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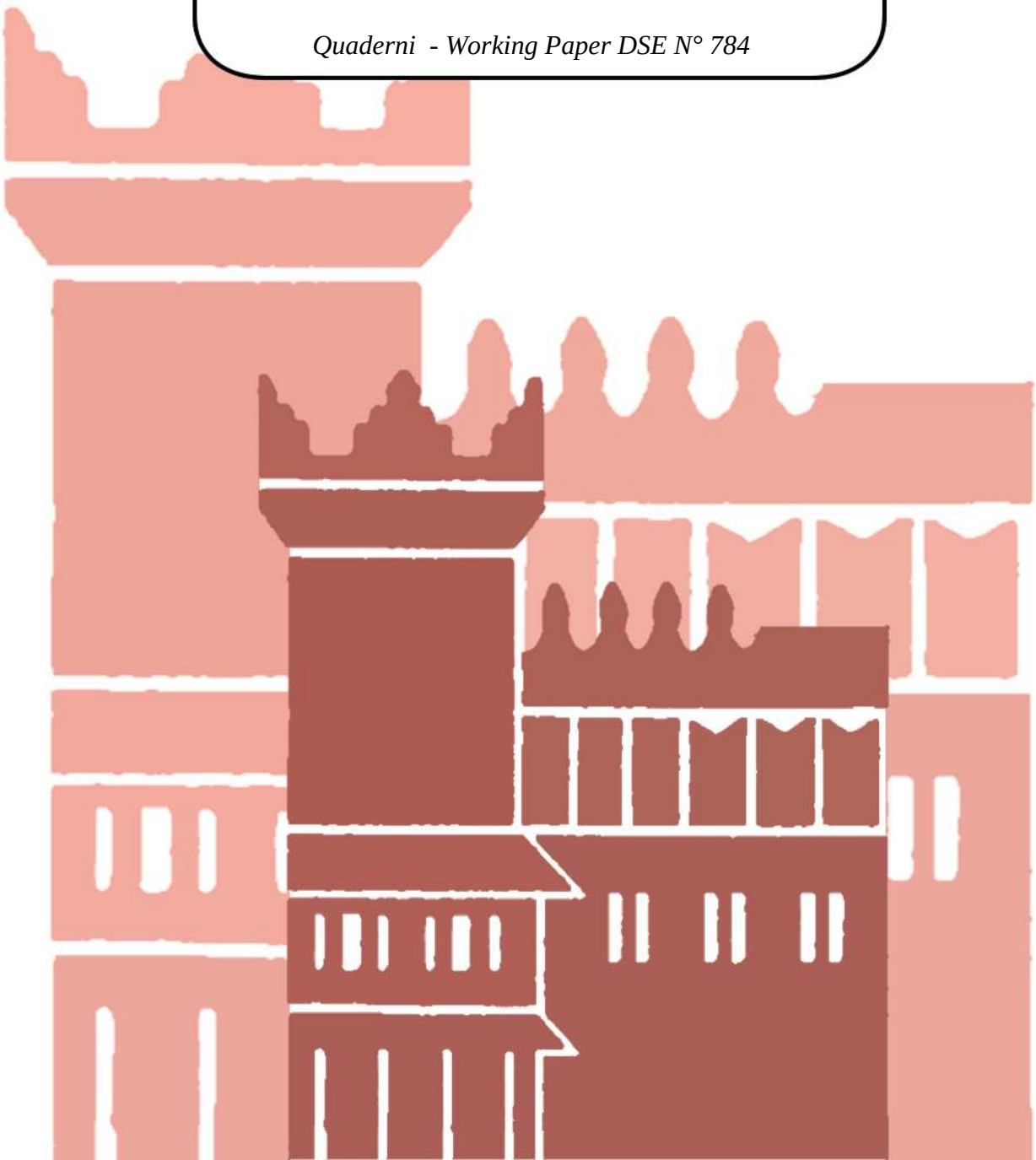

NIMBY Clout on the 2011 Italian Nuclear Referendum

Giuseppe Pignataro[1] and Giovanni Prarolo[2]

Abstract

This paper claims that the 2011 Italian referendum on nuclear power is taking shape as a clean laboratory for the measurement of one of the main aspects of the NIMBY (Not In My BackYard) issue. Since the citizens voted on the possibility for the government to set up new nuclear plants in well-known sites, we identify community preferences for their locations across Italian municipalities using the turnout rate. The Fukushima nuclear disaster that happened a few months before the referendum may have magnified negative attitudes toward nuclear power. Thus, taking into account regional and political features that may influence ideological aversion to nuclear power, we still find highly negative correlation between distance from nuclear sites and the turnout rate.

KEYWORDS: NIMBY, referendum, nuclear risk, distance

JEL Codes: D72, H41, Q48

1. Introduction

The 1987 referendum[3], influenced by the Chernobyl disaster, led Italy to permanently shut down its nuclear power plants in 1990. Two decades later, in 2008, Italian government announced its intentions to erect new reactors 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

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[3] In Western societies referenda constitute the more engaged form of democracy, giving 'the people' a chance, between elections, to have their say on important matters that are likely to affect their lives.

possibility confirming an indefinite ban on the nuclear energy option. Although one needs to proceed warily in documenting choices about the placement of nuclear power plants, the last referendum appears to be another case of ''Not In My Back Yard'' (NIMBY). In its most general and widespread meaning, it entails a resolute opposition by residents to new plans close to their homes. In Italy the nuclear option has involved a long public debate on environmental management, risk awareness and mobilization of local communities determined to defend their own territory. What is the key rationale for the Italian voters' continual rejection of proposals to build atomic power plants?

The fear of a nuclear disaster seems to be the public's natural feeling especially in the aftermath of the grievous occurrence in Japan, along with the conditional dread of losing their current quality-of-life status and their social property value. In Italy this 'overreaction' has brought in an anti-nuclear verdict with more than 95% of answers among the participants at the referendum[4]. The map of Italy (Figure 1) provides a snapshot of the locations of nuclear reactors already operational since 1987 and shut down by 1990, and the location of those that would have been built in 2013 upon referendum approval[5].

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 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. Hampton (1996) in particular measures the local resistance to the construction of a series of munitions' depots (as high risk facilities) in Australia. He shows that contrary to

[4] In Italy 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.

[5] Plants that have been shut off after nuclear referendum in 1987 are Caorso, Trino Vercellese, Latina and Garigliano. The list of the new potential locations (beside the previous ones) is: Chioggia, Monfalcone, San Benedetto del Tronto, Mola di Bari, Scanzano Jonico, Palma di Montichiaro, Oristano, Borgo Sabotino and Scarlino. It is proper to point out that 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.

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. As suggested by Shen and Yu (1997), Feinerman *et al.* (2004), however, 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[6]. 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[7].

On the basis of the last referendum response, in this study, we aim to assess the community preferences for the location of new nuclear plants. In particular, we try to gauge the rise in the turnout rate in proximity to prospective nuclear plants as a proxy for a NIMBY clout.[8] Thus, we intend to observe whether a greater proportion of residents who live in close proximity to nuclear reactors have been in favour of repealing the law on 'planning the realizations of nuclear reactors in Italy'[9].

Using *referendum* data help us measuring the effect of distance from nuclear sites on people's choices, since other quoted evidence are based on surveys in which "minimal safe distances" from hypothetical dangerous facilities are gathered from community questionnaires. We do

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

[7] 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.

[8] Note that 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.

[9] We feel quite safe in assuming that the only variable at play is distance, since no structured and detailed compensation plans have been associated to the decision of building new nuclear plants. However, we have information on a compensation plan (Resolution n. 111/2008, GU n. 70 25-3-2009) for municipalities and provinces hosting the four existing nuclear plants and other nuclear-related facilities, so we also do an exercise of controlling for possible economic benefits coming from the location of plants.

not aim at disentangling the (possibly endogenous) bias in voting pattern introduced by organizations backing or supporting nuclear power for two main reasons. First, regional (or provincial) fixed effects take into account all the differential local involvement of organizations uncorrelated with distance. Second, since the rise of endogenous forces is unavoidable in this kind of policy interventions, the interesting elasticity for policy analysis is the overall effect.

2. Institutional Background

The so-called popular referendum 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[10]. It can be proclaimed at the request of five regional councils or the collection of 500000 signatures of eligible voters signing a public validated petition and only in order to decide on whether to repeal an existing law. For the outcome of a referendum in Italy to be binding, turnout must be above 50%. For what involves our analysis, few months ago, balloting ended in a two-day referendum (on the 12-13 June 2011) with a clear-cut response on nuclear power. 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. Indeed Italy's nuclear industry was dismantled after votes in three referenda in 1987. Historically, this was the prelude of an anti-nuclear campaign guided by the environmental movement, which became a formidable social movement in Italy during the 1980s. 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[11]. Legislation was passed in the same year to guarantee the

[10] 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.

[11] Restarting nuclear plants was one of the key promises of the Centre-Right government when it was elected in 2008.

construction of nuclear power plants while economic agreements have been signed with energy companies to build at least four new nuclear plants from 2013. In few months fears about nuclear power have increased in the run-up to the nuclear 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[12]. Thus, what was surprising for us was not simply the size of the majority (95%) or the relatively high turnout of 57%, one of the highest in any Italian referendum for over a decade but rather the rise in the turnout rate in proximity to a potential nuclear plants which implicitly suggests that one of the main aspects of the NIMBY clout was in place[13,14]. For what we know this is the first investigation on *referenda* case study where public risk perceptions result in Not-in-my-backyard policy process to screeching halts. 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 NIMBY syndrome relevant to measuring risk perception impact and idiosyncratic aversion on nuclear plants characterized by the strong negative correlation between the turnout rate and the distance of municipalities. Relating to concerns about health, safety and environmental welfare[15], in this case community preferences are definitively expressed with higher turnout rate by local residents closest to potentially hazardous sites.

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[12] Moreover at the time of referendum in Italy, 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 was making a profound impact on public opinion in Italy.

[13] It is worth to note 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.

[14] 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.

[15] 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.

3. Data and Results

We use data about the referendum held on 12-13 June 2011 for most of Italian municipalities (8068 out of 8094)[16]. In particular the nature and the size of the dataset allow us to directly estimate the effect of distance on people's choices. As previously mentioned the usual way of assessing people's attitudes toward facilities is through surveys targeted at people living in the nearby of potential sites. Information about the number of residents and the entitled voters, the turnout, the share of YES and NO voters along with blank, null and contested ballots are also gathered. In particular 56.69% of extensive polling voted at the referendum on nuclear option, while the YES voters were more than 94% among participants. We develop a series of 'great-circle' distances from expected nuclear sites for each municipality examined and then a *minimum* distance as our main explanatory variable. The minimum distance points to a mean of 80.5 kilometres, a standard deviation of 40.2 and a median at 76.2. Since the only component in voting preference is the negative impact on living close to a nuclear structure, our main prediction suggests that areas in proximity to the new expected sites should experience higher turnout rates. We report in table 1 different specifications of a linear regression model in which the dependent variable is, in all but one case, the turnout rate while the main explanatory variable is the minimum distance from nuclear sites. In figure 2 we report a map depicting the distance from new nuclear plants where area gets darker with the distance from plants. All models are fitted by Ordinary Least Square (OLS hereafter), with standard errors robust to heteroscedasticity. The basic regression (Column 1) includes only a constant term and the distance, the latter showing a negative and significant coefficient (at 5% confidence level). The magnitude (-0.0055) indicates that augmenting the distance between a municipality and the closer nuclear site by 40 kilometres (one standard deviation) leads to a decrease in the turnout of more than 0.2%. In Column 2, instead, we control for 20 regional dummies, thus only the *within-region* variation of distance measures the impact of turnout. The explanatory power of the regression increases, while the coefficient about distance is unchanged. Column 3 includes the role of the political coalitions, grouping regions, by means of dummy variables, run by Centre-Right,[17] Centre-Left and Northern League administrations where the baseline is Trentino Alto-Adige, a region governed by a local

[16] Official data come from the Department of Internal Affairs.

[17] This coalition was aligned with the central government that put pressure on its electorate to keep turnout low and appealed to the courts for the vote to be declared illegal.

coalition where the turnout was at a maximum. As expected, the turnout within the regions politically aligned with the central government[18] is more than 10% lower than the one on the baseline, while in regions run by Centre-Left administrations the drop is about 6.5%. After controlling for regional political alignment with central government, the coefficient of distance increases (now significant at the 1% level) and implies a reduction of 0.85% standard deviation from the closer nuclear plant. Further exploring the political determinants of turnout, especially to control for the possible discrepancy between actual and perceived risk driven by local institutional aversion to, or preference for, nuclear power, we add to specification of Column 2 a set of four dummies that takes into account the affiliation of each municipality's mayor, i.e. the four dummies representing respectively, Centre coalition (61 observations), Centre-Left one (677), Centre-Right one (873), Autonomists (104) with Municipal party Lists as the baseline.[19] Results in Column 4 show that the coefficient of distance is slightly larger and more precisely estimated, while three out of four coefficients of political dummies have the expected significant sign. In Column 5 the dependent variable is the share of YES voters. Note that the 'distance' index is now not significantly different from zero suggesting that the relevant issue at the referendum was the threshold between voters versus abstentions, rather than the 'YES' and 'NO' shares of active electorate. Figures 3 and 4 draw respectively the entire profile of the share of YES voters and the turnout rate. We may point out that the first distribution is definitively right-skewed while the second one seems to be normally distributed.[20] As discussed, the turnout rate emerges as the key decision variable to look at in order to gather information on people's preferences. Moreover, instead of exploiting twenty regional dummies, we opt for a finer analysis and use 103 provincial dummies (Column 6), improving on the explanatory power of the regression (with respect to Column 2, R-squared increases by 0.11). The specification in Column 7 takes into account that for some municipalities, i.e. those already close to the four existing nuclear plants, the possibility of building new nuclear plants would not have any effects in terms of risk. Thus we construct a new variable based on the difference between the 'minimal distance' (in terms of

[18] The regions controlled by *Northern League,* partner in the central government coalition but in favour of the referendum, show a drop smaller than 8%.

[19] With data aggregated at municipal level we cannot do better in evaluating the perceived vs. actual risk, as for example Groothuis and Miller (1997) do using individual data.

[20] Note that a test for normality on the rate of turnover rejects the null hypothesis of non-normal distribution.

kilometres) between the existing and the new potential plants[21]. Figure 5 reports this variable: darker areas identify municipalities that experienced larger reduction in this difference. Note that Sicily, Sardinia and the Northeast regions would have been severely hit by the placing of new reactors, while most of Northwestern municipalities would have not changed their *risk status*. Approximately, half of the municipalities experience a zero (median is below 2 kilometres), while the mean and standard deviation of differential distance are around 73 and 104, respectively. In this case the coefficient is positive (0.0201) as expected and significant at the 1% level, suggesting that those municipalities for which risk would have increased are those that reacted with a higher turnout rate. As a final point, in Column 8 we relax the linearity assumption building dummies for different distance bins: less than 10 km, between 10 and 20, between 20 and 50 and between 50 and 100[22]. All dummies have positive coefficients; the first (the largest one) and the fourth are significant at 1% level.

To sum up, results hold even after controlling for provincial fixed effects, for ideological reasons and when we focus also on the previous nuclear experience of municipalities. What emerges from the results of the repealing referendum of 2011 on nuclear power is the highly observed negative relation between distance from (planned) nuclear sites and the turnout, validating the presence of the NIMBY effect in Italy.

Further we test several competing hypothesis concerning the proxy of NIMBY reaction, including demographics, proximity and partisanship. Further remarks are emphasized in table 2 where we propose some other regressions confirming the robustness of our results. In Column 1 we use the logarithm of distance so that the coefficient represents the change in turnout for a 1% variation in distance. The estimated coefficient, now interpreted as elasticity, is -0.3 and it is significant at 5% level. In Column 2 we replicate the same specification from table 1, that is the regression with distance and regional dummies, but instead of using robust standard errors we weight each observation for the number of electors in each municipality in order to interpret the results in terms of individuals rather than municipalities. Results are very similar in magnitude and even more significant. In Column 3 we restrict the analysis to those municipalities that experienced an increase in their risk status, i.e. the distance from the closer nuclear plant would have diminished. The coefficient of distance is larger in magnitude (-0.0227) and significant at 1% level, indicating that these are identified as the municipalities whose choices are more influenced by the potential implementation of nuclear plants. Again

[21] Remember that the four existing sites are also enclosed in the list of the new ones.

[22] The baseline case involves the municipalities' distant more than 100 kilometres.

on the whole sample, in column 4 we control for the (log of) population (and regional dummies) taking into account scale effects in turnout rate. As expected, larger municipalities show higher turnout, while distance is still negative and significant, although at 10% level. Once we split the sample between municipalities smaller and larger than 5000 inhabitants (Column 5 and 6, respectively), we find that distance has an effect on turnout only in small municipalities. Compared to the high turnout obtained in larger municipalities, this finding could be a signal that the NIMBY effect is strongly felt in places where the importance of environment is a valuable amenity and where ideological issues are weaker, as it is especially in small, rural municipalities.

The popular view suggests that rather than holding the policy process hostage to perception, economic compensation and incentives (transfers and tax benefits) could be a NIMBY ameliorative device (Dear, 1992; Mansfield et al., 2001). To somehow measure the impact of compensations we add two dummies for those municipalities and provinces that received money transfers because of them hosting (dismissed) nuclear plants or nuclear-related facilities, according to the Resolution n. 111/2008, GU n. 70 25-3-2009, by the Italian Inter-ministerial Committee for Economic Planning.[23] The results, in column 7, show that the turnout rate was 2.3% lower in provinces that received compensations, suggesting that monetary compensations could be a way to reduce the NIMBY effect. However, the impact of distance is now larger in magnitude (-0.0097) and more precisely estimated (1% significance level) with respect to the baseline results of Table 1, column 2.

4. Conclusions

Exploiting information about the 2011 Italian referendum on nuclear power our analysis sought out how local NIMBY-ism can crush nuclear power projects. In particular we try to gauge to what extent distance plays a role in people's aversion to the instalment of nuclear potential plants. This constitutes an important dimension in policies, which aim at solving NIMBY issues. 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, we claim that our estimates

[23] The fact that compensations were related to the old nuclear plants makes us cautious in interpreting the results, since the criteria used to design compensations did not took into account the expected location of new power plants.

do not suffer from severe biases. We find that augmenting the distance between a municipality and the closer nuclear site by 40 kilometres leads to a decrease in the turnout (the key margin in the Italian referenda-system) of more than 0.2% in the more cautious estimation, while the decrease in turnout can be up to 1% once we consider only those municipalities that, with the instalment of new nuclear plants, would have laid themselves open to increasing risk. Political alignment of municipal and regional institutions plays a role in determining turnout, but still distance significantly matters among turnout's determinants. Results are also robust to the inclusion of regional or provincial fixed effects, as well as different specification of distance, while, it turns out that although larger municipalities tent to show up more at the referendum, the effect of distance on turnout is more localized in smaller municipalities.

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Table 1: Results for regression analysis

	1	2	3	4	5	6	7	8
Dep.Var.	**Turnout**	**Turnout**	**Turnout**	**Turnout**	**Share of YES**	**Turnout**	**Turnout**	**Turnout**
Constant	57.1288 [0.1916]***	58.9842 [0.6561]***	67.1558 [0.4579]***	58.2650 [0.6344]***	94.2706 [0.1569]***	62.8862 [2.0637]***	57.1223 [0.5947]***	58.0304 [0.6006]***
Distance	-0.0055 [0.0024]**	-0.0059 [0.0025]**	-0.0209 [0.0022]***	-0.0070 [0.0025]***	0.0003 [0.0007]	-0.0101 [0.0050]**		
Left Region			-6.533 [0.4034]***					
Right Region			-10.8233 [0.3842]***					
League Region			-7.8562 [0.4117]***					
Center Munic.				0.1875 [0.8346]				
Center-Right Munic.				-1.0593 [0.2118]***				
Center-Left Munic.				3.5005 [0.2582]***				
Autonomist Munic.				8.4250 [0.5819]***				
Differential Distance							0.0201 [0.0021]***	
Distance <10 Km								1.9063 [0.6986]***
Distance 10-20 Km								0.7926 [0.4433]*
Distance 20-50 Km								0.1278 [0.2593]
Distance 50-100 Km								0.9251 [0.2229]***
Dummies	NO	Regional	NO	Regional	Regional	Provincial	Regional	Regional
Observations	8068	8068	8068	7791	8068	8068	8068	8068
Adjusted R-squared	0.00	0.24	0.12	0.27	0.57	0.35	0.25	0.24
Robust standard errors in brackets								
*** significant at 10%; ** significant at 5%; *** significant at 1%**								

Table 2: Additional results from regression analysis.

	1	2	3	4	5	6	7
Dep.Var.	**Turnout**	**Turnout**	**Turnout**	**Turnout**	**Turnout**	**Turnout**	**Turnout**
Constant	57.976 [0.5669]***	61.4258 [1.2600]***	59.4146 [0.2619]***	55.4172 [0.8723]***	63.6715 [0.8702]***	59.7427 [1.6096]***	59.3843 [0.6577]***
Distance		-0.0063 [0.0020]***	-0.0227 [0.0030]***	-0.0043 [0.0025]*	-0.0061 [0.0029]**	-0.0026 [0.0046]	-0.0097*** [0.0024]
Log(Distance)	-0.3042 [0.1366]**						
Log(Inhabitants)				0.4122 [0.0650]***			
Compensation Municipality							0.8739 [1.4928]
Compensation Province							-2.3149 [0.2722]***
Dummies	NO	Regional	NO	Regional	Regional	Regional	Regional
Observations	8068	8068	4104	8068	5668	2400	8068
Adjusted R-squared	0.00	0.39	0.02	0.24	0.21	0.37	0.24
Robust standard errors in brackets (Standard errors in Column 2). In Column 2 observations are weighted using the number of electors per municipality. In Column 5 (6) the sample is restricted to municipalities smaller (larger) than 5000 inhabitants.							
*** significant at 10%; ** significant at 5%; *** significant at 1%**							

Figure 1: Locations of nuclear reactors already working in 1987 and shut down by 1990 (red squares) and the location of those that would have been built starting in 2013 (blue circles).

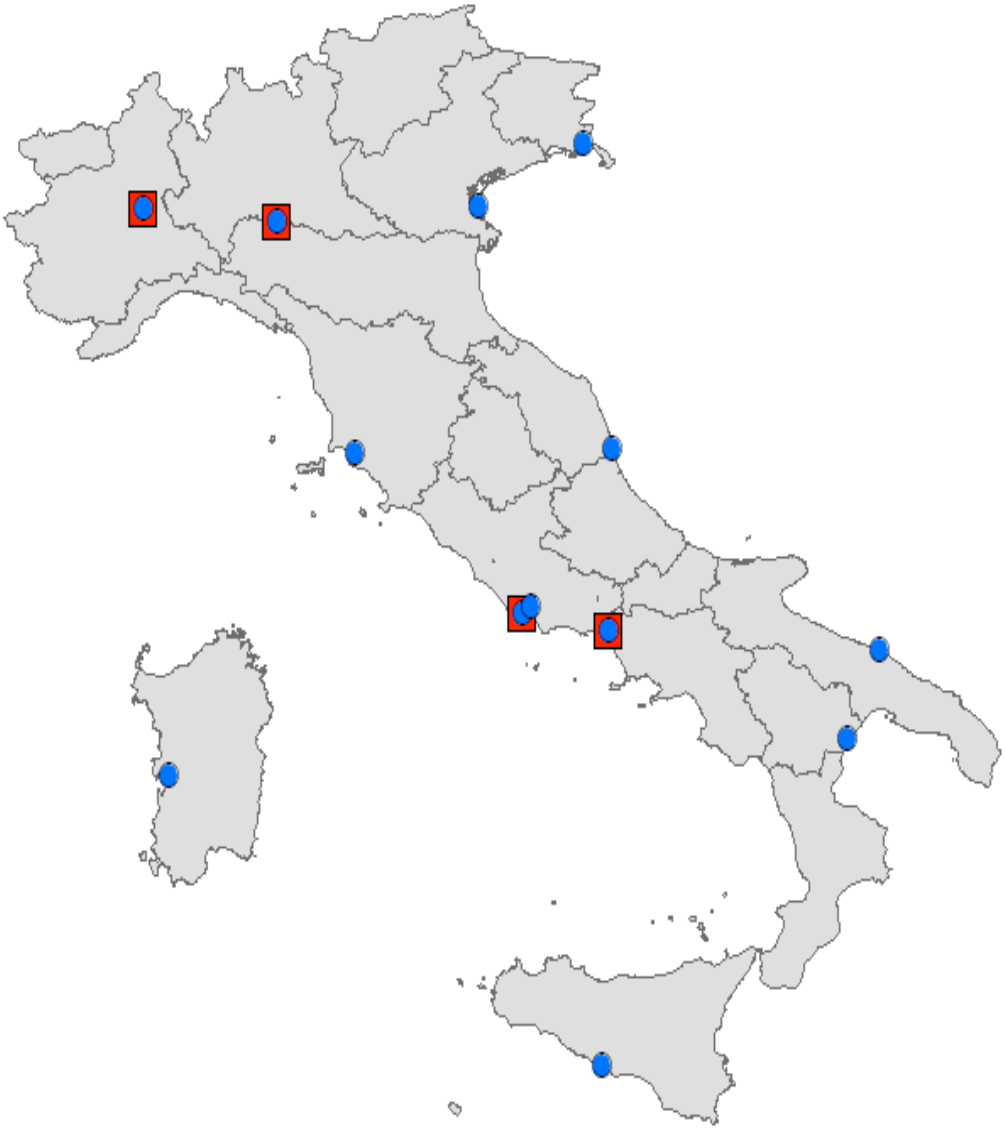

Figure 2. A map of Italy depicting the ranges from new nuclear sites. Area gets darker with the distance from new plants.

Figure 3. The share profile of YES voters.

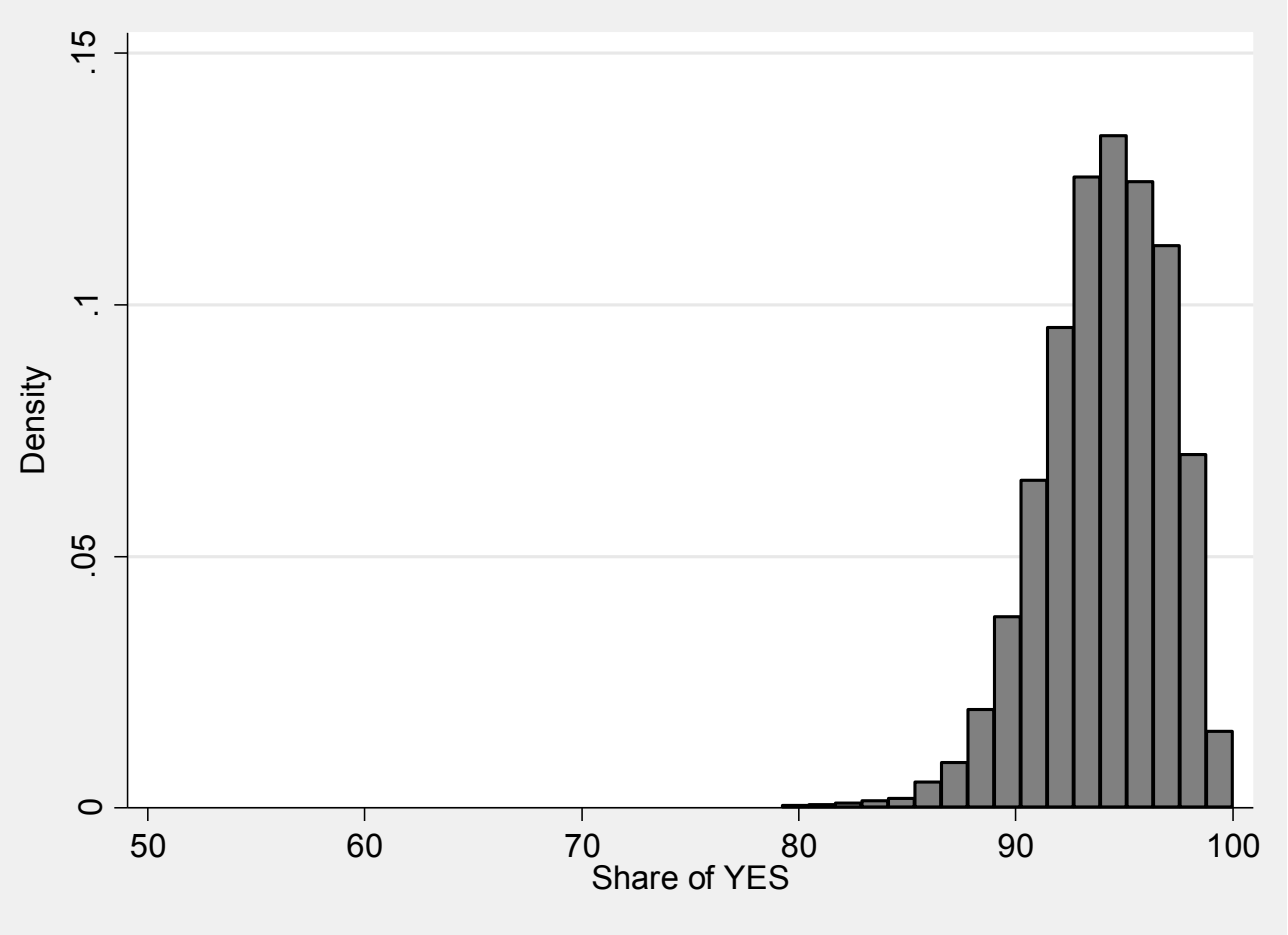

Figure 4. The distribution of turnout rate.

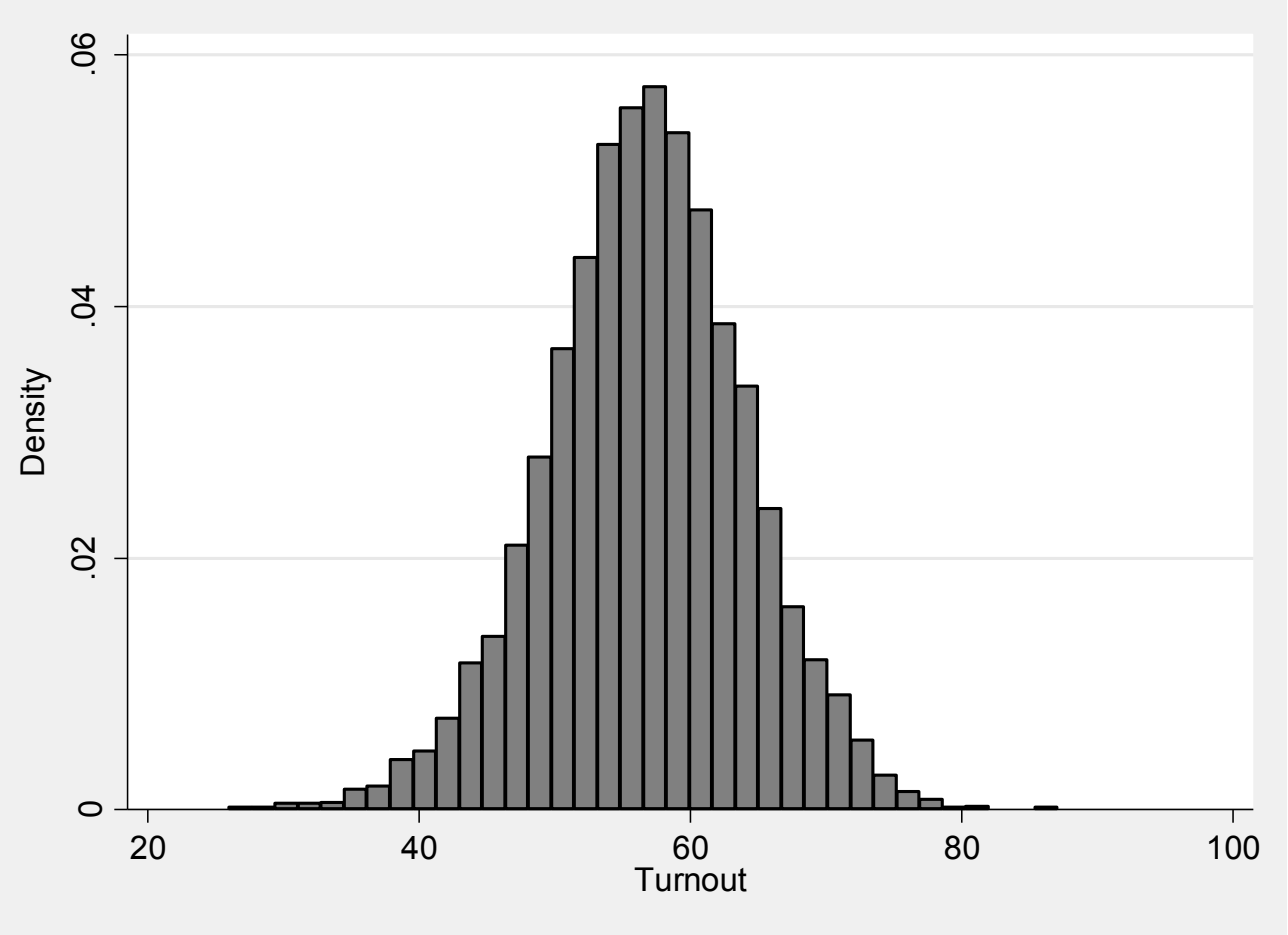

Figure 5. A map of Italy measuring the difference among distances between old plants and new ones. Darker areas identify municipalities that experienced larger reduction in this difference.

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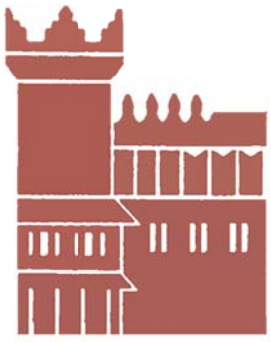

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