.* (2001) and Brunner and Sonstelie (2003) investigate voting behavior on school voucher observing that a support for school choice initiative is lower in area with good (public) school while is higher in precincts with poor ones. The motivation (even in this case) was guided by the perceptions that a higher subsidy for the voucher would have reduced the willingness to pay for household thus harming the property value of homeowners close to good public school. Furthermore, proximity to facility has been an issue on the appropriate extent and definition in cost-benefit analysis. Close in spirit to our paper is the idea proposed by Coates and Humphreys (2006) who explicitly take into account the role of proximity and its effect on support for a stadium proposal. In their case proximity have a positive influence on public attitudes although as expected stronger support is related by precincts near to a proposed site than from those close to the existing one.

The general concern for nuclear power, however, involves particular considerations that should be taken into account. Much of the controversy appears to have been firmly grounded in the perceptions of health and safety risks to those proximate to the nuclear facility. In this case community preferences are definitively expressed with higher opposition by local residents closest to potentially hazardous sites. Moreover several studies have investigated the net effect of proximity to a nuclear power plants and a large part tends to interpret perceived risk as the most prominent factor in driving NIMBY (Not In My BackYard) sentiments. NIMBY concerns are generally understood to reflect resistance to potentially hazardous facilities by local communities. Proximity to facilities that are perceived to pose risk to local residents has been shown to generate opposition to such facilities (Benford *et al.*, 1993). Frey and Oberholzer-Gee (1997) measure the detrimental effects of using price incentives in real-life issues (like the siting of locally unwanted projects) where individual's sense of civic duty assumes heavily a crucial role. They conjecture on a democratic political process among individuals able to solve the NIMBY conflict under the achievement of a well-defined political equilibrium. Schively (2007) and Rabe *et al.* (2008) discover that the perceptions of the affected residents concerning the risks posed by the site, trust for the groups involved, and acceptance of the process of site selection are some of the most important factors related to the NIMBY overreaction.

From the standpoint of social theories in this field (see e.g., Wolsink, 1994; Fischer, 1995), people's appreciation for the advantages derived from nuclear facilities (when they exist) is confirmed as long as it is not located near their place of residence. Kuhn (1998) for instance verifies a positive relationship between facility acceptability, risk perception, and distance from the place of residence among the supporters of a nuclear-fuel waste disposal plant in Canada. Lober and Green (1994) and Lober (1995) measure the aversion towards siting waste disposal plants. They discover that proximity to a proposed facility will affect support or opposition to it depending upon the type of facilities at issue and the perceived benefits and costs associated with them. Even in case different from nuclear power, the results are seemingly related. For instance Hampton (1996) measures the local resistance to the construction of a series of munitions' depots (as high risk facilities) in Australia. He shows that, contrary to what expected, residents living in close proximity did not perceive higher risk of damage compared to the residents of other areas. In the case of waste incineration, Hunter and Leyden (1995) observe that NIMBY attitude is more related to anxiety for generic health consequences rather than to property values. Shen and Yu (1997) and Feinerman *et al.* (2004) realize that motivation of public opposition may reflect a rational response by the communities who perceive an imbalance between the benefits they will receive from hosting a plant (e.g., new recruitments and tax concession) and the costs they will bear such as lower property values and potential health and environmental risks or undefined moral values[5]. Frey *et al.* (1996) observe that an adequate balance of costs and benefits characterized by cycles of monetary compensation to be received by the communities can lead to a political process in order to win the support of host communities. As suggested by Hermansson (2007) when faced with an increase in risky prospects, the evaluation of the decision process and its related *perception* costs is contingent upon an actual harmful occurrence at later date and is not simply amenable to insurance schemes.

The analysis in this paper sheds light on an interesting area of the local opposition relevant to measuring risk perception impact and idiosyncratic aversion on nuclear plants characterized by the strong negative correlation between share of voters (against the adoption of nuclear power) and the distance of municipalities. Specifically in our analysis a 'localized' effect is in place such that the construction of new facilities poses the nearby residents at largest risk, resulting in greater concern and opposition by those residents. Thus communities close to the plant reject even more the nuclear option because their expectations of localized losses outweigh the social prospects. The remarkable implication here is that this effect applies directly to proximity translating in an increase of the ballot at the referendum.

Section 2 describes the institutional background on which the referendum took place. Section 3 conceptualizes the measures of proximity applied in this context. Section 4 presents the data and section 5 collects the results. Conclusion follows in section 6.

[5] They conjecture on a democratic political process among individuals able to solve the NIMBY conflict under the achievement of a well-defined political equilibrium.

2. Institutional background

Before turning to the empirical analysis about determinants of voting in the referendum, it is necessary to put it into normative perspective and to recall the context in which it was held in Italy.

The so-called popular referendum (which is observed here) is one of the two forms of legally binding democratic devices provided for by the Italian Constitution (art. 75) to involve people' choice into the public decision process. The alternative mechanism, i.e. the *constitutional referendum* (art. 138), can be only called in order to decide on whether to approve a constitutional law or amendment passed through both legislative Houses of the Italian Parliament with a majority of *less* than two thirds in both or either Chamber. It can be called only at the request of one fifth of the members of either House, or five regional councils, or 500,000 electors.

The popular referendum can be proclaimed at the request of five regional councils or the collection of 500,000 signatures of eligible voters signing a public validated petition and only in order to decide on whether to repeal an existing law. The law-repealing referendum requires a minimum threshold (quorum) of more than half the electorate to vote to be binding, see Herrera and Mattozzi (2010) for the impact of a participation quorum in the turnout rate.

For what involves our analysis, balloting ended in a two-day referendum (on the 12-13 June 2011) in which almost 95% of Italian voters have rejected a law passed by government that aimed to restart Italy's nuclear energy plan stalled for more than 20 years. Note that, despite the striking result occurred among the voters, the strategy of those backing the implementation of nuclear power was to not show up at the ballot, so to miss the 50%+1 quorum needed for the referendum to be valid. It turned out that the referendum was valid, with a turnout of more than 56%. Historically, Italy's nuclear industry was dismantled after votes in the referendum proposed in 1987. Plants that have been shut off at that date (but were still dormant in 2011, such that the political decision would have refurbished them), were Caorso, Trino Vercellese, Latina and Garigliano. The 1987 referenda votes against nuclear power also came in the aftermath of the Chernobyl nuclear accident in Ukraine in 1986.

Afterwards a change in government policy in 2008 marked the beginning of plans for a program of nuclear construction to reduce the country's dependence on oil, gas and imported power. Note that restarting nuclear plants was one of the promises of Centre-Right government when it was elected in 2008. Thus legislation was passed in the same year to guarantee the construction of nuclear power plants while economic agreements have been signed with energy companies to build at least four new nuclear plants beginning in 2013. The list of the new proposed locations incuded: Chioggia, Monfalcone, San Benedetto del Tronto, Mola di Bari, Scanzano Jonico, Palma di Montichiaro, Oristano, Borgo Sabotino, Termoli and Scarlino.

The diffusion and circulation of the prospective nuclear sites comes from a circumstantial report brought out by the Italian Federation of the Greens during the months prior to the referendum. In few months fears about nuclear power have increased in the run-up to the referendum on June following the accident at the Fukushima nuclear plant, caused by a tsunami the 11th of March 2011. In the wake of the Japanese disaster, it was not, therefore, startling that Italian citizens voted to throw the proposal out. Moreover at the time of referendum, the Japanese catastrophe has already forced German government into a U-turn on nuclear power. In particular, Germany' choice to abandon nuclear energy over the next 11 years possibly might have influenced a profound impact on public opinion in Italy.

Thus, what was surprising for us was not simply the size of the majority (95%) or the relatively high turnout of more than 56%, one of the highest in any Italian referendum for over a decade, but rather the rise in the share of yes-voters in proximity to potential nuclear plants. On one side, referendum 'proponents' referred in the popular media and electoral drive to widespread general support about the proposal along all Italian regions (independently by the distance from nuclear reactors) due to the necessity to form the quorum. On the other side, Government instead of fighting for the legislation on its merits, have tried to deter voters from participating plus an attempt to block the vote failed in the courts a few days before polling.

It is worth noting that due to the incentives relied on nuclear power and its potential NIMBY impact on the distance of residents' dwellings from the proposed sites, the same voters also rejected other, very different laws in three further referenda. Two of them dealt with water privatization. A third concerned a law allowing Prime Minister and his cabinet to avoid court appearances (immunity from trial) by citing government business as a reason.

To the best of our knowledge this seems to be one of the few investigations on *referenda* case study at national level. We feel quite safe in assuming that after controlling for municipality attitudes, the only variable at play is proximity, since no structured and detailed compensation plans have been associated to the decision of building new nuclear plants. We test this by means of a *Difference In Difference* framework applied to transfers at municipality level (see Appendix A for the exercise).

3. Municipal-level distances

According to a cost-benefit analysis the spatial distribution of votes should reflect the spatial distribution of net costs that voters perceive from building or restoring plants at various distances from where they live. Nuclear energy could be interpreted as a nationwide good so the advantages exploited by consumers are independent of their distance from the facility, especially in Italy where the market for electricity allows for a unit cost that is virtually homogeneous within the Italian territory. However, two effects related to distance come in place. First, municipalities at all locations will be equally likely to vote in favor of abandoning the nuclear hypothesis but this effect is even higher since the perceived costs (in terms of risk) diminishes far away from the plant, thus those living near a facility will be more inclined to be against the nuclear proposal (i.e., voting yes at the referendum) than those living far away. Second, analogous reasoning can be applied to the spatial pattern of voting on a referendum by taking into account the different impacts (if there are) that existing and proposed plants may determine in voting preferences. Interpreting nuclear option as a public opportunity (ceteris paribus), municipalities living near existing plants and municipalities living near proposed ones will be equally likely to vote against the nuclear option. This is true because the presence of facility would confer identical disadvantages on all them. However municipalities living near proposed facilities will be more likely to vote against the proposal than those living near existing facilities. There are two reasons for this: first, voters near proposed facility are likely to have a high marginal disutility for the installation of new plant and second, (at least in the nuclear context we investigate) risk perception of the new proposed facilities seems to be an important factor in voters' dislike while this effect is attenuated in case of existing facilities.

Thus our main explanatory variable tries to capture some specific characteristics of the policy whose potential implementation would have been decided with the referendum. In particular, there are two features that differ with respect to the usual case of the location of a new facility as it is the case in

Schulze and Ursprung (2000), van der Horst (2007), Rushton (2005). First, we analyze the location of multiple plants and second, some (all in our case) of the existing plants have been reconfirmed as proposed facilities. This means that the four working (but not producing) nuclear plant would have been put again in production in case of failure of the referendum.

We address the first issue by assuming that, if any, people's concern is only due to the *closest* nuclear plant, as a quick look at local newspapers shows. Moreover, we look at provinces that are in the vicinity of two (existing and proposed) nuclear facilities and construct for them the Google Index for the names of the municipalities in which the nuclear plants are (or would be).[6] Suggestive evidence reported in Table 1 points to a situation in which the closest nuclear plant attracts more attention on the internet. In particular, with respect to existing plants the internet traffic related to close nuclear plants was overall scarce, with Milan province showing a higher Google Index for the Caorso nuclear plant, only marginally closer than Trino. For proposed nuclear plants the pattern of internet search is very clear: overall higher traffic and a clear polarization of traffic toward the closest plant. Based on this consideration and the suggestive evidence reported, we construct two types of municipality-level distance. These Euclidean distances are *distold* and *distall*, which refer to the minimal distance from existing and all (existing and prospective) plants, respectively.

EXISTING PLANTS	Trino Vercellese		Caorso	
	weighted distance (capital distance)	Google Index (Novara=100)	weighted distance (capital distance)	Google Index (Parma=100)
Alessandria	45 (40)	0	100 (100)	0
Como	95 (93)	0	101 (102	0
Genova	104 (101)	0	102 (105)	0
Milan	80 (78)	5	73 (64)	11
Pavia	61 (69)	0	67 (58)	0
PROPOSED PLANTS	Chioggia		Monfalcone	
	Weighted Distance (Capital Distance)	Google Index (Venezia=100)	Weighted Distance (Capital Distance)	Google Index (Gorizia=100)
Pordenone	91 (87)	0	70 (70)	12
Treviso	63 (50)	54	103 (101)	1
Venezia	34 (24)	100	100 (101)	6

Table 1. Distance between provinces and nuclear plants and Google Index. Weighted Distance is the average distance from each municipality weighted by the size of electorate, while Capital Distance is that of the capital city of each province.

[6] The Google Index (available through the Google Insights service, http://www.google.com/insights/search/), computed for each keyword referred to nuclear site location, reports on a 0-100 scale how the specific internet search was relevant in every Italian province. The Google Index is calculated for the period September 2010 - June 2011.

For what involves the co-existence of existing and proposed nuclear plants, we claim that municipalities should not react in the same way. Indeed, the literature stresses that risk is perceived more if the "risky object" is still not in place, while once it is constructed risk perception decreases. For this reason people living close to existing nuclear plants should not suffer a large increase in their perceived risk. In particular, if a new nuclear plant had to be built farther from their "reference" nuclear plant (i.e. the closest existing one), communities should not be affected at all.

Figure 1 shows the concept with the help of a linear world in which there are two existing plants (O_1 and O_2) and the proposed policy is to build a new plant (N_1) and to keep old ones in operation. *A* and *B* are two municipalities, so *distold* (*distall*) is computed for each municipality as the minimal distance from the old (old and new) plants. Finally, we define our key variable, *distdif*, as the difference between *distold* and *distall*, which represents how much the nuclear risk approaches to each municipality after the policy is implemented. It is immediately clear that (i) for municipality *A* nothing changes, since its closest nuclear plant is still operative (O_1 was working before and after the policy), (ii) for municipality B (and in this linear case for any municipality to the right of N_1) *distdif* increases with the distance between the (closest) old and (closest) new plants, O_2 and N_1, respectively. Note that there is a large segment where *distdif* is equal to zero, in particular to the left of the midpoint between O_2 and N_1.

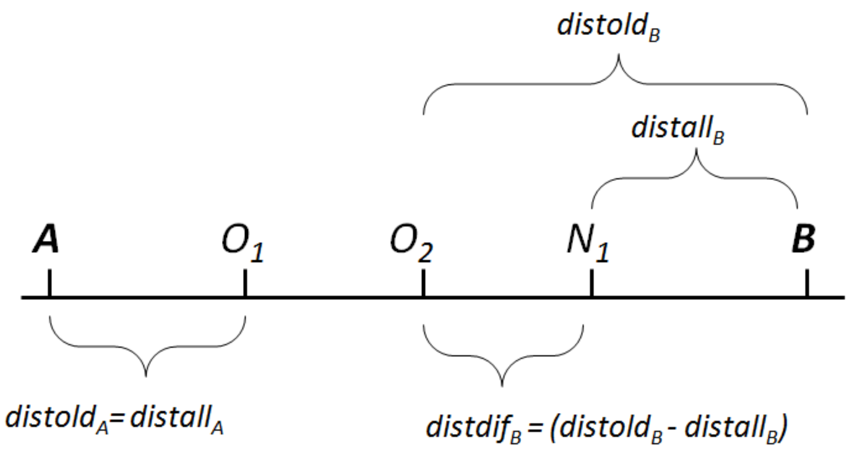

Figure 1. Representation of *distold*, *distall*, and *distdif* in a linear world. O_1 and O_2 are existing plants, N_1 is the new plant and A and B are two municipalities.

We relate this idea into the empirical analysis constructing $distold_i=min\{d_{ij}\}$;where *j={Caorso, Trino Vercellese, Latina, Garigliano}* and $distall_i=min\{d_{ik};distold_i\}$; while *k={Chioggia, Monfalcone, San Benedetto del Tronto, Mola di Bari, Scanzano Jonico, Palma di Montichiaro, Oristano, Borgo Sabotino, Scarlino, Termoli}* where elements d_{ij} (d_{ij}) are the Euclidean distances in thousand kilometers between municipality *i* and each old (new) plant *j* (*k*). Figure 2 reports a map of Italy with new and existing nuclear plants, together with the distribution of *difdist*, where lighter (darker) shades of grey represent small (large) values. For many municipalities (48% of the sample) *difdist* takes value zero, in particular this is the case in the Northwestern part of Italy where there are two existing nuclear plant (Trino Vercellese and Caorso) and no further nuclear plants are prospected, together with the area north of Naples and South of Rome. Note that on the contrary Sicily and Sardinia experience large values of *difdist* because they do not host any nuclear plant while it was expected to realize one in each region if the referendum would have been unsuccessful.

Figure 2. Location of existing (squares) and proposed (circles) nuclear plants.
Darker areas represent higher values of *distdif*

4. Data and related variables

We use municipality-level data about the referendum held on 12-13 June 2011 obtained from the Department of Internal Affairs. This information specifically include the size of the electorate (*ELEC*), the number of people that went to vote (*VOTE*) and the number of casted yes (*YES*) which indicates the option against nuclear power. With these variables we construct the turnout (*turn=VOTE/ELEC*), the share of yes among voters (*yesv=YES/VOTE*) and the share of yes among the electorate (*yese=YES/ELEC=turn*yesv*).

Given the institutional features sketched in the relative section, we take *yese* as our main variable of interest. It is highly correlated with *turn*, while *yesv* should be uninformative about the real preferences of population with respect to the issue at stake in the referendum. Descriptive statistics for these three variables and the other variables used in the empirical analysis are collected in Table 2. As expected, the distribution of *yese* and *turn* are similar in terms of mean, standard deviation and extreme values, while *yesv* is particularly concentrated around its mean and left skewed. The correlation between *yese* and *turn* is 0.98, while *yesv* correlates only 0.36 and 0.15 with *yese* and *turn*, respectively, see Table 3.

Our main explanatory variable is *distdif*, extensively described above. Its distribution presents a mass in zero (48% of observations are zeroes), a mean of 73 kilometers and, given the large right skew, the median of *distdif* is less than 2 kilometers. Out of curiosity the municipality experiencing the largest approach of risk is Palma di Montechiaro (in Sicily), which before being selected as location of a new plant, had the closer existing nuclear plant at more than 450 kilometers.

The other measures are *distall* and *distold* (already described in the discussion on the construction of *distdif*). Then, *distnew defined as* the minimal distance from the eight prospective nuclear plants and *distfor* which refers to the minimal distance from three nuclear plants in France and Switzerland that are close to the northern Italian border. Mean *distall* is smaller than that of *distold*, deriving from a prospected denser presence of nuclear plants. The potential increase in nuclear plants density would lead to have respectively more than 450 (5%) or 1900 (23%) of the overall municipalities within a distance of 25 or 50 kilometers from the closest nuclear plant.

We introduce several variables that may have a role in explaining the municipality-level voting pattern and their description is in Table 2. Demographic variables, including elderly share, education attainment, homeownership rate and representativeness of ten working sectors among others, are obtained from 2001 census while (the log of) population in 2011 comes with referendum data. Data on electoral outcomes at 2008 political elections comes from Ministry of Interiors, while we constructed the Google Index at province level using "nucleare" as keyword and March-June 2011 as time-period. The expected and actual effects on referendum's outcomes of these variables will be analyzed, whenever meaningful, in the next section.

Among the many pairwise correlations presented in Table 3, note the positive (negative) one between *yese* and *distdif* (*distnew*), as suggestive of our expected macro pattern. The correlations of *turn* with the same two variables show the same sign because of the large correlation existing between *yese* and *turn*. Moreover *yese* and *turn* are not surprisingly highly (negatively) correlated with *polright*, the vote share that the two main center-right parties obtained at 2008 political election. The center-right coalition indeed won the elections in 2008 and pushed for the quorum of the 2011 referendum not to be reached.

5. Empirical evidence and comments

We set up a linear regression model in which the dependent variable is, in large part of the analysis, *yese* while the main explanatory variable is *distdif*. A series of other explanatory variables is also included, together with a full set of regional fixed effects. All specifications are fitted by Ordinary Least Square (OLS, hereafter), with standard errors robust to heteroscedasticity. Given the spatial nature of the data, one could think of adding some additional structure to the error term and/or to the dependent variable (i.e., a spatial lag model). The issue of spatial correlation of errors should be mitigated by the inclusion of a large set of controls and, if any, the estimated parameters should be a lower bound of the true ones. On the other hand, we would have problem of upward bias if we had to estimate by OLS a model with spatial lags in the dependent variable. Reassuringly, the dependent variable is not subject to diffusive effects since the voting period was only two days and local results were only knew after the ballots have been closed. Some remarks are worth presenting here, in particular the statistic absence of compensations for municipality in the vicinity of nuclear plants that would in principle offset the expected negative utility drop caused by proximity itself, see Appendix A for details. We claim also that distance-related risk perception that people "converted" in voting behavior in the referendum has been strongly shaped by the Fukushima nuclear disaster of March 2011, few months before the referendum in Italy. With this aim in mind, in Appendix B using comparable data from the 1987 Italian nuclear referendum, we show that the proximity to nuclear plants seems to be an issue only in 2011 referendum implying a distance-related gradient in voting pattern.

The first specification is simply *yese* against a constant and *distdif*, the results being reported in column 1 of Table 4. The coefficient on *distdif* implies that the share of yes-votes among the electors increases by 1% for every 100 km approaching the nuclear facilities. In column 2 when we include the full set of regional dummies (taking into account institutional and political characteristics such as the regional electoral cycle and the political orientation of regional administrations) the coefficient of *distdif* is more than double. Further we include all variables from the 2001 census and the log of resident population in 2011 (column 3). The point estimate of *distdif* reduces from the previous 0.22 to 0.18, with standard error 0.02, delivering a t-stat of 9.03 that confirms the strongly positive effect of the distance variable on voting behavior. In this case, 1% increase in votes against nuclear power (i.e. yes-votes) is achieved every 60 kilometers approaching the closest nuclear plant. The share of elderly people has instead a negative coefficient, possibly reflecting a shorter time horizon of older cohorts and therefore their underestimation of long-run utility loss that the vicinity of a nuclear plant could imply through lower property value or health issues. Higher shares of commuters lead to higher yes votes and this seems to be a signal of higher environmental concerns in municipalities with higher income and wealth. This consideration could also be valid for the negative coefficient of unemployment. In terms of sectorial distribution of the working population, we spot that the presence of highly unionized sectors (public administration, manufacturing and education) is associated with higher percentage of yes-votes. Unions in Italy are by far closer to center-left positions, so at that time unions and center-left parties where at the opposition and a yes-vote was motivated (at least in part) by political reasons against the central government that sponsored the new nuclear policy.

Further we expected positive coefficients for agriculture and hotel and restaurants but these variables turn out to be not significant. The positive coefficient on the share of healthy workers may possibly reflect the higher health-related concern these people have in living close to nuclear facilities. Finally, the positive coefficient on the share of workers in the energy sector could reflect either aversion to nuclear power stemming from competition between alternative ways of producing energy (i.e. gas or coal power plants could be shut off if new nuclear plants had to be constructed) or higher aware to health risk associated with nuclear energy.

In the specification whose results are reported in column 4 we enclose two variables relative to political elections in 2008, *polturn* and *polright*. We consider the former as a measure of civic awareness (the aversion to nuclear power being part of this perception), close in spirit to the use of referenda turnout in social capital measurement, but more detailed since social capital indices are at provincial-level while *polturn* is at municipality-level. Its positive and highly significant coefficient confirms our expectations. *polright* is an indication of political leaning of the municipality toward right, so we expect it to be negatively correlated with *yese*. This is indeed the case while the coefficient is hugely significant, showing a t-stat above 56. Including these two variables, the adjusted R-squared increases by 0.23 (from 0.37 to 0.60) and some coefficients change their level of significance. For example homeownership, already positive, becomes strongly significant confirming the homevoter hypothesis that states that homeowners vote in favor of public projects they perceive increase residential property values and against those that do not, as stressed by Dehring *et al.* (2008). Also, education becomes positive and significant, backing the hypothesis of higher environmental concerns among highly educated people. Population, previously positive and significant, now become insignificant and this can be explained by the negative correlation between center-right leaning and population. In column 5 we considers also the Google Index, intended to capture local awareness to nuclear power. The coefficient is positive and significant and, even if positively correlated as expected with *difdist*, the coefficient of *difdist* does not change much and remains strongly significant, as it is the case for all other significant coefficients.

Column 6, our preferred specification, further adds the minimal distance from foreign power plants. Its coefficient is negative and significant, pointing at an "irrational" aversion to nuclear facilities being out of control by the Italian central government. The inclusion of *distfor*, positively correlated with *distdif* (since many municipalities with *distdif* equal to zero are those in the vicinity of French and Swiss power plant) makes the coefficient on *distdif* to increase until 0.12 (with robust standard error equal to 0.02). This implies that a 1% increase in votes against nuclear power is achieved every 85 kilometers of approaching the closest nuclear plant. In columns 7 and 8 we show that using as dependent variable the turnout rate *turn* results are basically unchanged, while results for the share of yes among the voters, *yesv*, are very much driven by political ideology (*polright* is negative and significant) and not nuclear risk, since *distdif* is not significant.

In order to spot possibly novel patterns in voting behavior, we now observe what happens in the vicinity of old and prospective nuclear plants separately. As suggested by the literature of risk perception when the experience of risk has, or has not, already taken place, the voting pattern could be in principle different (Cremer *et al.*, 1997). In Column 1 of Table 5 our variable of interest is a dummy flagging those municipalities within a radius of 10 kilometers and the null coefficient suggests that a differential voting pattern around existing nuclear plants cannot be spot. This could be however a mere small sample issue, since only 35 municipalities satisfy the criterion. Augmenting the radius to 30 kilometers (Column 2) the number of municipalities becomes 352 and the coefficient on this variable is surprisingly negative and significant, in line with van der Horst (2007) that stresses how new and unfamiliar facilities attract more opposition and that experiencing facilities lowers the perceived risk associated with the facilities themselves. In line with this reasoning, we find that when we look at municipalities in the vicinity of prospective nuclear plants (10 and 30 kilometers, results in Columns 3 and 4, respectively) results revert, i.e., people are more like to vote against nuclear power (between 1% and 3.5%), precisely because of inexperienced risk. Columns 5 and 6 replicate without discriminating between old and new and results are a combination of the previous two cases.

We support the analysis above by evaluating the "perspective vs existing" voting premium looking at the voting outcome, netting out the effect of distance. To do so we split the sample according to 10 kilometers intervals of distance at which each municipality is from the closest nuclear plant and set a dummy equal to one (zero) when the closest nuclear plant is a prospective (existing) one. We then run a regression for each subsample (i.e. municipalities between 0 and 10 kilometers, 10 and 20 kilometers and so on, from the closest nuclear plant) where the dependent variable is *yese*, control variables are those of Column 6 in Table 4, excluding regional dummies and *distdif*, while the key explanatory variable is the dummy equal to one if the closest municipality is a perspective plant. In Figure 3 we report the values that the coefficient of the dummy takes for each regression, together with the 95% confidence band. Results are consistent with the findings illustrated above and with literature on risk perception reported: Municipalities whose closer nuclear plant is a prospective one, irrespectively of the distance and controlling for other observables, vote more against nuclear power, and the difference is significant in all those municipalities within a 100 kilometers radius from the closest plant.

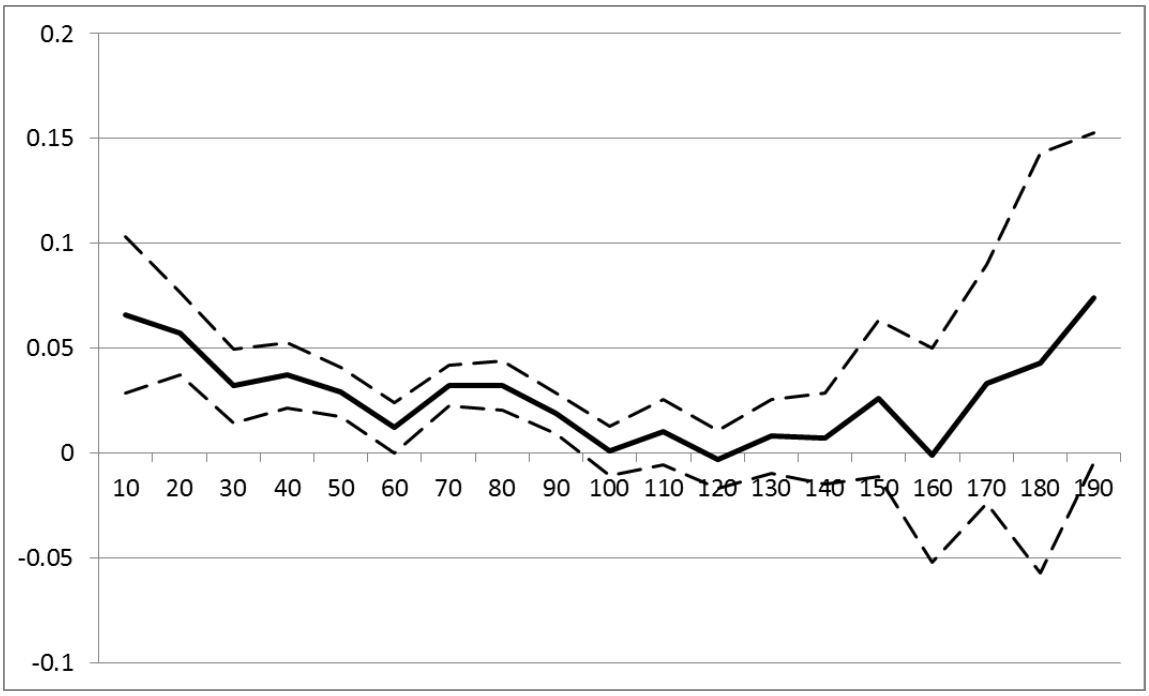

Figure 3. Point estimates and 95% confidence intervals of coefficients of the dummy for prospective vs existing plant of different distance bins.

We have shown that voting behavior in the surroundings of new or prospective nuclear sites is different, so in the next series of regressions we keep the sample as homogeneous as possible in terms of risk feeling. Regressions are performed restricting the sample to those municipalities that would have experienced an increase in nuclear risk if the referendum succeed, i.e., those for which *distdif* is positive. The specification reported in Column 1 of Table 6 mimics our baseline specification (i.e. Column 6 of Table 4) on the restricted sample and the coefficient of *distdif* does not change significantly. This result backs indirectly our hypothesis that voting pattern in municipalities (in case in which *distdif* is equal to zero) should not be affected by the proposed policy. Being *distdif* positive, we can take its log and evaluate whether the effect of *distdif* is decreasing in *distdif* itself. As reported in Column 2, the coefficient is less precisely estimated (5% level, with the linear specification it was 1%), while if we take the exponential of *distdif*, the coefficient is positive and more precisely estimated suggesting an increasing effect of *distdif* in *distdif* itself. An explanation for this result is that not only risk is increasing with the approaching of nuclear plants, but indirectly even the awareness and the experience of the risk itself increase. Thus, kindly interpreted, general risk perception, for any given level of risk, is increasing with *distdif*. Column 4 treats this issue using dummies that flag medium (100< *distdif* <300) and large (*distdif* >300) approaches of nuclear plants. The coefficients of both dummies are positive and significant, where in particular the latter is three times larger than the former. We then look at the raw distance from the prospective nuclear plants again in the subsample of municipalities where *distdif* is positive. As expected the coefficient on distance (Column 5) is negative but weakly significant, while taking the log of distance (Column 6) the coefficient is more precisely estimated suggesting a decreasing marginal disutility from living close to nuclear facilities. It is worth stressing here some differences in the estimated coefficients of the other variables stemming from the exclusion of municipalities for which *distdif* is equal to zero. The coefficient of *owners* is no more significant indicating a sort of short sightedness of homeowners, since it turns out that they only react to the presence of existing plants. On the contrary, maybe constructors and real estate people are more farsighted and they perceive a potential decrease in buildings' value, their coefficients (*constr* and *real*, respectively) being now positive and significant.

In the next set of regressions, we restrict the analysis to Sicilia and Sardinia (the two largest Italian islands) where in each of the two the proposed policy would have located a new nuclear plant. Since the two islands are not currently hosting any nuclear facility, this analysis turns out to be more easily comparable with other studies regarding the location of hazardous facilities, as for example (Groothuis and Miller, 1997). The natural explanatory variable in the regressions for Sicily (Sardinia) is the distance from the location of the prospective nuclear plant of Palma di Montechiaro (Oristano) coinciding with *distnew*. Results with the linear specification (Columns 1 and 4 of Table 7) deliver negative and strongly significant coefficients (with that of Sardinia twice as that of Sicily). With respect to the specification in Column 5 of Table 6, the more comparable specification with a larger sample, the coefficients of *distnew* are five and ten times larger for Sicilia and Sardinia, respectively. This suggests a higher distance-related risk perception in both regions. Results using the log of *distnew* (collected in Columns 2 and 5) are in line with those in the linear case. In Columns 3 and 6 we introduce dummies for different distance bins (*distnew* below 10 kilometers, between 10 and 20, between 20 and 30 and between 30 and 50) to evaluate more precisely the spatial pattern of voting behavior in the surroundings of prospective nuclear plants. For Sicily we get a pattern in which it seems that only municipalities in the close vicinity (<10 km) of the prospected nuclear plant voted significantly above the average (3.7% more, in particular), while for Sardinia the spatial pattern is clearer, i.e., it is consistent with diminishing rates between yes-votes and the distance from Oristano. The spatial patters of vote for Sicily and Sardinia are plotted in Figure 3. With respect to Sicily among the other variables used in the regressions only few ones remain significant. In particular construction is positive and strongly significant as in the case of the restriction to positive *distdif* above, together with the variables related to unionization: *edu*, *manuf* and *public* are positive and significant. As in all other specifications, the variables from political elections in 2008 are very significant, while surprisingly *google* has a negative coefficient. For Sardinia, only the variables from political elections in 2008 are significant, together with *google* that turns positive as in the large majority of previous specifications.

6. Concluding Remarks

We empirically analyzed the determinants of yes-votes cast in a referendum on the building and restoration of nuclear facilities in Italy. Several investigation patterns could be profiled. In particular we model the municipality voting decision in such a way that the correlation between yes votes and proximity to the proposed or existing plants can be interpreted as evidence on risk perception. A measure of distance was introduced allowing us to address the question of whether or not risk preferences might be reversed in different impact of distances between old and new facilities. In this case votes for and against the proposal might be even a function determined by different risk perceptions of existing or proposed plants. We further recognize the possibility that opposition at the referendum might be related to factors like demographics, political leaning and other community attributes as representativeness of employment categories, unemployment rate, education, share of foreigners, homeowners and elderly population. Due to the nature of data and to the absence of a well-defined compensation policy for the municipalities close to the potential nuclear plants (Coates *et al.*, 2006), we claim that our estimates do not suffer from severe biases. We find that a 1% increase in votes against nuclear power is achieved every 85 kilometers of approaching the closest nuclear plant. Political alignment of municipal and regional institutions plays a role in determining turnout, but still distance significantly matters even controlling for municipality attributes. Results are robust to the inclusion of regional fixed effects, as well as different specifications of distance.

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Variable	Description	Obs	Mean	Std. Dev.	Min	Max
yese	Share of yes among electors	8068	0.534	0.075	0.191	0.857
turn	Turnout	8068	0.567	0.074	0.209	0.871
yesv	Share of yes among voters	8068	0.941	0.030	0.524	1.000
distdif	Difference between old and new minimal distances	8092	0.073	0.104	0.000	0.451
distall	Distance from the closer nuclear plant among all the plants	8092	0.081	0.040	0.000	0.237
distold	Distance from the closer existing plant	8092	0.154	0.113	0.002	0.649
distnew	Distance from the closer prospective plant	8092	0.159	0.098	0.000	0.419
distfor	Distance from the closer foreign plant	8092	0.482	0.285	0.110	1.132
over65	Share of elderly people (+65 years)	8101	0.213	0.065	0.057	0.643
secondary	Share of people with at least high-school	8101	0.273	0.064	0.053	0.721
commuters	Share of people commuting to another municipality for work	8101	0.543	0.176	0.000	1.000
owners	Share of people owning the house where they reside	8101	0.773	0.072	0.293	1.000
foreign	Share of foreign population	8101	0.049	0.037	0.000	0.271
unemp	Unemployment rate	8101	0.101	0.088	0.000	0.513
logpop	Log of population in 2011	8068	7.851	1.338	3.526	14.831
agri	Share of workforce in agriculture	8101	0.099	0.091	0.000	0.683
public	Share of workforce in public administration	8101	0.076	0.050	0.000	0.555
constr	Share of workforce in construction	8101	0.105	0.045	0.000	0.506
manuf	Share of workforce in manufacturing	8101	0.255	0.128	0.000	0.738
hotel	Share of workforce in hotels and restaurants	8101	0.051	0.040	0.000	0.600
comm	Share of workforce in commerce	8101	0.129	0.035	0.000	0.340
health	Share of workforce in health	8101	0.061	0.027	0.000	0.596
real	Share of workforce in real estate	8101	0.044	0.020	0.000	0.193
edu	Share of workforce in education (schools and universities)	8101	0.061	0.033	0.000	0.313
energy	Share of workforce in energy	8101	0.008	0.010	0.000	0.215
polturn	Turnout at 2008 political elections	7903	0.812	0.063	0.178	0.980
polright	Vote share of the two main center-right parties at 2008 elections	7904	0.485	0.129	0.012	0.870
google	Google Index for "nucleare" search, mar-jun 2011 (province level)	8092	0.245	0.188	0.000	1.000

Table 2. Descriptive statistics.

	yese	*turn*	*yesv*	*distdif*	*distall*	*distold*	*distnew*	*distfor*	*over65*	*secondary*	*commuters*	*owners*	*foreign*	*unemp*	*logpop*	*agri*	*public*	*constr*	*manuf*	*hotel*	*comm*	*health*	*real*	*edu*	*energy*	*polturn*	*polright*
turn	.98																										
yesv	.36	.15																									
distdif	.12	.02	.49																								
distall	.02	-.03	.21	.07																							
distold	.12	.01	.52	.93	.43																						
distnew	-.14	-.04	-.46	-.53	.09	-.45																					
distfor	-.05	-.20	.63	.60	.24	.63	-.61																				
over65	-.01	.00	-.06	-.09	-.06	-.10	.09	-.05																			
secondary	.15	.17	-.06	-.13	-.03	-.13	.02	-.07	-.21																		
commuters	.09	.18	-.39	-.38	-.18	-.41	.39	-.52	.08	.01																	
owners	.09	.09	.03	.18	-.01	.16	-.19	-.02	.31	-.28	.19																
foreign	.00	.08	-.36	-.31	-.11	-.32	.10	-.43	-.06	.17	.11	-.20															
unemp	-.13	-.26	.55	.51	.15	.52	-.35	.77	-.12	-.15	-.41	-.12	-.49														
logpop	.07	.04	.20	.17	-.03	.14	-.26	.21	-.55	.38	-.50	-.40	.13	.16													
agri	-.12	-.18	.23	.21	.10	.23	-.09	.32	.29	-.42	-.24	.16	-.18	.24	-.29												
public	.06	-.04	.47	.41	.15	.42	-.37	.60	.17	.01	-.26	.05	-.41	.62	-.05	.11											
constr	-.18	-.18	-.06	-.02	.13	.03	-.02	.01	.03	-.34	.04	.22	-.13	.07	-.25	-.04	.01										
manuf	.06	.16	-.42	-.33	-.27	-.39	.20	-.49	-.18	-.02	.34	-.04	.40	-.55	.08	-.43	-.63	-.21									
hotel	-.03	-.03	-.01	-.03	.23	.06	.00	-.10	.07	.03	-.08	.03	-.03	-.06	-.15	-.12	.03	.13	-.29								
comm	.02	.03	-.02	-.01	-.05	-.03	.05	-.06	-.21	.35	-.02	-.23	.06	.01	.37	-.33	-.05	-.17	-.15	.07							
health	.09	.08	.07	.00	.05	.02	.03	.01	.00	.31	.02	-.10	-.07	.06	.13	-.20	.12	-.09	-.20	-.08	.09						
real	.07	.12	-.17	-.21	-.09	-.22	.23	-.25	-.17	.60	.15	-.20	.13	-.18	.30	-.40	-.13	-.22	.02	.00	.35	.18					
edu	.07	-.02	.46	.36	.20	.40	-.27	.59	-.08	.26	-.35	-.10	-.34	.57	.22	.06	.50	-.08	-.48	-.10	-.01	.22	.01				
energy	.08	.09	.01	-.01	-.01	-.01	.04	-.03	.08	.05	.01	.04	-.09	.02	-.06	-.07	.11	.04	-.14	.04	-.02	.06	-.01	.02			
polturn	.17	.26	-.38	-.39	-.11	-.39	.11	-.41	-.26	.20	.27	-.09	.39	-.51	.11	-.27	-.40	-.09	.42	-.05	.10	-.03	.17	-.30	-.04		
polright	-.61	-.52	-.53	-.24	-.14	-.26	.31	-.29	-.18	-.03	.18	-.10	.15	-.14	-.05	-.12	-.27	.14	.21	-.01	.08	-.08	.06	-.27	-.08	.17	
google	.12	.13	-.04	.06	-.11	.01	.02	-.22	-.02	-.05	.10	.08	.08	-.12	-.03	-.02	-.14	-.05	.10	.00	.04	.02	.02	-.14	-.06	.07	-.01
	yese	*turn*	*yesv*	*distdif*	*distall*	*distold*	*distnew*	*distfor*	*over65*	*secondary*	*commuters*	*owners*	*foreign*	*unemp*	*logpop*	*agri*	*public*	*constr*	*manuf*	*hotel*	*comm*	*health*	*real*	*edu*	*energy*	*polturn*	*polright*

Table 3. Pairwise correlations.

Dependent Variable	(1) *yese*	(2) *yese*	(3) *yese*	(4) *yese*	(5) *yese*	(6) *yese*	(7) *turn*	(8) *yesv*
distdif	0.096***	0.217***	0.184***	0.101***	0.095***	0.118***	0.121***	-0.000
	[0.008]	[0.021]	[0.020]	[0.016]	[0.016]	[0.018]	[0.018]	[0.005]
over65			-0.097***	-0.146***	-0.153***	-0.148***	-0.140***	-0.030***
			[0.019]	[0.017]	[0.017]	[0.017]	[0.018]	[0.007]
secondary			0.026	0.065***	0.067***	0.069***	0.090***	-0.025***
			[0.021]	[0.017]	[0.017]	[0.017]	[0.018]	[0.007]
commuters			0.087***	0.054***	0.053***	0.054***	0.052***	0.008***
			[0.008]	[0.006]	[0.006]	[0.006]	[0.006]	[0.002]
owners			0.022	0.034***	0.033***	0.035***	0.033***	0.011**
			[0.014]	[0.012]	[0.012]	[0.012]	[0.012]	[0.005]
foreigners			-0.162***	-0.064***	-0.067***	-0.064***	-0.061***	-0.016*
			[0.022]	[0.020]	[0.020]	[0.020]	[0.020]	[0.009]
unemp			-0.162***	-0.042**	-0.044**	-0.043**	-0.048**	0.009*
			[0.022]	[0.020]	[0.019]	[0.019]	[0.020]	[0.005]
logpop			0.005***	0.001	0.001	0.001	-0.001	0.003***
			[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.000]
agri			0.014	0.019	0.022	0.024	0.012	0.020**
			[0.031]	[0.024]	[0.024]	[0.023]	[0.024]	[0.010]
public			0.144***	0.112***	0.121***	0.120***	0.116***	0.014
			[0.043]	[0.035]	[0.035]	[0.035]	[0.035]	[0.014]
constr			-0.145***	0.019	0.026	0.026	0.029	-0.016
			[0.037]	[0.029]	[0.029]	[0.029]	[0.030]	[0.012]
manuf			0.099***	0.089***	0.090***	0.092***	0.091***	0.010
			[0.029]	[0.022]	[0.022]	[0.022]	[0.022]	[0.010]
hotel			-0.067	-0.002	0.002	0.002	-0.026	0.037***
			[0.041]	[0.032]	[0.032]	[0.032]	[0.032]	[0.013]
comm			-0.067	0.030	0.027	0.031	0.018	0.021
			[0.043]	[0.033]	[0.033]	[0.033]	[0.034]	[0.014]
health			0.158***	0.104***	0.098***	0.099***	0.078**	0.041***
			[0.041]	[0.033]	[0.033]	[0.032]	[0.033]	[0.014]
real			0.109*	0.066	0.066	0.057	0.064	-0.003
			[0.062]	[0.051]	[0.051]	[0.051]	[0.052]	[0.025]
edu			0.379***	0.184***	0.192***	0.190***	0.177***	0.028**
			[0.046]	[0.037]	[0.037]	[0.037]	[0.037]	[0.014]
energy			0.621***	0.310***	0.340***	0.332***	0.357***	0.010
			[0.095]	[0.074]	[0.074]	[0.074]	[0.080]	[0.032]
polturn				0.251***	0.243***	0.246***	0.269***	-0.020***
				[0.018]	[0.018]	[0.018]	[0.019]	[0.005]
polright				-0.375***	-0.377***	-0.378***	-0.357***	-0.070***
				[0.007]	[0.007]	[0.007]	[0.007]	[0.003]
google					0.026***	0.026***	0.028***	-0.000
					[0.004]	[0.004]	[0.004]	[0.001]
distfor						-0.041***	-0.049***	0.016***
						[0.014]	[0.014]	[0.005]
FE	NO	REG	REG	REG	REG	REG	REG	REG
Observations	8,068	8,068	7,791	7,754	7,754	7,754	7,754	7,754
Adjusted R-squared	0.018	0.248	0.398	0.599	0.602	0.602	0.589	0.637

Table 4. OLS results. Robust standard errors in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Dependent Variable	(1) *yese*	(2) *yese*	(3) *yese*	(4) *yese*	(5) *yese*	(6) *yese*
distold<10	0.005					
	[0.008]					
distold<30		-0.012***				
		[0.002]				
distnew<10			0.031***			
			[0.004]			
distnew<30				0.013***		
				[0.003]		
distall<10					0.019***	
					[0.005]	
distall<30						-0.001
						[0.002]
over65	-0.161***	-0.157***	-0.159***	-0.158***	-0.161***	-0.161***
	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]
secondary	0.063***	0.066***	0.064***	0.065***	0.063***	0.063***
	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]
commuters	0.053***	0.053***	0.052***	0.052***	0.052***	0.053***
	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
owners	0.042***	0.041***	0.042***	0.041***	0.042***	0.042***
	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]
foreigners	-0.065***	-0.065***	-0.064***	-0.063***	-0.064***	-0.065***
	[0.020]	[0.020]	[0.020]	[0.020]	[0.020]	[0.020]
unemp	-0.045**	-0.041**	-0.045**	-0.046**	-0.045**	-0.045**
	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]
logpop	0.001	0.001	0.001	0.001	0.001	0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
agri	0.025	0.027	0.026	0.025	0.025	0.025
	[0.024]	[0.023]	[0.023]	[0.023]	[0.023]	[0.024]
public	0.125***	0.125***	0.128***	0.129***	0.128***	0.125***
	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]	[0.035]
constr	0.025	0.021	0.028	0.029	0.027	0.025
	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]
manuf	0.090***	0.091***	0.093***	0.093***	0.092***	0.090***
	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]
hotel	0.007	0.003	0.007	0.009	0.008	0.006
	[0.032]	[0.032]	[0.032]	[0.032]	[0.032]	[0.032]
comm	0.036	0.038	0.036	0.036	0.036	0.036
	[0.033]	[0.033]	[0.033]	[0.033]	[0.033]	[0.033]
health	0.099***	0.101***	0.102***	0.101***	0.101***	0.099***
	[0.032]	[0.032]	[0.032]	[0.032]	[0.032]	[0.032]
real	0.064	0.053	0.064	0.065	0.067	0.062
	[0.051]	[0.051]	[0.051]	[0.051]	[0.051]	[0.051]
edu	0.200***	0.201***	0.201***	0.201***	0.201***	0.201***
	[0.037]	[0.037]	[0.037]	[0.037]	[0.037]	[0.037]
energy	0.346***	0.349***	0.344***	0.344***	0.343***	0.347***
	[0.074]	[0.074]	[0.074]	[0.073]	[0.074]	[0.074]
polturn	0.238***	0.239***	0.238***	0.238***	0.238***	0.238***
	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]
polright	-0.381***	-0.380***	-0.381***	-0.380***	-0.381***	-0.381***
	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
google	0.027***	0.026***	0.027***	0.026***	0.027***	0.027***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
distfor	-0.001	0.001	-0.003	-0.004	-0.003	-0.001
	[0.013]	[0.013]	[0.013]	[0.013]	[0.013]	[0.013]
FE	REG	REG	REG	REG	REG	REG
Observations	7,754	7,754	7,754	7,754	7,754	7,754
Adjusted R-squared	0.600	0.601	0.601	0.601	0.600	0.600

Table 5. OLS results. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Dependent Variable	(1) *yese*	(2) *yese*	(3) *yese*	(4) *yese*	(5) *yese*	(6) *yese*
distdif	0.105***					
	[0.021]					
log(distdif)		0.002**				
		[0.001]				
exp(distdif)			0.089***			
			[0.018]			
100<distdif<300				0.010***		
				[0.002]		
distdif>300				0.030***		
				[0.006]		
distnew					-0.047*	
					[0.025]	
log(distnew)						-0.005***
						[0.001]
over65	-0.067**	-0.077***	-0.066**	-0.070***	-0.077***	-0.075***
	[0.026]	[0.026]	[0.026]	[0.026]	[0.026]	[0.026]
secondary	0.149***	0.145***	0.149***	0.150***	0.144***	0.146***
	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]	[0.025]
commuters	0.060***	0.059***	0.061***	0.060***	0.058***	0.058***
	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]
owners	0.011	0.020	0.010	0.009	0.017	0.017
	[0.018]	[0.018]	[0.018]	[0.019]	[0.018]	[0.018]
foreigners	-0.078***	-0.068**	-0.079***	-0.087***	-0.068**	-0.065**
	[0.029]	[0.030]	[0.029]	[0.030]	[0.030]	[0.030]
unemp	-0.041*	-0.041*	-0.042*	-0.045*	-0.043*	-0.044*
	[0.024]	[0.024]	[0.024]	[0.024]	[0.024]	[0.024]
logpop	0.001	0.002	0.001	0.001	0.001	0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
agri	0.031	0.031	0.032	0.033	0.032	0.033
	[0.030]	[0.030]	[0.030]	[0.030]	[0.030]	[0.030]
public	0.069	0.075*	0.069	0.071	0.077*	0.081*
	[0.043]	[0.043]	[0.043]	[0.043]	[0.043]	[0.043]
constr	0.093**	0.086**	0.095**	0.093**	0.090**	0.097**
	[0.040]	[0.040]	[0.040]	[0.040]	[0.040]	[0.040]
manuf	0.123***	0.117***	0.123***	0.121***	0.121***	0.125***
	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]
hotel	-0.077*	-0.083**	-0.075*	-0.077*	-0.071*	-0.068*
	[0.039]	[0.039]	[0.039]	[0.040]	[0.040]	[0.039]
comm	0.082*	0.088*	0.082*	0.087*	0.092**	0.094**
	[0.045]	[0.045]	[0.045]	[0.044]	[0.044]	[0.044]
health	0.103**	0.099**	0.103**	0.102**	0.103**	0.108**
	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]
real	0.184**	0.180**	0.184**	0.178**	0.175**	0.177**
	[0.083]	[0.083]	[0.083]	[0.083]	[0.083]	[0.083]
edu	0.154***	0.158***	0.153***	0.152***	0.163***	0.165***
	[0.047]	[0.048]	[0.047]	[0.047]	[0.047]	[0.048]
energy	0.160	0.188	0.162	0.175	0.189	0.184
	[0.118]	[0.118]	[0.118]	[0.119]	[0.118]	[0.117]
polturn	0.216***	0.208***	0.217***	0.216***	0.209***	0.209***
	[0.024]	[0.024]	[0.024]	[0.025]	[0.024]	[0.024]
polright	-0.364***	-0.368***	-0.364***	-0.367***	-0.369***	-0.368***
	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]
google	0.035***	0.038***	0.035***	0.035***	0.035***	0.035***
	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
distfor	0.019	0.059***	0.019	0.039*	0.075***	0.070***
	[0.022]	[0.020]	[0.022]	[0.020]	[0.019]	[0.019]
FE	REG	REG	REG	REG	REG	REG
Observations	3,923	3,923	3,923	3,923	3,923	3,923
Adjusted R-squared	0.622	0.620	0.622	0.623	0.620	0.621

Table 6. OLS results. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*yese*	*yese*	*yese*	*yese*	*yese*	*yese*
Region	*Sicily*	*Sicily*	*Sicily*	*Sardinia*	*Sardinia*	*Sardinia*
distnew	-0.265***			-0.568***		
	[0.090]			[0.148]		
logdistnew		-0.014***			-0.021***	
		[0.005]			[0.006]	
distnew<10			0.037**			0.056***
			[0.015]			[0.016]
10<distnew<20			0.047			0.066***
			[0.040]			[0.013]
20<distnew<30			0.001			0.036**
			[0.017]			[0.015]
30<distnew<50			0.016			0.031**
			[0.013]			[0.013]
over65	0.027	0.018	-0.001	-0.068	-0.031	-0.009
	[0.104]	[0.105]	[0.107]	[0.115]	[0.116]	[0.119]
secondary	0.082	0.063	0.037	0.106	0.090	0.105
	[0.099]	[0.098]	[0.099]	[0.089]	[0.089]	[0.087]
commuters	0.012	0.007	0.003	-0.006	-0.008	-0.003
	[0.031]	[0.031]	[0.031]	[0.030]	[0.030]	[0.031]
owners	-0.121*	-0.117*	-0.110*	0.027	0.030	-0.010
	[0.063]	[0.064]	[0.065]	[0.089]	[0.091]	[0.091]
foreigners	-0.251	-0.253	-0.246	0.597*	0.563	0.523
	[0.222]	[0.228]	[0.231]	[0.347]	[0.348]	[0.348]
unemp	-0.100	-0.106*	-0.112*	-0.003	-0.002	0.004
	[0.062]	[0.062]	[0.064]	[0.061]	[0.061]	[0.061]
logpop	0.006	0.006	0.006	-0.007	-0.008	-0.006
	[0.005]	[0.005]	[0.005]	[0.006]	[0.006]	[0.006]
agri	0.185*	0.199*	0.215*	-0.039	-0.023	-0.054
	[0.106]	[0.107]	[0.110]	[0.106]	[0.107]	[0.109]
public	0.229	0.257*	0.285*	-0.055	-0.027	-0.043
	[0.143]	[0.144]	[0.145]	[0.137]	[0.138]	[0.139]
constr	0.503***	0.511***	0.514***	0.069	0.083	0.080
	[0.140]	[0.141]	[0.146]	[0.143]	[0.145]	[0.145]
manuf	0.292**	0.313**	0.332**	0.121	0.163	0.121
	[0.135]	[0.136]	[0.137]	[0.122]	[0.124]	[0.123]
hotel	0.075	0.082	0.095	-0.195	-0.230	-0.271*
	[0.152]	[0.152]	[0.155]	[0.144]	[0.140]	[0.138]
comm	0.114	0.131	0.158	0.178	0.213	0.148
	[0.165]	[0.166]	[0.171]	[0.150]	[0.152]	[0.154]
health	0.345**	0.382**	0.414**	-0.154	-0.101	-0.135
	[0.169]	[0.167]	[0.167]	[0.166]	[0.169]	[0.171]
real	0.145	0.153	0.196	0.510**	0.479*	0.380
	[0.323]	[0.326]	[0.334]	[0.254]	[0.255]	[0.265]
edu	0.336**	0.362**	0.398**	0.122	0.145	0.111
	[0.151]	[0.153]	[0.156]	[0.170]	[0.172]	[0.168]
energy	0.640	0.610	0.617	-0.210	-0.187	-0.186
	[0.552]	[0.539]	[0.532]	[0.350]	[0.353]	[0.334]
polturn	0.480***	0.486***	0.475***	0.307***	0.308***	0.327***
	[0.095]	[0.097]	[0.097]	[0.089]	[0.089]	[0.088]
polright	-0.314***	-0.331***	-0.347***	-0.282***	-0.295***	-0.312***
	[0.038]	[0.037]	[0.038]	[0.042]	[0.043]	[0.046]
google	-0.114***	-0.098***	-0.085**	0.033**	0.035**	0.028*
	[0.033]	[0.033]	[0.035]	[0.014]	[0.014]	[0.015]
distfor	0.279***	0.275***	0.272***	0.062	0.105	0.123
	[0.070]	[0.071]	[0.072]	[0.075]	[0.074]	[0.080]
Observations	389	389	389	254	254	254
Adjusted R-squared	0.406	0.403	0.397	0.335	0.331	0.349

Table 7. OLS results. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

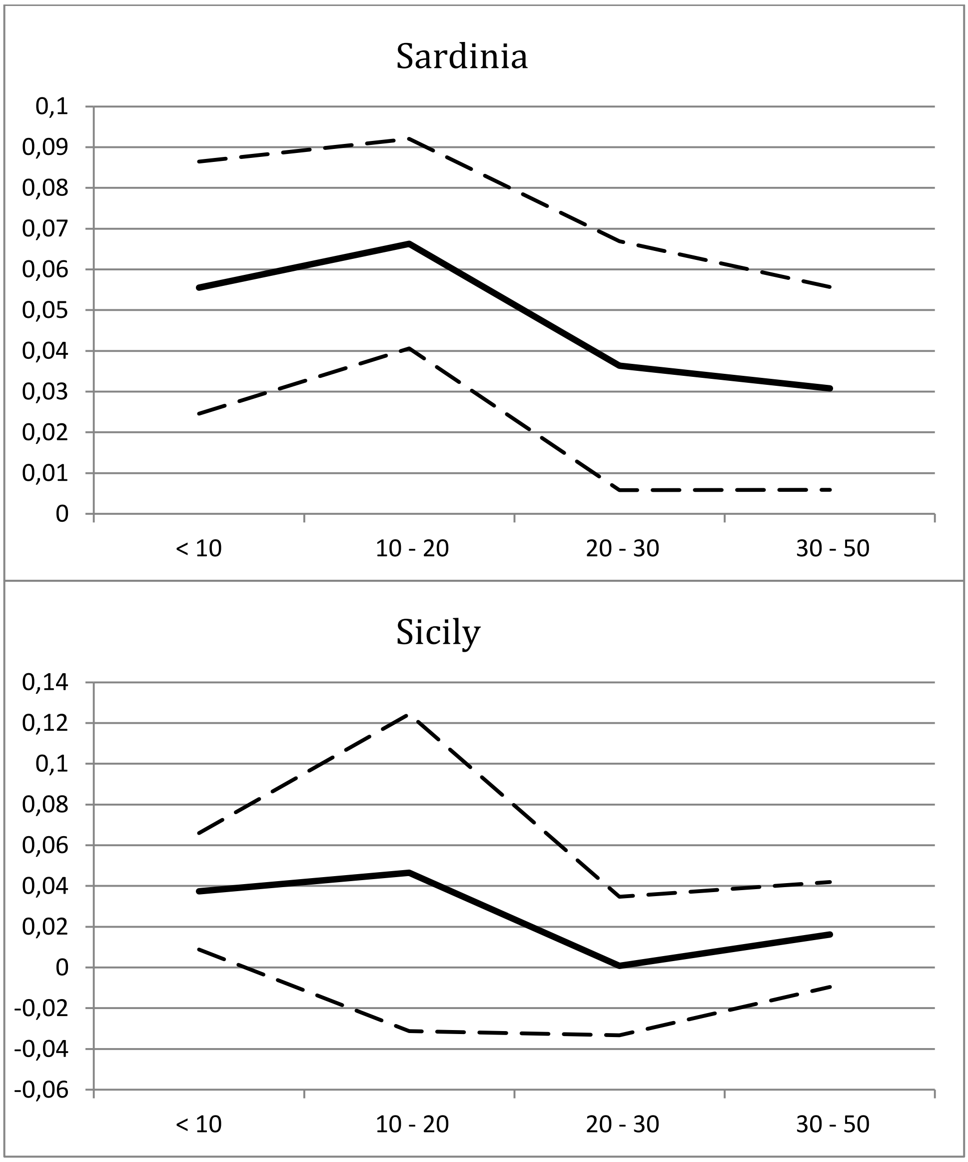

Figure 4. Point estimates and 95% confidence intervals of coefficients of distance bins in Sardinia and Sicily.

Appendix A - Transfers

In this Appendix we test whether we can find track of higher transfers (i.e., compensations) from the central government to municipalities close to the nuclear facilities that the government planned in 2009 to build by 2013. The referendum in 1987 abolished official compensations to municipalities hosting (and in the vicinity of) nuclear facilities. However different forms of compensations arose in the subsequent years through a series of laws and regulations whose detailed analysis is beyond the scope of this work. Thus although a referendum abolished compensations, it is still possible for the central government to discretionary transfer funds to municipalities in order to "buy" political support for new facilities or to compensate for existing (and likely to be re-activated) ones. This can be done using a variety of policy instruments, for instance the so called "Thousand Prorogations", a law voted between Christmas and New Year's Eve in which parliamentarians use to allocate central government's funds, usually toward their electoral district, at their own wish.

To tackle this issue we construct a simple Difference in Difference framework, thus we regress the per capita transfers (in euro) from the central government to municipalities in 2007 and 2008 (or 2009) against municipality fixed effects, a dummy for year 2008 (or 2009) and the same dummy interacted with a measure of municipal vicinity to nuclear plants, which is our treatment. Municipal vicinity takes value one when the center of the municipality is within a distance of 10 or 50 kilometers from the closer (existing or all) nuclear facility. Numbers of treated municipalities is not so small, especially in the case of 50 kilometers radius: there are 33 (72) municipalities within 10 kilometers from old (all) nuclear facilities and 1097 (1810) municipalities within 10 kilometers from old (all) ones. As baseline case, we use transfers in 2007 since the central government was at that time led by a center-left coalition opposed to nuclear power. Then elections came in 2008 and a center-right coalition (having nuclear power in its policy agenda) got the majority, so that rumors of new nuclear facilities began to spread, crystallizing in the document by the Green Party (discussed in the core of the paper). We use as treatment year either the 2008 or 2009 with a trade-off between having closer time periods (2008 instead of 2009) and having a possibly sharper effect (policies in 2008 may still be mainly focused on key issues of the winning coalition's political platform announced during the campaign, which nuclear was not part). In Table A1 we report the results for our Difference in Difference estimation. All the specifications show that municipalities in the vicinity of existing or all nuclear facilities did not enjoy an increase in transfers from central government after the decision to set up nuclear facilities has been taken.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
distold<10 * 2008	-12.51							
	[28.03]							
distold<50 * 2008		-16.34						
		[31.60]						
distall<10 * 2008			-18.18					
			[27.80]					
distall<50 * 2008				-20.59				
				[35.41]				
distold<10 * 2009					-1.06			
					[33.22]			
distold<50 * 2009						-17.58		
						[31.87]		
distall<10 * 2009							-13.48	
							[29.18]	
distall<50 * 2009								-28.95
								[35.65]
2008 or 2009 dummy	YES	YES	YES	YES	YES	YES	YES	YES
municipality FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	15500	15500	15500	15500	15382	15382	15382	15382
Within R-squared	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A1. Results for OLS estimation. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Appendix B (1987 vs 2011 Italian nuclear referendum)

Contrary to all results obtained in 2011 referendum, here, we investigate the voting pattern in the Italian nuclear referendum in 1987. Results did not show a clear trend in terms of distance from nuclear facilities and voting behavior. This suggests that while in 1987 there was an overall increase in the aversion toward nuclear energy for its widespread dangerous effect in case of accidents; instead in 2011 the consequences of the Fukushima accident support the hypothesis that the distance-related risk component associated to a localized nuclear disaster does play a role in voters' behavior.

The relevant events around both referenda occurred following similar patterns. The Chernobyl nuclear disaster happened in April 1986, its effects being felt across the whole Europe. Few months later, a referendum about nuclear power has been set up to take place in November 1987. Similar to the 2011 case, the two specific questions in the referendum asked (i) whether to impede the central government to decide where to set up new nuclear plants and (ii) whether to eliminate monetary compensations to municipalities hosting nuclear plants.

In June 2011 the referendum took place three months after the Fukushima nuclear accident and was a response to the government's intention to return to nuclear power declared since 2009.

In the Fukushima case, contrary to the Chernobyl one, there was not widespread direct negative impact on Italian population (no problems of contamination from rain, for instance) and then, the detailed coverage that the disaster received in the mass-media conveyed the message that the danger associated to nuclear disasters was a localized phenomenon, rather than a widespread one.

To support this view, we compare the results of 1987 referendum with those of 2011 referendum. We test (by means of OLS regressions) whether the distance from (existing) nuclear facilities has a role in determining the province-level results both in 1987 and 2011. We aggregate data on the 2011 referendum in order to have the same level of analysis. In particular, 1987 data are relative to the 95 provinces, so we aggregate 2011 municipality-level data and construct a provincial-level distance to nuclear facilities as the average of variables capturing distances while exploiting the size of electorate in each municipality as weights.

For the 1987 referendum the only distance we use is *distold*, since at that time there was not any short-term plan to set up new facilities in defined sites. Instead for 2011, we use *distdif* (our main explanatory variable) or *distnew*. As dependent variables we use the share of yes-voters and the turnout rate, since the preferred choice for those backing the *no*-option was to avoid showing up at the ballot. Our results are collected in Table A2. Given the limited number of observations we only control for regional fixed effects (19 dummies) and the log of population in 1991, the closest census observation for 1987 referendum.

Columns 1 and 2 show that distances from existing nuclear facilities have no role in the outcome of 1987 referendum as concerns the possibility for the central government to decide upon the location of new nuclear plants. Column 3 refers to the abolition of compensations to municipalities hosting existing nuclear facilities. In this case we do not find any role for distance. Column 4 and 5 replicate the last two specifications in terms of turnout and results are unchanged. Columns 6 and 7 refer to results of 2011 referendum showing that even at this level of aggregation, *distdif* plays a role, i.e. the closer becomes nuclear risk and more provinces are likely to vote against nuclear power. The pattern of turnout is the same as that of *yes*-votes, as Column 8 shows. In the spirit of mimicking 1987 specifications in terms of comparable measures of distance, in specification 9 we use *distnew* and its coefficient is, as expected, negative and significant at 5% level, with a magnitude that is not surprisingly similar, in absolute value, of that obtained in the three previous columns.

	1987 referendum					2011 referendum			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	yes(i)	yes(i)	yes(ii)	turnout(i)	turnout(ii)	yes	yes	turnout	yes
constant	0.505***	0.467***	0.451***	0.747***	0.746***	0.615***	0.494***	0.531***	0.545***
	[0.040]	[0.062]	[0.062]	[0.069]	[0.070]	[0.022]	[0.035]	[0.034]	[0.037]
distold	0.057	0.075	0.069	-0.009	-0.008				
	[0.153]	[0.143]	[0.144]	[0.167]	[0.167]				
distdif						0.275***	0.287***	0.272***	
						[0.073]	[0.075]	[0.074]	
distnew									-0.282**
									[0.113]
log(pop)		0.006	0.007	-0.001	-0.001		0.005	0.004	0.004
		[0.006]	[0.006]	[0.007]	[0.007]		[0.003]	[0.003]	[0.003]
regional FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	95	95	95	95	95	95	95	95	95
Adjusted R-squared	0.663	0.664	0.658	0.703	0.704	0.604	0.610	0.644	0.581

Table B1. Results for OLS estimation. Robust standard errors in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

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