Department of Economics

Three Essays in Applied Economics

Decio Coviello

Thesis submitted for assessment with a view to obtaining the degree of
Doctor of Economics of the European University Institute

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EUROPEAN UNIVERSITY INSTITUTE
Department of Economics

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To my family, with me in any moment of my life.

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Preface

Declaration

I declare that this dissertation is the result of my own work and, except for the usual studentsupervisor discussions, includes nothing that is the outcome of any work done solely by others. No part of this dissertation has previously been submitted for any similar qualification or degree.

Decio Coviello
(November 2008)

Published work and Coauthoring

A paper based on the work presented in Chapters 1 has been published in the Economics Letters, N.96,(2007), pg.301-306 and realized with Matteo Bobba, (Bobba and Coviello, 2007). I have had the benefit of several useful suggestions and comments from the referees. A paper based on the work presented in Chapter 2 has been circulated as a CSEF Working Paper and EUI Working Paper and realized with Mario Mariniello, (Coviello and Mariniello, 2008). A paper based on the work presented in Chapter 3 has been realized with Stefano Gagliarducci, (Coviello and Gagliarducci, 2008)

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Introduction

The aim of this dissertation is to answer three real life economic questions with the following three chapters.

Chapter 1, (joint with Matteo Bobba), deals with the problems of weak instruments in identifying the effects of education on democracy. This chapter shows that when the problems caused by weak instruments are properly considered Education affects Democracy.

Chapter 2, (joint with Mario Mariniello), analyzes both theoretically and empirically what are the effects of potential competition on actual competition in public procurement auctions in Italy. A model of endogenous entry in auctions is adapted to inspect the theoretical problem and a regression discontinuity design is exploited to identify the causal effects of advertisement on entry and competition in this market.

Chapter 3, (joint with Stefano Gagliarducci), explores the relationship between politics and the functioning of public procurements auctions in Italy. In particular, we use the introduction of the two-limit law in 1993 to identify the causal effect of political longevity in office, longer tenure of the mayors, on several outcomes of the auctions. The channel of discretional renegotiations appear to be the tools to distribute political favors which building entry barrier limits competition at the auction level.

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Chapter 1

Weak instruments and weak identification, in estimating the effects of education, on democracy

Synopsis

Is there any relation between education and democracy? Once we correct for weak instruments and identify education as weakly exogenous we find new evidence that education systematically predicts democracy. Our results are robust across model specification, instrumentation strategies, and samples.

1.1 Introduction

The relationship between education and democracy has been at the heart of both academic and political debate of the last decade. Recent empirical work has reached mixed results. Glaeser et al. (2004), using OLS, present evidence that countries level of education predict changes in democracy. Nonetheless, Acemoglu et al. (2005) demonstrate the fragility of those results. Both analysis consider past levels of education exogenous to countries levels of democracy. In this paper we argue that (1) given the forward-looking nature of investments in human capital, education is endogenous and thus its effects on democracy are weakly identified and (2) given the high persistence in democracy and education, the findings of Acemoglu et al. (2005) are subject to weak identification and weak instruments problems. Indeed, we show that (lagged) levels of education systematically predict changes in democracy by considering a different identification assumption (weak exogeneity) for education and by using additional and more informative moment conditions to instrument all the regressors.

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1.2 Identification assumptions

We consider the following dynamic specification to disentangle the relationship between democracy and education:

$$d_{it} = \alpha d_{it-1} + \gamma s_{it-1} + \beta X_{it-1} + \eta_i + \delta_t + e_{it} \tag{1.1}$$

where d_{it} is the democracy (level) of country i in period t, s_{it-1} is the lagged value of average years of schooling, X_{it-1} is a vector of (non-contemporaneous) control variables, and η_i and δ_t denote a full set of country effects and time effects. In order to assess the effects of education on democracy, Acemoglu et al. (2005) estimate Eq. (1.1) in first differences and employ lagged levels of the regressors as instruments for the equation in first differences.[1] The so-called "Difference" GMM estimator relies upon the following orthogonality conditions:

$$E[d_{it-s}\Delta\epsilon_{i,t}] = 0 \tag{1.2}$$

for $t = 3, ..., T$ and $s \geq 2$, where d_{it-s} represents the instruments set used in this GMM estimator. In this setting, it is well known that the higher the persistence of the series used as instruments, the lower the correlation between levels and subsequent differences.[2]

It is widely recognized that both democracy and education are highly persistent[3], therefore lagged levels are weak instruments for the differences and it is possible to gain precision in terms of point estimates bias by exploiting some additional moment restrictions.[4]

The so-called System GMM estimator stacks together the equation in first differences and the equation in levels in a system of equations and employs both lagged levels and differences as internal instruments. In order to consider the additional moments as valid instruments for Eq. (1.1), the following additional linear moment conditions must be

[1] The first differences are a standard way to deal with country effects; see Arellano and Bond (1991).

[2] Simulation results show that the Difference GMM may be subject to a large downward finite-sample bias in this case, particularly when T is small. This weak instrument argument can be seen by considering the following transformation of a simple AR(1) process $\Delta d_{it} = (\alpha - 1)d_{it-1} + eit$. The higher the persistence of α, the lower $E(\Delta d_{it} d_{it-1})$. See Blundell and Bond (1998).

[3] Our preferred estimates of the univariate AR(1) processes deliver estimates of the autoregressive coefficient for Democracy and Education that are respectively 0.66 and 0.93, thus both very persistent; see Blundell and Bond (1998). Those results are not presented because of space limitations but are available on request.

[4] See Blundell and Bond (1998) for simulation results.

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satisfied:

$$E[\Delta d_{it-s}(\eta_i + \epsilon_{it})] = 0 \tag{1.3}$$

for $t = 4, 5..., T$ and $s \geq 2$.

Condition (1.3) implies that changes in democracy are orthogonal to the country fixed effect. We test the validity of this assumption. Our identification strategy differs from previous empirical work where past education has always been assumed to be exogenous. We consider this assumption to be strong since education can be viewed as a forward-looking variable: people take into account the expected future level of political development when investing in human capital. With internal instruments we can control for a weak form of exogeneity in education (and in other covariates) only by assuming that our explanatory variables can be affected by current and past realizations of democracy but must be uncorrelated with future unpredictable innovations in democracy (the error term). The dataset employed in our analysis is the same used by Acemoglu et al. (2005).[5]

1.3 Results

In a multivariate panel data framework it is not clear how to test for weak instruments, hence we use the known bias in the Difference GMM by comparing its sample performances with alternative estimators with known properties in dynamic panel data and test whether our preferred estimator, the System GMM, improves the precision of the estimates.7 Table 1 reports the main results of estimation of model (1) across various estimators using the baseline sample 19652000. Column 1 and 2 show the results of Within Groups and Pooled OLS estimators that provide, respectively, the lower and upper bound for the autoregressive coefficient of democracy.8 Columns 3 and 4 employ alternatively one and two step Difference GMM estimators9; the estimated autoregressive coefficient is smaller than or equal to the corresponding Within Groups estimate, which should be the lower bound in a short panel like this one. We then conclude that this estimator is likely to be seriously downward biased, and the consequent finding that education is not statistically different from zero (and sometimes negative) under both specifications is not instructive. Columns 5 and 6 report the System GMM estimates, one and two step, respectively, and the results are striking: the estimated autoregressive coefficient lies between the two bounds, and the lagged level of education now has a pos-

[5]Because of space restrictions we do not describe them here and refer the reader to the original paper. Our dataset is a five-year panel with 108 countries spanning the period between 1965 and 2000.

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itive and significant effect on democracy at the 1-percent significance level. The point estimate is 0.099, implying that an additional year of schooling increases the steady-state value of democracy by 18 percentages points.10 To address the validity of the additional moment conditions (3) we run an incremental Sargan test for over-identification restriction based on the difference in the Sargan tests between the System and Difference estimator.11 The corresponding Chi-square statistic does not reject the null of validity of condition (3). A possible concern with this last result is that it may be driven by the presence in our sample of industrial countries in which the level of democracy is very high and persistent across our time span, hence the change in democracy is zero for these countries and condition (3) holds trivially. In columns 7 and 8 we exclude industrial countries from the base sample and estimation results confirm both the validity of condition (3) and the positive and significant effect of education on subsequent democracy. Note that the estimated coefficient of education might include both direct and indirect effect of education on democracy working through income (or other possible channels); this motivates us to perform various robustness checks of our results by adding standard covariates, as per capita GDP (in logs), investments and population (in logs).12 Table 2 presents these additional results. Columns 1 to 3 add each covariate and show that none of these variables is significant, while our variable of interest, education, remains significant at the 1-percent level, which is not true for GDP. In order to disentangle the effect of education on democracy, in Column 4 we consider all three covariates simultaneously and find that the estimated coefficient of education remains highly significant, with a point estimate slightly lower (0.029) than the baseline case of Table 1. We interpret this result as evidence of the primacy of the direct effect of human capital on political institutions and supportive of the interpretation that the indirect effect working from income to democracy is negligible once we take human capital into account. In order to further stress this argument, we run a regression of the five-year change of our democracy index on past levels of education and three standard covariates. The results are reported in column 5 and are entirely consistent with the findings of Glaeser et al. (2004), but they are now robust to weak instruments and to considering education as weakly exogenous.[6] Levels of schooling appear to be a strong predictor of improving institutional outcomes, while per capita income has no predictive power.[7]

[6]See in particular Glaeser et al. (2004), Table 12, panel B.

[7]Due to space limitations we omit comments on all the Sargan tests and AR (1) and AR(2) specification tests which in Table 2 confirm the correct specification of all the estimated models considered.

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1.4 Conclusions

We have revisited the nature of the relationship between political institutions and investment in human capital by taking into account two sources of bias: weak instruments and endogeneity. Using an alternative estimator, a different identification assumption, and different sub-samples we have found evidence of a statistically significant relationship between past levels of education and levels and changes of democracy.

1.5 Tables

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Table 1.1: **Bounding procedure: Results for baseline model across various estimators**

Dependent variables: democracy (t)	Within group (1)	Pooled OLS (2)	Diff-1 GMM (3)	Diff-2 GMM (4)	Sys-1 GMM (5)	Sys-2 GMM (6)	Sys-1 NO-OECD (7)	Sys-2 NO-OECD (8)
Democracy (t-1)	0.387	0.703	0.319	0.399	0.450	0.506	0.422	0.484
	(-7.05)	(-19.51)	(-2.06)	(-2.37)	(-4.52)	(-5.1)	(-4.12)	(-4.67)
Education (t-1)	-0.005	0.027	-0.066	-0.024	0.099	0.062	0.128	0.10
	(-0.25)	(7.17)	(-0.66)	(-0.28)	(3.40)	(2.43)	(3.16)	(2.54)
Constant	0.366	0.061	-0.009	0.076	-0.155	-0.108		
	(5.56)	(3.04)	(-0.14)	(1.62)	(-1.83)	(-1.47)		
Time effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hansen	0.49	0.49	0.29	0.29	0.50	0.50		
Diff Hansen					0.19	0.19	0.33	0.33
A R(1)	0.00	0.00	0.00	0.00	0.00	0.00		
A R (2)	0.69	0.92	0.73	0.73	0.80	0.76		
Obs.	775	775	667	667	775	775	601	601
N	108	108	104	104	108	108	86	86

Note: Dependent variables is the Augmented Freedom House Political Rights Index. Diff-1 GMM and Diff-2 GMM are the one (two) step difference GMM estimation. SYS-1 (-2) GMM are the one (two) step system GMM estimation. Robust standard error are computed for the t-tests reported in (). For one step estimates are computed HuberWhite standard errors, while the two step estimates are Windmeijer corrected. The values reported for the Hansen test are the p-values for the null hypothesis of instrument validity. The Diff Hansen reports the p-value for the validity of the additional moment restrictions required by the SYS GMM. The values reported for A R (1) and A R (2) are the p-values for first and second order auto correlated disturbances in the first differences equations. Five-year panel, between 19652000, as in Acemoglu et al. (2005).

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Table 1.2: **Robustness checks, additional covariates**

Dependent variables: democracy (t)	Sys-2 GMM (1)	Sys-2 GMM (2)	Sys-2 GMM (3)	Sys-2 GMM (4)	Sys-2 GMM (5)
Democracy (t-1)	0.562	0.554	0.572	0.556	-0.444
	(8.10)	(7.68)	(6.98)	(8.43)	(6.74)
Education (t-1)	0.025	0.05	0.043	0.029	0.029
	(1.42)	(5.31)	(3.37)	(2.29)	(2.29)
Ln (rgdpch) (t-1)	0.042			0.035	0.035
	(1.16)			(0.95)	(0.95)
Ln (pop) (t-1)		-0.032		-0.013	-0.013
		(-1.33)		(-0.92)	(-0.92)
Ln (ki) (t-1)			-0.047	0.154	0.154
			(-0.21)	(0.79)	(0.79)
Constant	-0.156	0.37.	0.022	-0.118	-0.118
	(-0.65)	(1.75)	(0.43)	(-0.41)	(-0.41)
Time effect	Yes	Yes	Yes	Yes	Yes
Hansen	0.27	0.25	0.36	0.99	0.99
Diff Hansen	0.39	0.52	0.8	0.99	0.99
AR(1)	0.00	0.00	0.00	0.00	0.00
AR(2)	0.81	0.75	0.86	0.84	0.84
Obs.	692	763	696	685	685
N	97	106	97	96	96

Note: Dependent variables is the Augmented Freedom House Political Rights Index. SYS-2 GMM are the two step system GMM estimates. Windmeijer corrected standard error are computed for the t-tests reported in (). The values reported for the Hansen test are the p-values for the null hypothesis of instrument validity. The Diff Hansen reports the p-value for the validity of the additional moment restrictions required by the SYS GMM. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations. Five-year panel, between 19652000, as in Acemoglu et al. (2005).

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Chapter 2

Does Publicity Affect Competition? Evidence from Discontinuities in Public Procurement Auctions

Synopsis

Calls for tenders are the natural devices to inform bidders, thus to enlarge the pool of potential participants. We exploit discontinuities generated by the Italian Law on tender's publicity to identify the effect of enlarging the pool of potential participants on competition in public procurement auctions. We show that most of the effects of publicity are at regional and European level. Increasing tenders' publicity from local to regional determines an increase in the number of bidders by 50% and an extra reduction of 5% in the price paid by the contracting authority; increasing publicity from national to European has no effect on the number of bidders but it determines an extra reduction of 10% in the price paid by the contracting authority. No effect is observed when publicity is increased from regional to national. Finally, we relate measures of competition to ex-post duration of the works finding a negative correlation between duration and the number of bidders or the winning rebate.

2.1 Introduction

Public procurement contracts in Member States amount to a huge slice of the European Union's GDP: 16 % in 2002. Only 16.2 % of the Union's public procurement is published in the European Official Journal, though.[1] Member States and the European

[1] European Commission, 2004.

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Commission are pushing to increase the use of advertising policies by the contracting authorities considering it as the natural device to improve the performance of public procurement markets. For instance, Directive 2004/18/CE stresses the importance of an extensive use of advertising in order to foster the participation of European firms in tenders taking place within the European Market. Surprisingly, however, no consensus in the theoretical and empirical literature exists on the effects of increasing the pool of potential participants on the outcome of public procurement auctions.

In this paper we use regression discontinuity methods (Angrist and Lavy, 1999; Hahn,Todd and van der Klaauw, 2001) to test for the effects of enlarging the pool of potential participants (i.e. of advertising a tender) on the level and nature of competition in public procurement auctions in Italy. Furthermore, we report evidence of the benefits of competition for the ex-post duration of the works.

Assessing the benefits of publicity in public procurement auctions requires going through the following steps: first, one should ask whether, and to what extent, advertising influences competition; second, one should ask how competition, as it is influenced by advertising policy, affects the price paid by the auctioneer to the winning bidder, i.e. it determines the auctioneer's rent. As for the first point, notice that a firm can join an auction only if the firm knows that the auction exists. Since participating in an auction requires sustaining some fixed cost, however, a firm might decide not to participate if it thinks that competition will be too harsh.[2] As for the second point, it is well accepted that an increase in the number of participants increases the auctioneer's rent: firms are pushed to bid more aggressively if the number of bids is increased.[3] Beyond that, advertising can affect participants' characteristics, by stimulating entry of outsiders (i.e. those firms which are located outside the region where the auction is taking place). Outsiders might decrease the likelihood of collusion, since local firms find

[2]Indeed, suppose you are an entrepreneur and that yours is one of the few companies which know that the tender is taking place. When deciding whether to participate or not in the auction, you will take into account that the number of competitors that you will face is small and that the likelihood of submitting a winning bid is high. As a result, your incentives to join the auction are likely to be very high. Now, suppose that one day you open your favorite national newspaper and realize that another contracting authority is advertising a similar tender. If the agency did not advertise the tender, surely you would not have participated: you actually would not have any clue that tender was taking place. However, your incentives to participate are now smaller: since the tender is advertised on a national newspaper, you expect competition to be harsh. You might then decide not to participate because your expected profits (which are a function of the probability of submitting a winning bid) are not enough to offset your participation costs. In other words, increasing the number of potential participants has an ambiguous effect on auction's outcome.

[3]See, for example, Brannman et al. (1987) and Klemperer (2002).

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it more difficult to coordinate, having fewer contacts with competitors.[4] Outsiders can even have a different cost structure: firms located far from the auctioneer participate only if their costs to operate at distance are very low. On the other hand, wide publicity may discourage entry of local firms since, ceteris paribus, the incentive to participate is lower when more firms are applying. Local firms may have a deeper knowledge of the procedure implemented and of the work's features and they can exploit scale economies by dealing with the same authority more than once. It turns out that if local firms are driven out of the market, there can be an efficiency loss. It is not clear, then, what is the magnitude of the effect on auctioneers' rent which is associated to publicity and its selective effect rather than to its direct effect, on the number of participants. Figure (2.1) offers a graphical representation of these simple concepts.

To analyze this issue, we introduce a simple model of first price sealed bid auctions with participation costs where the number of bidders is endogenously determined. Under certain assumptions (namely: that publicity reduces firms' searching costs), we show that the optimal level of publicity can be below its maximum possible level, independently of its cost. It turns out that a rule forcing contracting authorities to a certain publicity level may reduce the revenues of the auctioneer and thus reduce welfare, in a context of public procurement auctions. Next, we empirically test the effect of publicity on competition exploiting the discontinuities generated by the Italian law on public procurement which imposes different levels of publicity according to the auction's starting value. Italian law prescribes that every public procurement auction should be advertised at 1 of the 4 different available publicity levels (Local, Regional, National, European) on the basis of their starting value.[5] Our empirical analysis is based on a unique administrative data set from the Italian Authority for Surveillance of Public Procurement (*"Autorita' per La Vigilanza sui Lavori Pubblici", AVLP*). The Authority collects data on the universe of Italian public procurement auctions, for tenders starting value greater or equal to 150,000 (we had access to the data referring to the period 2000-2005). A Regression Discontinuity Design (RDD), a quasi-experimental setting, can then be used to compare the outcomes of auctions with starting value immediately above or below each discontinuity threshold. Auctions above and below the thresholds have different publicity levels, but should otherwise be identical in terms of observable and unobservable characteristics determining the outcome of interest, which in our case are: the number of bidders and the winning rebate. Using this source of identification of the causal effect we show that increasing tenders' publicity from local to regional

[4]See Compte et al. (2005).

[5]In particular see Law n. 109 del 11 February 1994, so called "Legge Merloni"; *"Legge quadro in materia di lavori pubblici"*

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determines an average increase of 19 percentage points in the number of bidders with respect to a sample average of 38, and an average increase in the winning rebate of 4.9 percentage points with respect to a sample average of 16 %. A back of the envelope calculation suggests that if all the auctions that by law are published at local level were published at regional level then average revenues would have been increased by 25,000 for tenders with average starting value of 516,000, provided that the average cost of publishing at regional level is 1,000. In contrast to the regional effect, we observe no effect on the number of bidders and the winning rebate when publicity is increased from regional to national level.[6] Interestingly, on the other hand, we observe that an increase in publicity from national to European level has no effect on the number of bidders but it determines an increase in the winning rebate of 10 percentage points. This suggests that selection of the bidders via advertisement plays a major role when the auction has an European relevance.

Further, we analyze the relationship between competition in auctions and the time to accomplish the works after the auction has taken place. It might be, indeed, that a substantial increase in the number of participants encourages firms to over-bid inducing a non sustainable commitment for the winner.[7] Using duration analysis models, we report evidence of a negative and statistically significant correlation between the time it takes for the winner to accomplish the tendered works and the number of participants or the winning rebate.

The rest of the paper is organized as follows. In section (2.2) we describe the related literature, in Section (2.3) we introduce the theoretical model, Section (2.4) describes the institutional framework; Section (2.5) reports the empirical analysis. Conclusions and policy implications are discussed in Section (2.7).

2.2 Related Literature

The literature looking at what fosters competition in public procurement auctions is large. In this paper we mainly draw from the theoretical contributions of Levin and Smith (1994) and Menezes and Monteiro (1996, 2000) and we consider the link between publicity and competition in a stylized model of endogenous entry to auctions where entry is costly and advertising tenders decreases firms' search costs. Both Levin and Smith (1994) and Menezes and Monteiro (1996, 2000) consider a mechanism by which firms decide whether or not to participate in an auction. They differ, though, in the

[6] As Table (2.5) shows, the effect on the number of bidders would be negative, if any, at a 10% significance level

[7] This is the well known winner's curse phenomenon

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timing dimension of their models: in Levin and Smith (1994) firms incur a fixed cost of entry before seeing their values for the object while in Menezes and Monteiro (1996, 2000) firms learn their values prior to incurring bid preparation costs. Their conclusions are thus different: Levin and Smith (1994) suggest that the seller should not limit entry through a restriction policy (e.g. an entry fee) while Menezes and Monteiro (1996, 2000) find that entry fees may be optimal for the seller since they help to screen low valuation bidders when increased competition reduces the seller's expected revenue. Our model follows the one used by Menezes and Monteiro (1996, 2000) and integrates it with the possibility for the seller to advertise the tender.

From an empirical point of view, the effect of advertising tenders on competition has never been directly tested. Bajari and Hortacsu (2003) use a structural analysis to test the model of Levin and Smith (1994) with a dataset of E-Bay coin auctions. They find that the expectation of one additional bidder decreases bids by 3.2% in a representative auction. In addition, they find that the value of the object is among the main determinants of entry. They do not consider advertising, though. Lundberg (2005) investigates the choice of procurement procedure in public auctions in Sweden where the contracting entity may choose one among several available mechanisms which are linked with different restrictions on entry. Indeed, since publicity is a tool used to favor entry, the choice of advertising an auction may be seen as the choice of relaxing entry restrictions. Lundberg's (descriptive) results do not show any significant impact from contract specifications and municipality characteristics on the probability that the contracting authority does not restrict entry. Finally Leslie and Zoido (2007) study how markets can provide private incentives to increase the provision of information in public procurement auctions. They find evidence that the introduction of an 'information entrepreneur', i.e. an entrepreneur who collects and sells announcements about forthcoming auctions, causes a 2.9 % decrease in the cost for drug procurement in public hospitals in Buenos Aires, Argentina.
Our paper aims at supplementing this literature with empirical results based on (quasi-) experimental evidence.

2.3 Theoretical Framework

In this section we introduce a theoretical framework for the question tested by our empirical analysis. The model described below is a tool which allows to grasp the economic phenomenon underlying the issue tackled by this paper i.e. the effect of an increase in tender's advertisement level. The empirical analysis, though, is not supposed to test the predictions of the model. Indeed, as described in the following section,

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the auctions included in our database show some similarities with the traditional first price auction model but cannot be properly considered as such, since they implement a complex model of selection of the bids. While a specific model capable to capture this complexity would go beyond the scope of this paper, the model described below lets us achieve a main result, reported in proposition 1, which we believe to hold also in the context of the data used in the empirical analysis.

Following Menezes and Monteiro (2000) - henceforth (MM) - we model a public procurement auction as a first price sealed bid auction where the number of bidders is endogenous. A single contract is put out to tender. The auctioneer is assumed to have zero reserve price. Firms bid a rebate b on the auction's starting amount for which they would be willing to do the works. Bidder i knows her own value v_i of the contract and the distribution $F(v_i), \forall i \neq j$ of other n bidders' values. $F(.)$ is continuous with support $[0, \overline{v}]$. Participating to the auction requires sustaining a fixed cost c plus some searching cost δ which for the moment are assumed to be 0.[8] Each bidder decides whether to submit a bid before knowing how many competitors will participate in the auction. Assuming that everyone else except i use the same strategy b, we have that i's expected profits are:

$$\pi_i(v_{i,}b_i, b) = (v_i - b_i)(F(\max\left\{b^{-1}(b_i), v_\rho\right\}))^{n-1} - c$$

where v_ρ solves $v_\rho F(v_\rho)^{n-1} - c$ and it is such that $\pi_i(v_\rho, b^*) = 0$ i.e. v_ρ is the cut-off value when all bidders use the same equilibrium strategy b^*.[9] The optimal bidding strategy which maximizes i's expected profits is then given by:

$$b^*(v) = \{.0pt0\frac{\int_{v_\rho}^{v}(n-1)xF(x)^{n-2}f(x)dx}{F(v)^{n-1}}, v \geq v_\rho 0, v < v_\rho \tag{2.1}$$

Equation (1) is crucial. It tells us that increasing the number of potential participants has two opposite effects on the optimal bidding strategy. On the one hand, since the cut-off value v_ρ value is increasing in n (provided that $c < 1$), it decreases the probability that a player i participates to the auction (since that happens only if $v_i > v_\rho$). On the other hand, it increases the equilibrium bid, since participating players take into account that, in equilibrium, other bidders participate only if their value is greater than v_ρ.

The expected revenue generated by the auction is then given by the highest bid among those submitted:

$$R = \int_{v_\rho}^{\overline{v}} b^*(x)nF^{n-1}(x)f(x)dx$$

[8] You may well think about c as the cost of preparing a project and submit a bid, while δ is the cost of looking around for existing tenders.

[9] (MM) show that such strategy exists. Notice that for any $c < 1$, $v'_\rho(n) < 0$.

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MM then show that the revenue generated by a first price sealed bid auction is equivalent to that generated by a second price sealed bid auction when the number of potential players is fixed and participation is endogenous. It turns out that R can be rewritten as follows:

$$R = n(n-1)\int_{v_\rho}^{\overline{v}}(1-F(x))x(F(x))^{n-2}f(x)dx$$

Now suppose that the auctioneer is able to control the number of participants in order to maximize her revenue. MM uses a variable $\delta \in (-c, 1-c)$ which represents an entry fee (if positive) or a subsidy (if negative). In our context, δ represents firms' searching cost, which are assumed to be decreasing in the level of publicity. Let us introduce a new continuous variable $p \in [0, \delta]$ which is directly correlated with the auctioneer's advertising effort. Let us assume that a marginal increase in p is translated in an equivalent reduction in δ at a cost $\frac{p^2}{2}\lambda z$, where z is the advertising cost (e.g. the cost of publishing the tender on a national newspaper) and λ is the shadow cost of public expenditure.

Thus, total revenue can be maximized by:

$$\varphi(\widehat{\delta}) = \max_p \left(n(n-1)\int_{v_\rho(\delta-p)}^{\overline{v}}(1-F(x))x(F(x))^{n-2}f(x)dx - \frac{p^2}{2}\lambda z \right)$$

which yields:

$$\varphi'(\delta-p^*) = -n(n-1)(1-F(v_\rho(\delta-p^*)))v_\rho(\delta-p^*)\cdot\cdot(F(v_\rho(\delta-p^*)))^{n-2}f(v_\rho(\delta-p^*))v'_\rho(\delta-p^*)-p^*\lambda z = 0 \tag{2.2}$$

which implicitly defines the optimal level of publicity p^*.

Equation (2) has a simple and powerful implication: the optimal level of publicity may be lower than its maximum possible level even if its cost is zero i.e. $z = 0 \nRightarrow p^* = \delta$. In other words, it might be optimal for the auctioneer not to increase the number of potential bidders in order to increase its revenue, even if it did not spend anything to do so. The intuition comes directly from equation (1). Indeed, to show that this is the case, it is sufficient to find at least one case in which the optimal level of δ is positive notwithstanding $z = 0$. The following example illustrates this possibility.[10]

Assume that the n players are represented by random draws from the distribution $F(x) = x^4$ and $p = z = 0$. Expected revenue is then:

$$R = 4n(n-1)\left(\frac{1-c-\delta}{4n-3} - \frac{1-(c+\delta)^{\frac{4n-1}{4n+3}}}{4n+1}\right)$$

[10]Example 1 is similar to example 4 of MM.

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Assume further that $n = 20$ and $c = 0.1$. It turns out that the level of δ which maximizes R is positive and it is $\delta = 0.031$.

We can then state the following proposition:

Independently of its cost, the optimal level of publicity can be below its maximum possible level.

It follows directly from example 1.

From a policy point of view Proposition (2.3) suggests that a rule prescribing a unique level of publicity, given the starting value of the auction can be sub-optimal.[11] In this paper we show that this can be the case once we have considered tenders' publicity at national level. Indeed, the empirical analysis reported in section (2.5) shows that increasing publicity from regional to national level has no effect on the winning rebate and no or negative effect on the number of bidders.

We now proceed illustrating the data and the institutional framework.

2.4 Data and Institutional Framework

We base our empirical analysis on a unique administrative data set from the Italian Authority for Surveillance of Public Procurement (*"Autorità per la Vigilanza sui Lavori Pubblici", AVLP*), which collects data on the universe of public procurement auctions in Italy for public works with starting value greater or equal to 150,000 euros. For our analysis we refer to the data collected between 2000 and 2005. The database includes information at auction level on the contracting authority (i.e. the auctioneer which is also the buyer), the advertisement level, on the typology of the works which are put out to tender, on bidding behavior and on the identity of the winning firms (i.e. the seller). Tables (2.1) and (2.2) report the descriptive statistics relative to the sample. Our database amounts to 41510 auctions with direct participation of firms ('Pubblico Incanto' in the terminology used by the law). The contracting authorities are mainly municipalities (52% of the sample). The rest of the sample is made up of tenders invited by provinces (12%), health-care public bodies (ASL) and other public bodies or corporations.[12] The contracting authorities in the sample are mainly located in the North of Italy, (45%), while 25 % are in the Center and 22 % are in the South of Italy.

[11] Notice that there might be other reasons why a uniform level of publicity could be desirable, though. The most obvious one is that a case by case analysis for deciding which is the optimal level of publicity would be very expensive and likely unfeasible.

[12] We do not report those figures (they are available on request).

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Similar figures are reported in Table (2.2) once we consider the descriptive statistics for the main typologies of auctions. Some differences in the descriptive statistics of the typology "Road and Constructions" can be observed, although no difference exist in the general provision of the law for the different typologies analyzed.

The contracting authority must define all the details concerning the works that have to be carried on by the winning firm, including the starting price that the auctioneer would pay to the winner if only one firm participates to the auction. On average, the auctions' starting value in the sample amounts to 720 thousands of euros, though the standard deviation is rather high. Indeed, the median starting value is 360 thousands of euros. Notice, moreover, that most of the auctions are done to contract out road's constructions (30.6% of the total) which include maintenance, reconstruction and whatever is necessary to guarantee truckage, by rail and air transport. The contracting authority must define the requirements which have to be satisfied by bidders as well. Bidders have to be certified that they are able to carry on the works of that particular size and in that particular sector i.e. they need to be audited by an attestor society (*SOA*, *società organismo di attestazione*) and be registered for the required category in a specific book. So, for example, if the construction of a road is put out to tender and the contracting authority estimates that the amount of qualified work that has to be done is valued 700,000 euros, the required SOA category will likely be: 3-OG3, where 3 refers to the size of the works and OG3 to the category "road constructions". The size requirements are mainly based on firms' turnover.[13] Table (2.1) reports that 13% of the auctions require the category Buildings e.g. OG1, while 29% of the auctions a SOA category, e.g. size of the works of 3.

All the auctions considered in the following analysis are structured as first-price sealed-bid auctions: firms bid the price for which they are willing to do the works in the form of a percentage reduction - rebate - with respect to the auction's starting value. In all the considered auctions the selection criterion for the winner is uniquely based on the rebate i.e. the technical component of firms' offer plays no role (provided that the winner will satisfy some minimum quality standards which are set by the contracting authority). Notice, however, that because of the institutional mechanism prescribed by the law, the winning rebate is not necessarily the highest bidden: in order to prevent firms from over-bidding (i.e. bidding a price which does not allow to recoup works' expenses) a

[13]Notice that the required SOA category is not a direct function of the auction's starting value. Indeed, the works to be done are usually a complex combination of several expertises and hence the required SOA categories may be more than once. For our analysis we consider just the primary required SOA category. Moreover, by a careful study of the Law 109/94 we exclude that both requirements change discontinuously at the publicity thresholds.

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complex (and criticizable) mechanism is implemented. According to this rule, all bids which exceed the average bid by more than the average deviation from the average are automatically excluded.[14] It turns out that the auctions included in our database are not proper first price auctions.

The first five rows of Table (2.1) report descriptive statistics of auctions' outcomes. In the sample, it is observed that the average number of firms participating to the auction is 32 (standard deviation is 35), and a median of 21. The winning rebate is on average 16% (standard deviation is 8.9), which is very close to the median value (15%). To further characterize the nature of competition within auctions we consider three main indicators: the probability of a winner coming from outside the region were the auction is held, the legal nature of the winner, and the indication of whether the winner is a member of a group of related firms. In the sample the probability that the winner is coming from outside the region is 37 % while only 6.5% of the winners are public companies and 18% of the winners are member of a group of firms.

Concerning tenders' advertisement, until July 2006, auctions were classified by the law according to their starting value.[15] Table (2.3) illustrates that rule: the first column reports y, the auction's starting value (in hundreds of thousands euro), the second column reports the level of publicity required by the law, the third and the fourth columns reports the correspondent cost of advertising and the percentage of non-compliance to the prescribed rule, respectively.

According to Table (2.3), auctions with starting value below 500 thousands of euros have to be published on the contracting authority's notice board. This is the least amount of possible publicity, since only firms which have direct access to the auctioneer's premises or have direct contact with its staff may get information on the tender. The cost of publishing on the notice board is zero. Not surprisingly, the degree of compliance is very high: 94% of the auctions observe the prescribed rule. The second interval goes from 500 thousands to one million and it identifies those auctions for which the compulsory level of publicity is regional i.e. those tenders that must be advertised in at least

[14] Bidders thus have to guess which will be these 'anomaly thresholds', as they are called, and try to place a bid within them. As for illustration, consider this simple example. In a hypothetical auction there are three participants placing the following bids (rebates to the auction's starting value): 5, 6 and 19. The average bid is thus 10. The average difference from the average bid is 6. Thus the bottom and the upper anomaly thresholds are 4 and 16 respectively. It turns out that in this case the winning bid is 6 even if 19 is the highest bidden rebate. Albano et al. (2006b) provide a summary of the properties of several winning methods in public procurement auctions.

[15] From July 2006, Law 163/2006 removes the thresholds and forces the contracting authorities to publish on GURI at a national newspaper level, regardless of the auction's starting value (if it is greater than $150,000$ euros). By focusing on data before 2006, this paper provides insights to assess that reform.

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two newspapers spread all over the province where the works should be made and in the official regional journal (*Bollettino Ufficiale Regionale, BUR*). Publishing on BUR is very cheap: an average tender should not cost more than 200-500 euros. Provincial newspapers are cheap as well, since advertisement's price is proportional to the number of printed copies. However, the degree of compliance is rather low: only 71% of the auctions satisfy the publicity requirements. The third level of publicity is national and concerns those tenders with starting values above one million of euros and below the community threshold (five million of SDR, *special drawing rights*[16]). These tenders must be published on two national and two regional newspapers and on the national official journal (*Gazzetta Ufficiale della Repubblica Italiana, GURI*). The average cost for publishing on a national newspaper is about 800 euros (somewhat less for a regional newspaper). GURI, though, is very expensive: publishing a tender's abstract may cost around 7-8 thousands of euros. The degree of compliance is here as well rather low: 78%. Finally, the maximum amount of publicity is enforced when tenders' starting value is above the community threshold. In that case the contracting authority must also advertise on the Official Journal of the European Community (*Gazzetta Ufficiale Comunità Europea, GUCE*) in addition to the obligations defined for the tenders belonging to the previous group. Notice, however, that publishing on GUCE is free of charge, so no additional cost is sustained by the contracting authorities. The degree of compliance is consistently rather high: 90%.

A major concern on the assignment of public tenders to publicity levels is the possibility for authorities of splitting the starting value of the auction in order to avoid the publication. Art. 24 of of Law 109/1994 prescribes that a public authority must not split or vary a particular procurement need in order to circumvent the monetary threshold requirements. In Sections (2.5.2) and (2.7) we provide statistical evidence of no systematic sorting around the thresholds.

Summarizing, in our sample: 92% of the tenders were published on the contracting authority's notice board, 25% on the Regional BUR and about 18% on the GURI. On the other hand, the average number of newspapers on which the advertisement of the tender appeared is: 0.24 for provincial newspapers, 0.42 for regional newspapers and 0.61 for national newspapers. From a more general perspective we can conclude that the sample show a sufficiently large variation in the data leaving the possibility for the econometric analysis which is illustrated in the following Section.

[16] At the time of writing, 5,000,000 SDR were equivalent to 6,550,000 euros.

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2.5 The Empirical Analysis

2.5.1 Identification strategy

Contracting authorities which maximize the auctioneer's revenue implement different advertisement strategies with respect to contracting authorities which pursue other aims, such as maximize political rents through collusion with local firms. Authorities' unobservable incentives determine a non random assignment to publicity levels which causes endogeneity problem; we thus expect Ordinary Least Squares (OLS) estimates of the effects of publicity on competition to be a wrong estimate of the true causal effect of publicity on competition, no matter how big the sample it is. To disentangle the causality relationship between publicity and auction's outcome discussed in Figure (2.1), we implement a more refined technique: the Regression Discontinuity Design (RDD). In Section (2.4) we saw that a higher level of publicity (the *treatment*) is assigned to auctions if an observed covariate, the starting value of the auction, crosses a known threshold. We are aware that using exogenous thresholds which are identified by the law is not equivalent to a controlled experiment because individuals' assignment might be not completely random. Lee (2007), however, shows that in these cases the RDD can nevertheless identify impact estimates that share the same validity as those resulting from a randomized experiment.

In this Section we discuss the assumptions required to implement the RDD. We define y_j as the j-th threshold in the auctions' starting value which determines a discontinuity point in the support of the publicity function, as established by the law. The $j-th$ discontinuity point separates the j and $j+1$ levels in publicity assignment imposed to contractors. We call these levels "publicity brackets". We aim at identifying the causal effect of publicity on auctions' outcomes by focusing on auctions in the neighborhood of those discontinuity points. Let Y be the auction's real starting value (the so called running variable), and Z be the level of theoretical publicity that the contractor should implement under perfect compliance to the assignment rule. We denote by P the level of publicity actually observed in the auction. P may differ from its theoretical level if the contracting authority does not comply with the law assignment: indeed, it is very unlikely that a contracting authority would be punished from AVLP if P differs from Z.[17] Finally let C represent the outcome of auctions. In the analysis we alternatively consider C to be the number of bidders or the winning rebate. Let C_l and C_h being

[17]Notice, by Law a violation of the publicity requirements invalidates the proceedings of the public auction and the person in charge of the auction can be persecuted by both the criminal and the administrative law for such violations. Nonetheless, to overcome the non-perfect compliance problem of the contracting authorities to the publicity Law, we use a *Fuzzy Regression Discontinuity Design.*

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the values of C respectively below and above the generic discontinuity point j. To identify the causal effect of publicity on competition we need the following continuity assumptions:

$$E\{C_l|Y = y_j^+\} = E\{C_l|Y = y_j^-\} \tag{2.3}$$

$$E\{P_l|Y = y_j^+\} = E\{P_l|Y = y_j^-\} \tag{2.4}$$

where y_j^+ and y_j^- represent the left and the right limits of the starting value of the auction. As in Hahn et al. (2001) and Garibaldi et al. (2007), under the continuity conditions, for an auction in a neighborhood of the cut-off point the mean effect of being assigned to a higher theoretical publicity bracket $Z = h$ (instead of the lower one $Z = l$) on the actual publicity level P and on the competition level C are:

$$E\{P|y_j^+\} - E\{P|y_j^-\}. \tag{2.5}$$

$$E\{C|y_j^+\} - E\{C|y_j^-\}. \tag{2.6}$$

(5) and (6) are usually called the *intention-to-treat* (ITT) effects.[18]
Following Angrist et al. (2000) seminal paper we interpret the ratio of the two ITT effects of expressions (5) and (6) as the causal effect of P on C (of publicity on competition). This can be done only if two more conditions are satisfied: the validity of the exclusion restriction and the monotonicity condition. The exclusion restriction requires that the theoretical publicity Z affects the outcome, C, only through the observed level of publicity (which is reasonable in our context, see Section (2.4) where the Institutional framework is discussed). The monotonicity condition requires that no auction is induced to display a lower (higher) actual level of publicity if the theoretical publicity is exogenously moved from l to h (from h to l).

If the three assumptions are satisfied, then the ratio:

$$\Pi(y_j) = \frac{E\{C|y_j^+\} - E\{C|y_j^-\}}{E\{P|y_j^+\} - E\{P|y_j^-\}}, \tag{2.7}$$

identifies the average effect of a change in the actual level of publicity on the level of competition at $Y = y_j$ for those who are induced to show a higher level of publicity because their theoretical publicity increases from l to h.
We plot in Figure (2.3) non-parametric estimates of the main variables of interest. The two boxes on the left plot P on Y at the discontinuity thresholds 1 and 2, respectively.

[18]To keep the notation as simple as possible, we omit time subscripts. In the empirical analysis we consider all the relations conditioned on time periods.

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The other two boxes on the right plot the number of bidders on Y for the same discontinuity points. We estimate these locally weighted smoothing regression separately on the left and on the right of the cut-off points. Jumps in the plots show the effect of the threshold on the variable of interest thus offering a graphical interpretation of the intention-to-treat effects as defined by equations (2.5), and (2.6). As it can be noticed, the figures show that the actual publicity is uniformly not lower than the theoretical publicity on both discontinuities at the left of the threshold. At the right of the threshold we observe some problems of compliance with the law on publicity but not that big to violate the monotonicity condition required by RDD, as pointed out in Garibaldi et al. (2007). Concerning the number of bidders, we observe a jump at the right of the first cut-off point while a drop at the second. The mean impact of the actual publicity on competition, which is the ratio of the jump of the level of competition and the jump of the level of actual publicity, turns out to be positive at the first discontinuity and negative but very small at the second. The figures show that there is a substantial effect of publicity on competition at the first threshold. This impact weakens at discontinuity 2 and 3 (not reported in the figures).
To implement the RDD to our analysis we go through the following steps, (see Imbens and Lemieux (2007)):

1. Inspect the Graphical Analysis,
2. Estimate the treatment effect using TSLS (IV-LATE) where standard errors are computed using the usual (robust) TSLS standard errors,
3. Assess the identification assumptions by looking at possible jumps in the value of pre-treatment variables at the cut-off point and implement a formal test for the lack of continuity of the density function of the running variable (i.e. auction's starting value),
4. Assess the robustness of the results using alternative models and additional specifications.

2.5.2 Graphical Analysis

According to Table (2.3) publicity is a discontinuous function of the auction's starting value. We thus have:

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$$P = \begin{cases} P & Geographical\ Level & & Running\ Variable \\ 0 & Local & if & 1.5 \leq Y < 5 \\ 1 & Regional & if & 5 \leq Y < 10 \\ 2 & National & if & 10 \leq Y < Y^* \\ 3 & EU & if & Y \geq Y^* \end{cases}$$

Where Y is the starting value of the auction expressed in 100,000 euro (real value year 2000) and Y^* varies across the year of analysis. Due to non perfect compliance, we construct an indicator of theoretical publicity, which will be used as the instrument for actual publicity:

$$Z = \begin{cases} 0 & if & 1.5 \leq Y < 5 \\ 1 & if & 5 \leq Y < 10 \\ 2 & if & 10 \leq Y < Y^* \\ 3 & if & Y \geq Y^* \end{cases}$$

Under perfect compliance Z and P should coincide. Figure (2.2) shows that this is not the case in our context: the green line (which represents the actual publicity) indeed do not overlap with the orange line (which represents the theoretical publicity). Because of this differences we consider a "Fuzzy" Regression Discontinuity Design.

To graphically inspect the validity of the continuity assumption we implement two graphical methods that are complementary. We follow Mc Crary (2007), and Lee (2007) to support our identification strategy.
Figure (2.4) shows that the distribution of the auctions' starting value is right skewed. No significant mass probability around each of thresholds is identified, although a suspect of a peak is observed at discontinuity two. An abnormal mass in the distribution of the starting value around each of the thresholds may suggest a lack of continuity in the density function of the running variable. We further investigate on this possibility considering the density based test *à la* Mc Crary (2007).[19] The inspection consists in two steps. In the first step we obtain a very undersmoothed histogram of the distribution of the starting value where the bins of the histogram are defined carefully enough that no one histogram bin includes both points to the left and right of the discontinuity point. In the second step we run a local linear smoothing of the histogram where we treat the midpoints of the histogram bins as a regressor, and the normalized counts of the number of observations of the bins are considered as the outcome variable. Figure

[19]We comment this graphical inspection of the estimated density function at discontinuity one only, see Figure (2.5). Results for the other discontinuities are available from the authors.

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(2.5) suggests that there are no jumps in the density estimates.

As discussed in Lee (2007) we further investigate this issue through the pre-intervention variables. We define our set of pre-intervention variables from the detailed information available to the researchers. These variables, in principle, should meet the following two conditions: they should not be affected by the publicity law, but they may depend on the same unobservables (e.g. efficiency/collusion of the contractors with participants), likely to affect the level of competition C. To test the continuity condition we use the information available on the person in charge to take care of the auction's administrative process and on the administrative nature of the contracting authority. In particular in figure (2.6) we plot and indicator of whether the age of the person in charge is above the median distribution, and an indicator of whether the contracting authority is the municipality against Y, the starting values, and we analyze the behavior of the plots around the three discontinuities thresholds. In the graphical analysis we present the plots on these two pre-treatment variables around discontinuity 1 and 2. A characteristic of these variables is they are observed before the determination of the publicity levels and before the auction takes place, thus they can be used as pre-treatment variables. The graphical test for the continuity assumption would suggest evidence of sorting and lack of continuity if the plots of these indicators against Y would show a jump at the cut-off points. Identification would not be possible in those cases since auctions assigned to high theoretical level of publicity Z_h would be not comparable to auctions assigned to a low level of publicity Z_l with respect to unobservables relevant for the outcome C. Figure (2.6) shows that there are no jumps at the first threshold while jumps are very small at the second.

Thus the graphical analysis suggests the presence of no manipulation of the running variable Y.

In addition to the graphical analysis, Table (2.4) reports descriptive statistics of the auctions' observable characteristics around discontinuity 1. In this table we check whether the observable covariates are balanced to the right and to the left of the first threshold. The rationale of this check is that around discontinuities we should not observe any jump in the observable characteristics with the exception of the outcome of the auctions and the publicity level. Except for some differences in the required category (SOA3) we observe no systematic differences around discontinuity one. We further inspect the institutional requirement for the SOA categories, and we exclude by the study of the publicity law any systematic shift of the SOAs' categories at discontinuity one.[20]

In the following Section we further investigates these graphical results by considering a

[20] see Section (2.4).

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battery of regression based tests.

2.5.3 Regression Analysis: Discontinuities Effects

Van der Klaauw (2002), among others, discusses how to estimate the intention-to-treat effects as defined by equations (2.5), and (2.6). In this paper we consider a fully parametric model representation to evaluate the causal effects of publicity on competition running several versions of the following equation:

$$C_i = \alpha + \beta P_i + \epsilon_i \tag{2.8}$$

When assignment to treatment is not random, endogeneity bias in the estimation of β can rise because of a dependence between P_i and ϵ_i. In this case $E[\epsilon/P] \neq 0$ and then any OLS estimate of equation (2.8) will deliver inconsistent estimates of β. Using Regression Discontinuity design we have additional information on the selection in to the treatment rule. To see how the effect of publicity can be identified and estimated with RD design we have to compare a sample of individuals within a very small interval around the cutoff because they are essentially identical but they differ for the level of publicity. Van der Klaauw (2002) clearly explain that increasing the interval around the cutoff point is likely to induce a bias in the effect estimate, especially if the assignment variable was itself related to the outcome variable conditional on treatment status. In this paper, as suggested by Angrist and Lavy (1999), Van der Klaauw (2002) and Garibaldi et al. (2007), we specify and include the conditional mean function $E[\epsilon/P, Y]$ as a "control function" in the outcome equation:

$$C_i = g(Y_i) + \beta P_i + \delta_t + \omega_i \tag{2.9}$$

where $g(Y_i)$ is a third order polynomial in Y, P the observed level of publicity, δ is a year indicator, and $\omega = C_i - E[C_i/P_i, Y_i]$. Providing that we can correctly specify $g(Y_i)$ we gain the property that $E[\omega/Y] = 0$ and thus equation (2.9) can be correctly estimated via OLS because P will be free from correlation with the disturbances.
As discussed in section (2.4) the assignment to treatment is known to depend partially on the running variable Y and partially on other unobservable phenomena (e.g. local collusion, perverse incentives, or simply measurement error) that can potentially be correlated with the unobservable components of the outcome equation. This second type of Regression Discontinuity design is referred to the literature as "fuzzy". As in Angrist and Lavy (1999), Van der Klaauw (2002) and Garibaldi et al. (2007) we propose

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a fully parametric approach and we assume that the assignment to treatment status can be summarized by the following equation:

$$P_i = g(Y_i) + \gamma Z_i + \delta_t + \nu_i \tag{2.10}$$

We estimate the causal effect of publicity on competition via Two Stages Least Squares (TSLS, or IV-LATE) with $Z = \mathbf{1}\{Y_i \geq \overline{Y}\}$ as excluded instruments and the polynomial $g(Y_i)$ as included one.

In reporting the estimation results of equation (2.9) we comment the estimates at each of the three discontinuity thresholds generated by the publicity law.

Table (2.5) reports the estimated coefficients, $\widehat{\beta}$, of the effects of publicity on auctions' outcomes of Equation (2.9). In the two Panels A, and B, of Table (2.5), we report the sample averages of the outcomes of interest (the number of bidders and the winning rebate), the intention-to-treat, the OLS and the IV-LATE estimates with the (robust) standard errors for the coefficients of publicity only. The odd rows, starting from the third report the estimated coefficients considering separately the three different discontinuities in the publicity function.

Column 1 of Table (2.5) reports the intention-to-treat effect of theoretical publicity (e.g. the excluded instrument) on actual (e.g. the observed level) publicity.[21] The estimates indicate that an increase from a lower starting value bracket, say $1.5 - 5$ hundreds of thousand of euros, to an higher one, say $5 - 10$ hundreds of thousand of euros, shifts the actual publicity by 0.2 with a standard error of 0.02 (by the 0.36 with a standard error of 0.07 if we consider the second income bracket, and by 0.65 with a standard error of 0.21 if we consider the third income bracket). These results clearly identify a lack of full treatment compliance due to non perfect law enforcement. We believe that this problem is not such big to invalidate the monotonicity assumption required by the RDD, see Garibaldi et al. (2007). Column 2 of Table (2.5) reports the intention-to-treat effect of theoretical publicity on the number of bidders and the winning rebate (Panel A, and B). The estimates obtained separately for each discontinuity point are not statistically different from zero. The OLS estimates of the number of bidders and the winning rebate on the actual level of publicity suggest different results: they show a negative and statistically significant correlation between publicity and the number of bidders at

[21] This is the estimated coefficient of the instrument on the endogenous regressor. For all the estimates the ratio between the estimated coefficient and the standard error is the t-statistics which happen to be always greater than two. In this model we have one instrument and thus the first stage F-statistics are just the square of the t-statistics. The first-stage F are always greater than 10 (not reported, but available on request) suggesting that the IV-LATE estimates are not affected by the weak instruments problem.

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discontinuity 2 and a negative and statistically significant correlation between publicity and the winning rebate at discontinuity 1 and 2.

Column 4 of Table (2.5) reports the Instrumental Variables Local Average Treatment Effects (henceforth, IV-LATE) estimates (and robust standard errors below) at each discontinuity. The estimates around discontinuity 1, indicate that an increase in tenders' publicity, from local to regional levels, determines an average increase of 19 in the number of bidders with respect to a sample average of 38, and an average increase in the winning rebate of 4.9 with respect to a sample average of 16 %. Both effects are statistically different from zero at 5 % significance level. As anticipated in the Introduction, this result suggests that increasing the publicity level from local to regional can yield considerable benefits for the contracting authority, such as an average saving of 25,000 euros for an auction with average starting value of 516,000 euros. The empirical analysis support the validity of the law. In other words, the "knowledge effect" of letting more firms know about the existence of the auction here dominates the "deterrence effect" of a fiercer competition to be faced while bidding. This result is especially meaningful if we consider that, at least in Italy, the cost of publishing at regional level is very low. The estimates around discontinuity 2, indicate that, rather surprisingly, an increase in tenders' publicity, from regional to nation levels, determines a decrease of 21 in the number of bidders with respect to a sample average of 38, and an average increase in the winning rebate by 3 with respect to a sample average of 16 %. However, both effects are not statistically significant at 5 %. It appears, thus, that shifting the publicity level from regional to national, at the very last does not attract other potential bidders to the auction. This rather striking result suggests that the regional level of publicity is already sufficient to let potential national bidders be aware of the existence of the auction. Hence, any additional advertisement at national level would yield only additional costs and no additional benefits. Finally, the estimates around discontinuity 3 indicate that an increase in tenders' publicity, from national to European levels, determines an average decrease of 6.4 in the number of bidders with respect to a sample average of 38, and an average increase in the winning rebate of 10 with respect to a sample average of 16 %. The former effect is not statistically significant at 5 %, while the latter is statistically different from zero at 5 % significance level. This last result appears to be coherent with the previous ones nd it suggests an additional interesting consideration: increasing publicity to European level does not increase the number of bidders, but it probably affects the quality of them. When an auction causes a great stir at European level, most efficient firms likely move into play, keeping constant the number of participating firms (because the least efficient firms, knowing that they cannot compete, do not even apply) but increasing the auctioneer's rent by increasing the winning rebate. This explanation

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is of major interest and should be tested with further empirical investigation. We plan to address this issue when new additional data will be available.

2.5.4 Sensitivity Analysis

One concern with our model so far it is that the apparently discontinuous relationship between the level of competition and the publicity levels may be due to the model specification, to sample selection, or to the omission of the relevant characteristics of public procurement auctions. In Section (2.3) the baseline model includes the third order polynomial in the starting value and the year effects only. This specification may not be sufficiently flexible to absorb all the auctions characteristics. To assess this possibility, in Table (2.7) we present estimation results for 5 alternative specifications but we comment the results for the winning rebate, only.[22] In column 1 we reduce the discontinuity sample by more than 50 %.[23] The reduced discontinuity sample includes auctions with starting vale between 4 and 6 hundred thousand euros instead of 3.5 and 7.99 hundred thousand euros at discontinuity 1, auctions with starting vale between 9 and 11 hundred thousand euros instead of 8 and 13 hundred thousand euros at discontinuity 2, and auctions with starting vale between 55 and 75 hundred thousand euros instead of 20 and 111 hundred thousand euros at discontinuity 3. In column 2 we add the fourth order power of the starting value. In column 3 we add the fourth order power of the starting value and reduce the discontinuity sample. In column 4 we add the LARGE information set. The LARGE information set contains the following list of observable characteristics:

- Works' characteristics: wether the works are for roads, education, culture, or other
- Auctions' characteristics: the technical requirement to participate (OG, and RSOA characteristics)
- Auctioneers' characteristics: whether the contracting authority is the municipality or the province.

Finally, in column 5 we add the fourth order polynomial in the starting value and the LARGE information set.
In Table (2.7) the odd row reports the OLS estimates while the even rows report the

[22] Results on the number of bidders are available on request.

[23] Given the inclusion of the polynomial in the starting value, the control function, we did not perform a cross-validation selection procedure of both the original discontinuity sample and the reduced sample in order to select the sample windows around the three discontinuities. As expected we do not observe a remarkable change in the results considering different selections of the sample although we reduced the sample by more than 50 %.

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across-models IV-LATE effects of publicity on the winning rebate at each discontinuity thresholds. We comment the IV-LATE effects only.
In column 1, the reduced sample in the neighborhood of discontinuity 1 is of 5983 auctions instead of the original discontinuity 1 sample of 11434 auctions. The reduced sample estimates of the effect of an increase in publicity from local to regional on the winning rebate is of 6.2 percentage points with standard error 4.4 compared to 4.9 percentage points with standard error 2.1 of the baseline effect. The point estimates appear to be not remarkably different but as expected estimated with less precision. We observe the same pattern at discontinuities 2 and 3. Once we augment the model specification with the fourth order polynomial in the starting value, column 2, we estimate the effect of publicity on the winning rebate to be respectively 6.7 (with standard error 2.7), 2.5 (with standard error 2), and 9.9 (with standard error 4.7) at the three discontinuities. The augmented model results appear to be pretty similar to the baseline estimates that are 4.9 (with standard error 2.1), 3 (with standard error 2.1), and 10 (with standard error 3.8) at the three discontinuities. In column 3 we both reduce the sample size by 50 % and add the fourth order polynomial in the starting value. The estimation results are similar to the baseline effects of publicity on the winning rebate only at discontinuity one where the sample size is larger. Although the effect of an increase in publicity from local to regional is of 5.6 it has a standard error of 4.6 suggesting that it is not statistically different from zero. Estimation results in column 3 are not statistically different from zero at any of the three discontinuities. In columns 4-5 firstly we add at the baseline specification the set of regressors included in the LARGE information set; secondly we add the fourth order polynomial in the starting value. Once we augment the model specification with the LARGE information set, column 4, we estimate the effect of publicity on the winning rebate to be respectively 4 (with standard error 2.1), 2.8 (with standard error 2.1), and 13 (with standard error 6.7) at the three discontinuities. Once we augment the model specification with the LARGE information set and the fourth order polynomial in the starting value, column 5, we estimate the effect of publicity on the winning rebate to be respectively 5.5 (with standard error 2.7), 2.2 (with standard error 2.1), and 12 (with standard error 6.8) at the three discontinuities. The estimation results of the augmented models reported in columns 4-5, are very similar to the baseline estimates that are 4.9 (with standard error 2.1), 3 (with standard error 2.1), and 10 (with standard error 3.8) at the three discontinuities. Hence, sensitivity analysis results appear to be robust to sample selection, functional form restrictions, and the inclusion of the characteristics of the goods and the auctions.

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2.6 Benefits from Competition: Duration Analysis

In this Section we ask whether an increase in competition in auction may lead to the selection of more efficient winners and, thus, to a reduction in the time needed to accomplish the works, provided that the works are satisfying tenders' technical requirements. We consider the time to accomplish the works provided that the works are satisfying tenders' technical requirements. We report evidence of a negative correlation between proxies of competition and the time to accomplish the works. In particular we describe the behavior of the hazard function, $h(l) = \frac{f(s)}{S(s)}$, defined as the (instantaneous) probability of accomplishing the works at s given survival until s.[24] We use duration analysis models because our data are right-censored: indeed, several works are still not accomplished at the day the data were collected. Hence, for each i the observed duration $T_i = t$ is the minimum among the complete duration $L_i = l$ and the censored duration $C_i = c$. We first report non parametric hazard estimates and then we add some structure to the hazard function in order to link its behavior to auctions' indicators of competition. In the non parametric analysis we let $d_i(t)$ be the number of works accomplished at duration t and $r_i(t)$ be the number of works at risk of being accomplished at time t with duration t (where $r_i(t)$ includes the works censored at t or later). The estimated hazard function is

$$\hat{h}_i(t) = \frac{d_i(t)}{r_i(t)} \tag{2.11}$$

and the, the Kaplan-Meier estimated survival function is

$$\hat{S}_i(t) = \prod_{s \leq t} \left(1 - \frac{d_i(s)}{r_i(s)}\right) \tag{2.12}$$

Figure (2.7) plots the Kaplan-Meier (KM) estimates of the survival function of the duration of the works, by the number of bidders for road constructions. From left to right, the orange line represents the KM estimates considering all the auctions where the number of bidders are above the median of the sample distribution of the number of bidders. The green line pools together all the observations while the blue line represents auctions with the number of bidders below the median. According to Figure (2.7) the survival functions are parallel, and always higher for auctions with number of bidders below the median, which implies that they have a higher overall duration rate. Given the properties of the non parametric KM survival function we add structure to the du-

[24] Let $L \geq 0$ be the random variable representing the duration of the works (expressed as the number of days between the moment in which the auction takes place and the accomplishment of the works) and l the realized duration. $F(l) = Pr[L \leq l]$ is the cumulative distribution function, while $S(l) = Pr[L > l] = 1 - F(l)$ is the survival function.

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ration analysis and we implement a battery of parametric models to formally test the statistical significance of this finding. In the parametric models we pool together all the available information and control for it by considering two set of information: MEDIUM and LARGE.[25] We base our analysis on the partial-likelihood approach proposed by Cox (1972).[26] We report the estimates of the $\hat{\beta}$ of a series of models as follow:

$$h_i(t|x,\beta) = h_0(t)e^{X'\beta} \tag{2.13}$$

where h_0 is the baseline hazard probability. Table (2.8) reports the results of the analysis on works' duration. Columns 1 and 2 show the correlations between a shift of the number of bidders and of the winning rebate above the median of their sample distribution, respectively, with the hazard probability. The estimated coefficients are reported in the form of $\hat{\beta}$ (and not as hazard ratios) with the robust standard errors in parentheses. For instance, the first row $\hat{\beta} = 0.17$ indicates that a shift of the number of bidders above the median determines an increase in the hazard relative to the baseline hazard of 17% (and hence a significative reduction in the duration of the works). This effect is significant at 1% level. A positive and significant effect is also observed for the winning rebate. Evidence thus suggests a negative correlation between the number of bidders and the winning rebate and the duration of the works.
The estimates thus report some preliminary evidence of the theoretical predictions by Compte et al. (2002) suggesting that an increase the level of competition is correlated to the efficiency of public good procurement.

2.7 Conclusions

Economic theory suggests that increasing the actual number of bidders in an auction has a positive effect on the auctioneer's rent, Klemperer (2002). Increasing the number of potential bidders via an increase in the level of publicity made to advertise the tender has an ambiguous effect on the auction's outcome, though. On the one hand, a firm may not be aware that a tender is taking place if the contracting authority does not

[25] Those characteristics are discussed in the previous section.

[26] We report the COX-PH model only. Results for Exponential, Weibull, and Gompertz are available on request. Notice that this class of models requires the proportionality assumption to write the hazard function as in equation (11). As suggested in Jenkins' class notes (http://www.iser.essex.ac.uk/teaching/degree/stephenj/ec968/), we inspect the shape of the survival function and we observe a parallelism among them. We thus considered feasible the implementation of the proportional hazard class of models.

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advertise it. On the other hand, a firm might be discouraged from participating if it observes a high level of publicity because this signals that competition in the auction will be fierce: if the probability of recouping the participation cost is too low, the firm might decide not to enter the competition.

In the paper we first adapt the model of Menezes and Monteiro (2000) on endogenous entry into auctions allowing for the optimal choice of publicity and show that it can be the case that the optimal level of publicity is not the maximal one, even if publicity comes for free to the auctioneer. That is: it might be the case that keeping the number of potential bidders smaller than what it could be is an optimal policy, because of the trade-off illustrated above. Next, we apply our econometric analysis to the database collected by the Italian Authority for Surveillance of Public Procurement and using the RDD method we disentangle the causal effect of publicity on the number of bidders and on the winning rebate. Our empirical analysis reports evidence of a positive and statistically significant effect of publicity on the number of bidders and on the winning rebate when the level of publicity is increased from local to regional level (+50 % and +31 % respectively). This result suggests that increasing the publicity level from local to regional can yield considerable benefits for the contracting authority, especially if we consider that the cost of publishing at regional level is rather low in Italy. On the other hand, no statistically significant effect is observed when publicity is increased from regional to national level. It appears, thus, that this increased level of publicity is not useful in attracting other potential bidders to the auction. A possible conclusion that can be drawn from this result is that regional advertisement is already per se sufficient to inform national dimensioned firms, and publishing at national level most likely causes an additional (rather high) cost to the contracting authority without yielding any additional benefit. Finally, publicity is found to have a strong effect on the winning rebate but not on the number of bidders when it is increased from national to European level: +62 %. We can interpret this result as a signal that publicity at European wide level has an impact on the final outcome of the auction which is determined not by the quantity of the participating bidders but, likely, by the quality of the firms which are participating the auction. Publishing on the Official Journal of the European Community might then be a way for the contracting authority to select efficient European firms and ultimately increase its rent.

The results described above are supported by the tests of the continuity conditions which we perform both graphically and within the regression analysis' framework.

We also report evidence of a negative correlation between competition and the time to deliver the public good within a duration analysis framework. Indeed, a shift of the number of bidders above the median determines an increase in the hazard of 12% and

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a shift of the winning rebate above the median determines an increase in the hazard rate by 10%. These effects are all significant at the 1% level. The empirical analysis thus suggests that, within the context of our data, increasing the level of publicity has a positive effect on public procurement outcomes. At this level of the analysis, however, we cannot disentangle the positive effect which is due just to the number of potential competitors from several other effects which publicity might have on the nature of competition. Indeed, increasing the publicity level might determine a reduction in the probability of collusion (simply because a 'maverick entry' from outside becomes more likely) or it might attract a particular kind of competitor which might induce local firms to bid more aggressively. We plan to address that issue in further research.

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APPENDICIES

Testing for the presence of Sorting and Lack of Continuity Conditions

As discussed in Section (2.5.1), the RDD identification strategy is mainly based on the validity of the continuity conditions, equations (2.3) and (2.4). In this application of the RDD we have in mind the caveat that auctions' starting value is not exogenously determined and that the publicity thresholds are public knowledge. Strategic contracting authorities may set auctions' starting value just below the publicity thresholds. That is, pro-local authorities that do not care of maximizing auctions' revenues may have incentives to strategically reduce the starting value below the discontinuity thresholds in order not to publish the tenders and favor local entrepreneurs. Although we have already discussed that this strategic splitting of the starting value is forbidden by the Law on public procurement and we report graphical evidence of no sorting, we formally test the possibility of such violations. We focus the statistical analysis following McCrary (2007), and Lee (2007). Since the two methods are complementary we comment the results based on the pre-treatment variables only.[27] We estimate the same models as in equation (2.9) but use as outcomes a set of pre-treatment variables. We extend the graphical analysis of Section (2.5.2), increasing the available information on the person in charge for the auction's administrative process (age and gender) and on the administrative nature of the contracting authority (Province and Municipality). In Panel A of Table (2.6) the first pre-treatment outcome that we consider is an indicator of whether the person in charge is above the median distribution of age (52 years old). If the estimates of the coefficients on the actual publicity indicator using the theoretical publicity as an instrument are statistically different from zero, that would indicate that there are systematic differences in the age of the profession of the person in charge before and after the thresholds. This would suggest the possibility that in some of the auctions there was selection around the thresholds and lack of continuity in the baseline outcomes. The second indicator is whether the person is the gender of the person in charge. In Panel B of Table (2.6) the first pre-treatment outcome that we consider is an indicator of whether the contracting authority is the Province and the second of whether it is the municipality. In both Panel A and B we report estimates for the entire sample and for the discontinuity 1 sample. Estimation results reports evidence of no selection around the discontinuities. The intention-to-treat estimates in the first

[27]The McCray (2007) density tests confirm the analysis on the pre-treatment variables and are not reported but available on request.

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column indicates that a one unit increase in the publicity level is associated with a reduction of 0.0046 of the indicator of the median age of the person in charge. This estimate is small and statistically not different from zero. We find significant effects for the IV-LATE estimates in the fifth and sixth columns of the table when we consider the MEDIUM and the LARGE information set. The MEDIUM information set is the same as for the regression for Table (2.5) and includes a third order polynomial in the starting value and time indicators. The LARGE information set includes the MEDIUM and indicators on the nature of the good (roads, culture, education) the administrative nature of the contracting authority (Municipality or Province), technical and financial characteristics required by the contracting authority to the bidders (RSOA, and OG, see section (2.4)). We further enquire this issue by using other information on the person in charge such as the gender.[28] As in the first row of Table (2.6), also in the other rows each coefficient comes from a separate regression. For example, the left cell of the row corresponding to the gender of the person in charge indicates that an increase in the amount of publicity increases the probability of being male of the person in charge by 0.002 and this estimate is small and statistically not different from zero. The coefficient get smaller if we consider the same regression at discontinuity 1. This is exactly what we should find if our identification strategy is correct and such conclusion is confirmed by the rest of the table. Moreover, all the estimates in Panel B indicate no systematic differences with respect to the indicators of whether the contracting authority is the Province or the Municipality. Estimation results allow us to exclude the existence of sorting around the thresholds.

[28] We obtained this information from the fiscal code.

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Figure 2.1: **Publicity and Competition: Forces at Work**

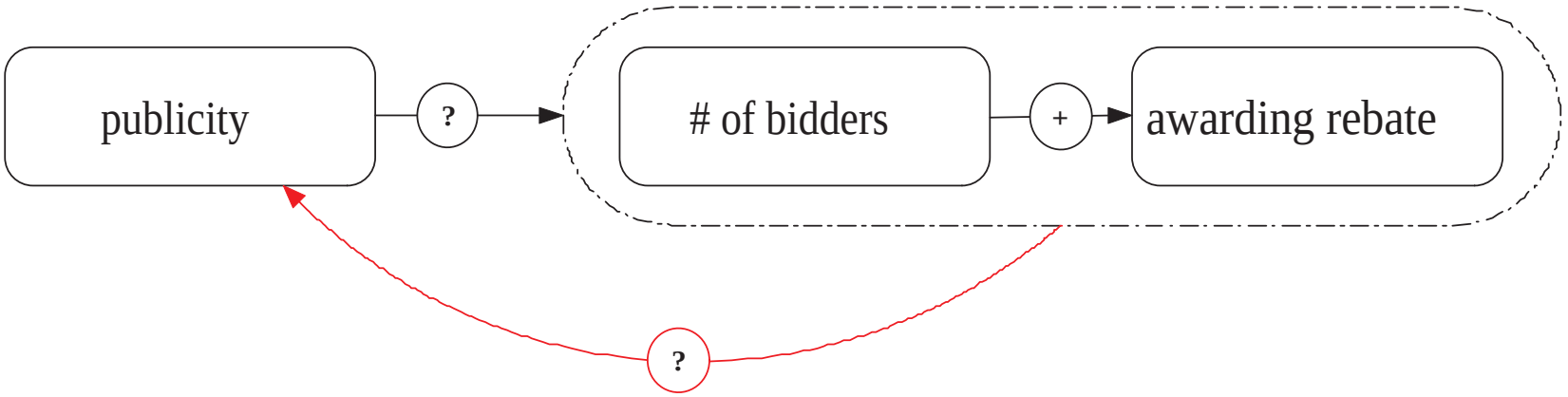

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Table 2.1: **Descriptive Statistics**

			Percentiles					
	mean	sd	p10	p25	p50	p75	p90	n
Number of Bidding Firms	32	35	3	9	21	44	77	41510
Winning Rebate	16	8.9	4.7	10	15	21	29	41510
Notice Board	.92	.27	1	1	1	1	1	41510
Regional Official Journal	.25	.43	0	0	0	1	1	41510
Italian Official Journal	.18	.39	0	0	0	0	1	41510
Number of Province Newspapers	.24	.72	0	0	0	0	1	41510
Number of Regional Newspapers	.42	.81	0	0	0	0	2	41510
Number of National Newspapers	.61	.92	0	0	0	1	2	41510
Starting Value (in 100000 Euro)	7.2	12	1.8	2.2	3.6	7	15	41510
Technical Requirements: Buildings	.13	.34	0	0	0	0	1	41510
Required Category at least 3	.29	.45	0	0	0	1	1	41510
The contractor is a Municipality	.52	.5	0	0	1	1	1	41510
The contractor is a Province	.12	.33	0	0	0	0	1	41510
The contractor is in the North	.45	.5	0	0	0	1	1	41510
The contractor is in the Center	.25	.43	0	0	0	0	1	41510
The contractor is in the South	.22	.42	0	0	0	0	1	41510

Source: Statistics for all the public procurements works tendered between 2000 and 2005.

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Table 2.2: **Descriptive Statistics, by Typology of the Object**

Typology	Roads	Education	Culture	Others
Number of Bidding Firms	46	23.5	20.4	28.1
Winning Rebate	16.6	15.3	14.1	16.2
Notice Board	.935	.953	.948	.9
Regional Official Journal	.229	.261	.274	.261
Italian Official Journal	.144	.161	.181	.204
Number of Province Newspapers	.252	.228	.236	.234
Number of Regional Newspapers	.407	.341	.422	.432
Number of National Newspapers	.545	.635	.604	.633
Starting Value (in 100000 euro)	6.33	6.95	7.5	7.47
Technical Requirements: Buildings	.0146	.271	.204	.164
Required Category at least 3	.271	.269	.302	.294
The contractor is a Municipality	.5	.608	.774	.459
The contractor is a Province	.208	.269	.0445	.0542
The contractor is in the North	.437	.499	.461	.432
The contractor is in the Center	.237	.246	.327	.242
The contractor is in the South	.243	.191	.169	.235
Fraction of the total	30.6	10.9	7.09	43.1

Source: Statistics for all the public procurements works tendered between 2000 and 2005.

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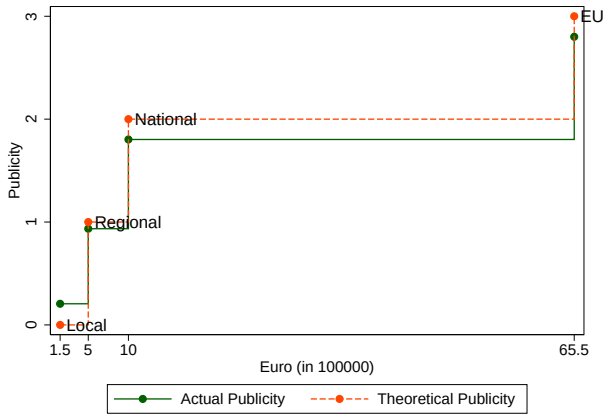
Table 2.3: **Advertisement: Rules and Costs**

Starting Value y (in 100000 euro)	Theoretical Publicity	Costs of publishing (in euro)	Non-Compliance to the Law (%)
$y \geq 65.5$	EU-Official Journal (GUCE)	Free	10
	Italian Official Journal (GURI)	7000-8000	
	National Newspapers (at least 2)	800	
	Regional Newspapers (at least 2)	600	
$10 \leq y < 65.5$	Italian Official Journal (GURI)	7000-8000	22.5
	National Newspapers (at least 2)	800	
	Regional Newspapers (at least 2)	600	
$5 \leq y < 10$	Regional Official Journal (BUR)	200-500	28.9
	Provincial Newspapers (at least 2)	400	
$y < 5$	Notice Board	Free	6.5

Note: In the table y represent the starting value of the auction. To compute the third threshold we considered 65.5 as the value of 5,000,000 of SDR in EURO 2000. The cost average of regional official journals, and of the regional, and provincial newspapers are regional and provincial averages.

Source: Law 109/1994 and Authors' interviews with national advertisement companies.

Figure 2.2: **The Publicity Function**



Source: Theoretical publicity and actual publicity (aggregate average) for all the public procurements works tendered between 2000 and 2005.

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Table 2.4: **Descriptive Statistics of the Characteristics of the Object Around Discontinuity One**

Panel A:					
Characteristics	Roads	Education	Culture	Municipality	Province
Before Disc.1	0.31	0.11	0.07	0.53	0.11
(sd)	0.46	0.31	0.26	0.50	0.31
After Disc.1	0.30	0.11	0.08	0.50	0.12
(sd)	0.46	0.31	0.27	0.50	0.33
Total	0.30	0.11	0.07	0.52	0.12
(sd)	0.46	0.31	0.26	0.50	0.32
Panel B:					
Characteristics	North	Centre	South	Tec.Req.: Buildings	Req. Cat. at least 3
Before Disc.1	0.45	0.25	0.23	0.14	0.05
(sd)	0.50	0.43	0.42	0.34	0.22
After Disc.1	0.47	0.24	0.21	0.13	0.51
(sd)	0.50	0.43	0.41	0.33	0.50
Total	0.46	0.24	0.22	0.13	0.26
(sd)	0.50	0.43	0.41	0.34	0.44

Source: Statistics for all the public procurements works tendered between 2000-2005.

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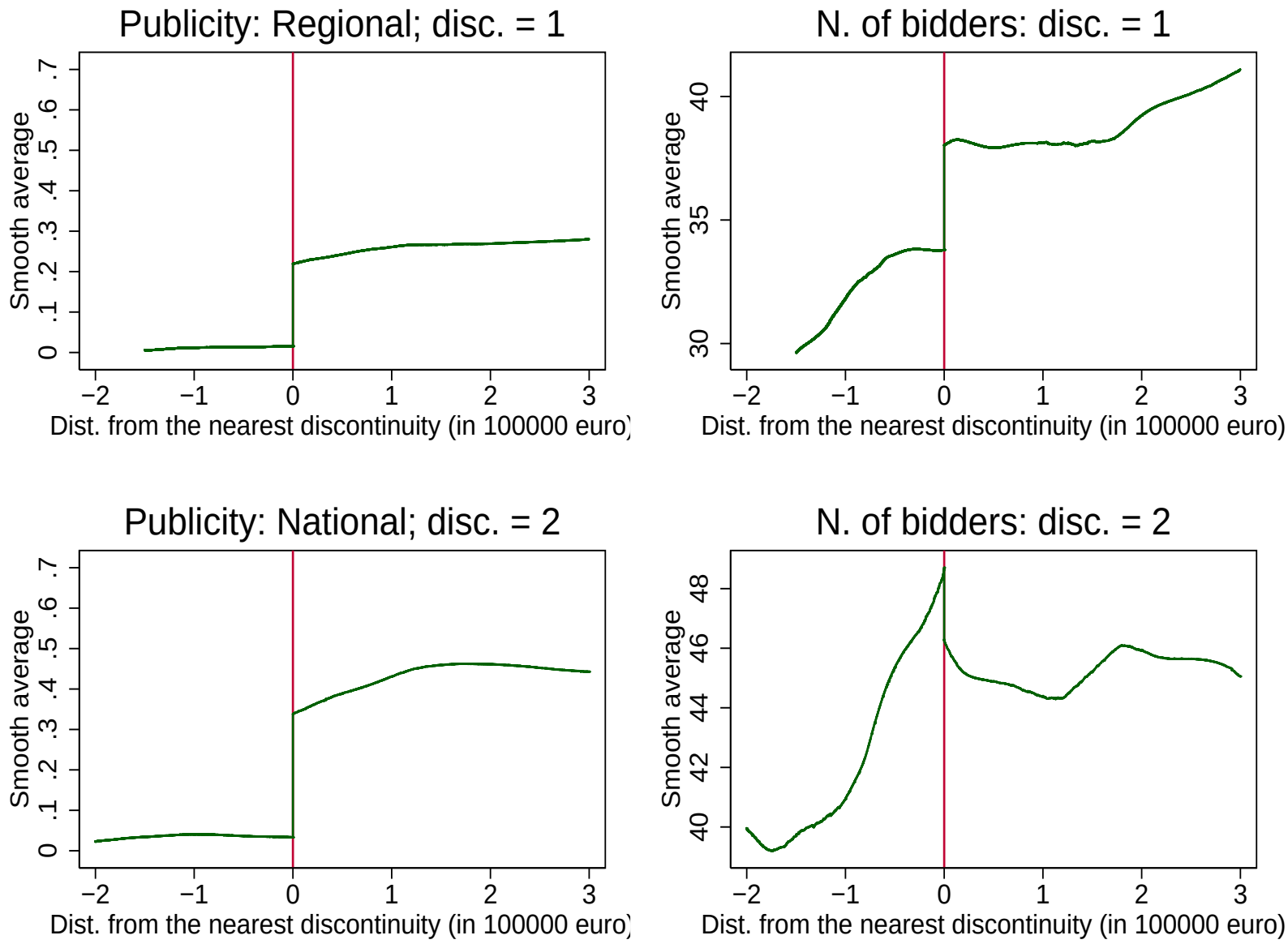
Figure 2.3: **Intention-to-treat effects**



Source: Statistics for all the public procurements works tendered between 2000 and 2005 in the discontinuity sample.

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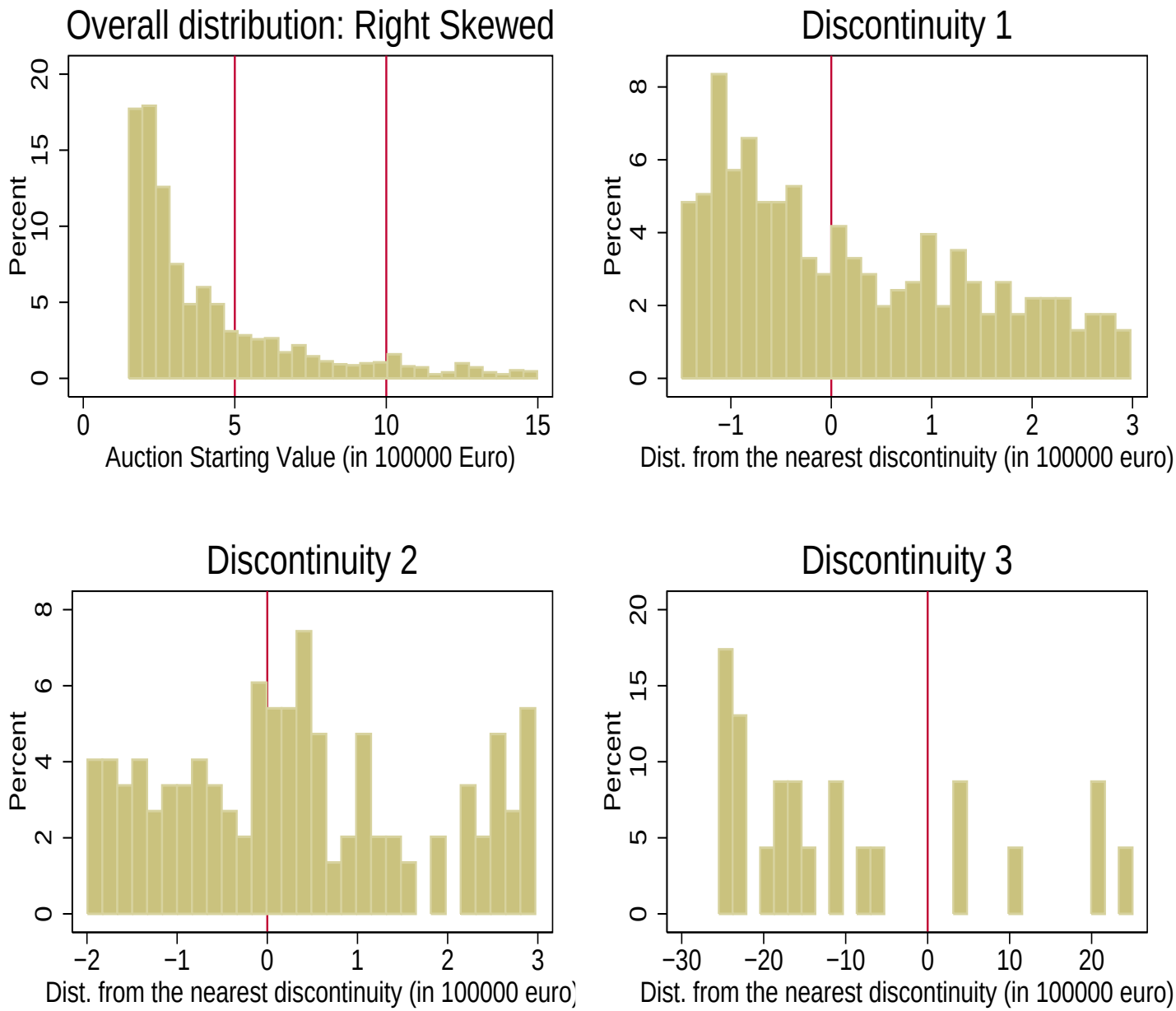
Figure 2.4: **The distribution of the Starting Value**



Source: Statistics for all the "Roads and Construction" tendered in year 2000.

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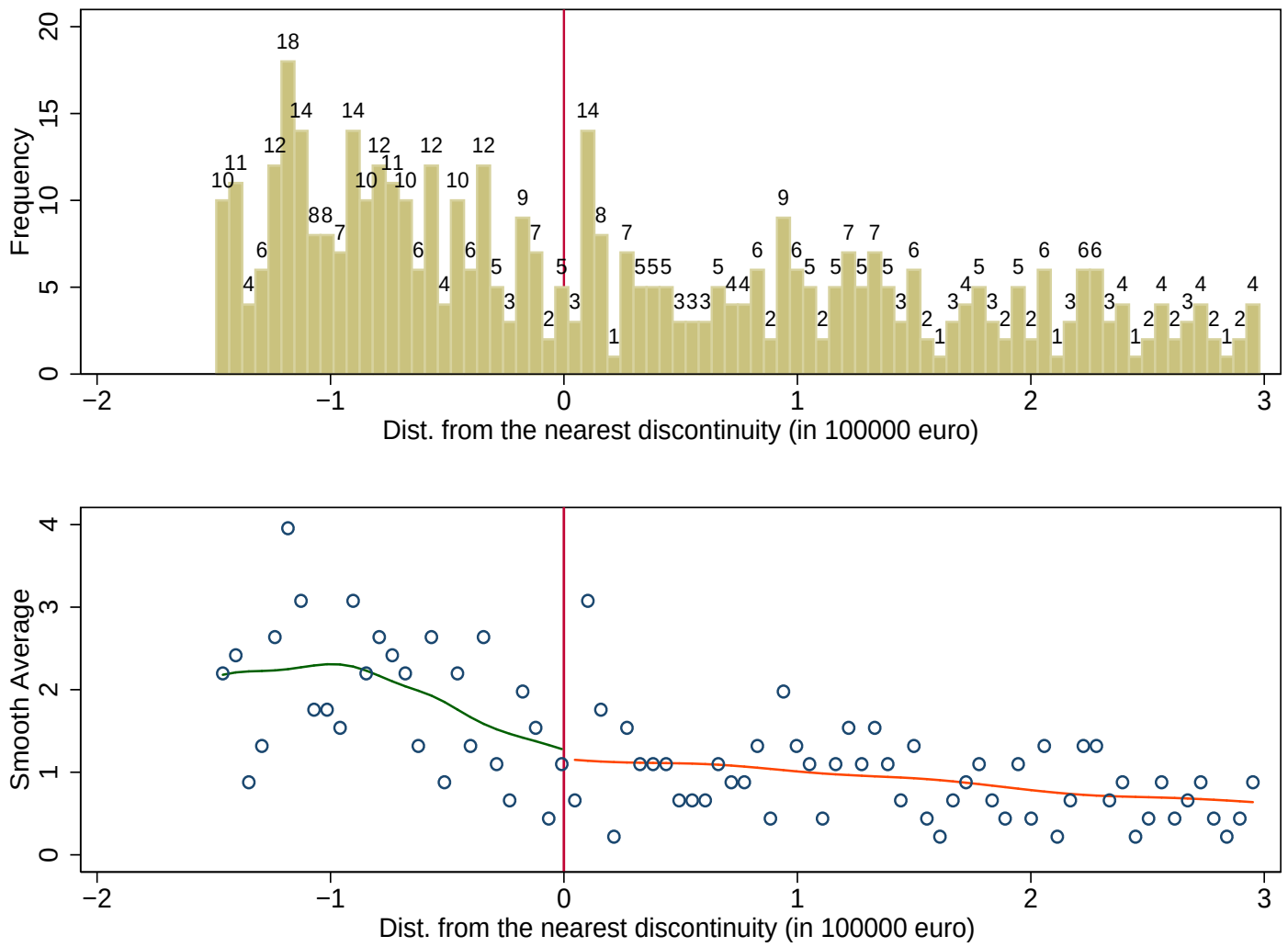
Figure 2.5: **Graphical Density Test for Lack of Continuity and Sorting of the Running Variable**



Source: Statistics for all the "Roads and Construction" tendered in year 2000 around Discontinuity 1.

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Figure 2.6: **Continuity conditions and sorting: Age of the person in charge and Municipalities**

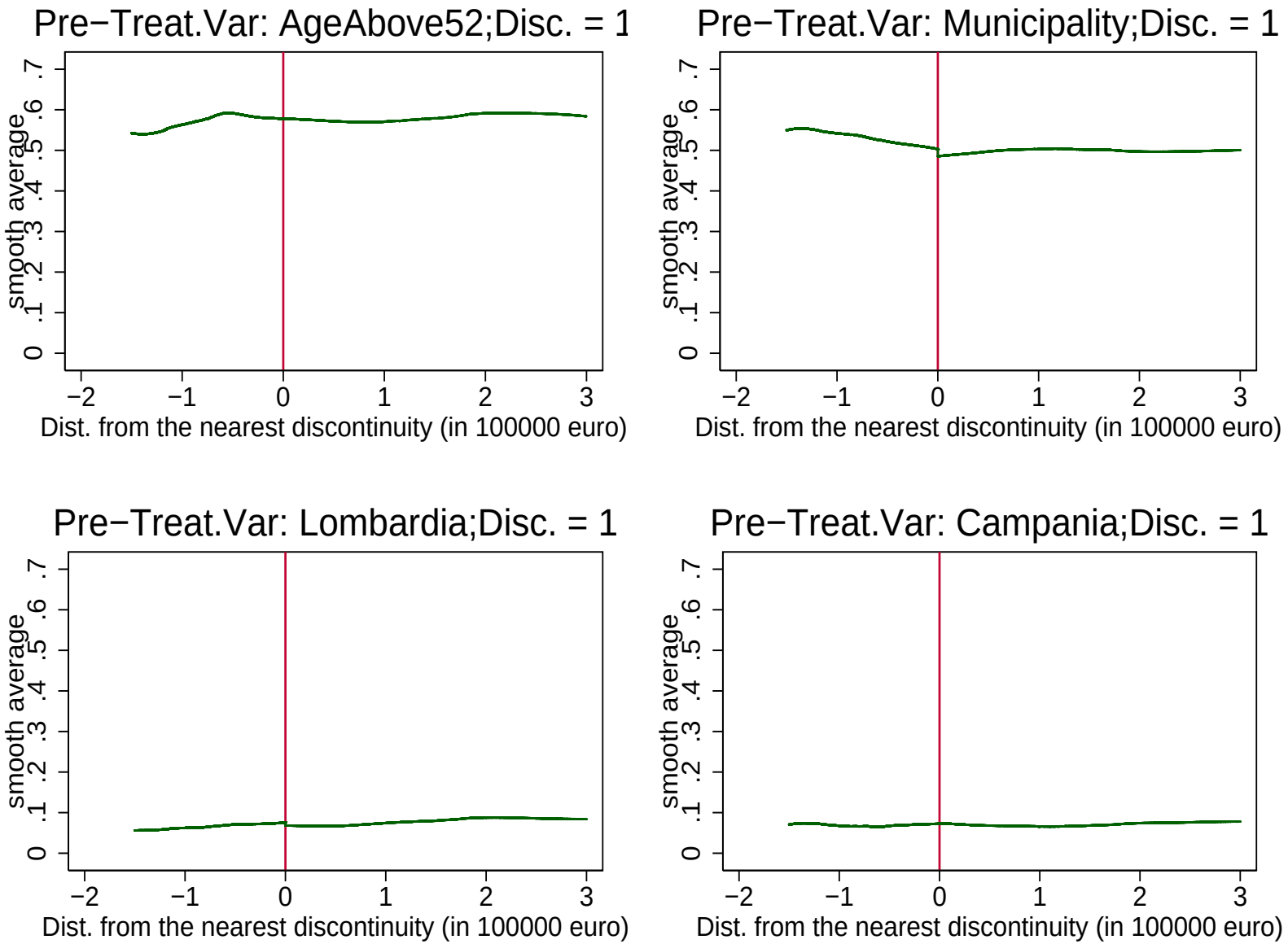

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Table 2.5: **Discontinuity Estimates of the Effect of Publicity on Competition**

Method	OLS-ITT	OLS-ITT		OLS	IV-LATE	N. of Obs.
Dep.Var	Publicity	Auction's outcome		Auction's outcome	Auction's outcome	
Treatment	Theo.Publ.	Theo.Publ.		Publicity	Publicity	
Instrument					Theo.Publ.	
	(1)	(2)		(3)	(4)	
		Panel A: Number of Bidders				
Mean-Outcome	.	.	38	.	.	17336
(sd)	.	.	35	.	.	.
Discontinuity 1	.2	3.1	.	.93	19	11434
(se)	.019	1.6	.	.96	8.5	.
Discontinuity 2	.36	-4.6	.	-3.5	-21	3528
(se)	.069	3.7	.	.9	11	.
Discontinuity 3	.65	-4.6	.	.56	-6.4	2374
(se)	.21	4	.	.67	7.1	.
		Panel B: Winning Rebate				
Mean-Outcome	.	.	16	.	.	17336
(sd)	.	.	8.7	.	.	.
Discontinuity 1	.2	.82	.	-1	4.9	11434
(se)	.019	.39	.	.22	2.1	.
Discontinuity 2	.36	.81	.	-1.1	3	3528
(se)	.069	.65	.	.17	2.1	.
Discontinuity 3	.65	6.1	.	-.16	10	2374
(se)	.21	1.6	.	.18	3.8	.

Note: Each coefficient (and standard error in parenthesis) is an estimate of β obtained from the regressions of the form: $C_i = g(y_i) + \beta P_i + \delta_t + \omega_i$ where C is the actual level of publicity in column 1 and: the number of bidders in Panel A, and the winning rebate in Panel B; P is the theoretical publicity in columns 1 and 2, and the observed publicity in columns 3 and 4. $g(y_i)$ is the third order polynomial in the starting value. Columns 1, 2 and 3 report OLS estimates: column 4 IV using the theoretical publicity as instrument for observed publicity. δ_t are year indicators.

Source: Statistics for all the public procurements works tendered between 2000 and 2005.

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Table 2.6: **Tests for the Presence of Sorting and for the Validity of the Continuity Conditions.**

	Method	OLS-ITT	OLS-ITT	OLS	OLS	IV-LATE	IV-LATE	N	N
	Treatment			Publicity	Publicity	Publicity	Publicity		
	Instrument	Theo.Publ.	Theo.Publ.			Theo.Publ.	Theo.Publ.		
	Info. Set	MEDIUM	LARGE	MEDIUM	LARGE	MEDIUM	LARGE	MEDIUM	LARGE
					Panel A: Information on the Person in Charge				
	Age above 52	-.0046	-.0045	.003	.0028	-.026	-.027	17336	17336
	(se)	.0029	.0032	.0016	.0016	.0084	.0097	.	.
Full Sample								.	.
	Male	.0038	.0048	.01	.0088	.017	.022	17336	17336
	(se)	.0048	.0056	.0032	.0032	.015	.018	.	.
	Age above 52	.01	.0096	-.00024	-.0005	.019	.019	11434	11434
	(se)	.0069	.0069	.003	.0029	.031	.031	.	.
Discontinuity 1								.	.
	Male	-.0079	-.007	.015	.013	.0072	.012	11434	11434
	(se)	.014	.014	.0068	.0068	.07	.071	.	.
					Panel B: The Contracting Authority is				
	Province	.0042	.0047	-.004	-.0021	.027	.024	17336	17336
	(se)	.0043	.0049	.0033	.0032	.015	.017	.	.
Full Sample								.	.
	Municipality	-.028	-.025	-.073	-.068	-.021	-.023	17336	17336
	(se)	.0068	.0079	.0049	.0049	.022	.026	.	.
	Province	.0039	.0023	.0062	.01	.039	.026	11434	11434
	(se)	.013	.013	.0081	.0078	.07	.068	.	.
Discontinuity 1								.	.
	Municipality	-.0092	-.0063	-.069	-.062	.055	.061	11434	11434
	(se)	.021	.021	.012	.012	.11	.11	.	.

Note: Each coefficient (and standard error in parenthesis) is an estimate of β obtained from the regressions of the form: $\mathrm{K}_i = g(Y_i) + \beta P_i + \delta_t + \omega_i$ where K is the pre-treatment outcome indicated in each row of column 1. P is the theoretical publicity in columns 1 and 2, and the observed publicity in columns 3 and 4. $g(y_i)$ is the third order polynomial in the starting value. Columns 1-4 report OLS estimates: column 4-6 IV using the theoretical publicity as instrument for observed publicity. δ_t are year indicators. Columns 2, 4, 6 includes indicators on the nature of the good (roads, culture, education) the administrative structure of the contracting authority (Municipality or Province), technical and financial characteristics required by the contracting authority to the bidders (RSOA, and OG) and 21 regional indicators. Statistics for all the public procurements works tendered between 2000 and 2005.

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Table 2.7: **Sensitivity Analysis: Discontinuity Effects of Publicity on the Winning Rebate**

Model	Reduced sample	4^{th} Order polynomial	Reduced sample + 4^{th} Order polynomial	LARGE Info-Set	LARGE Info-Set + 4^{th} Order polynomial
	(1)	(2)	(3)	(4)	(5)
		Panel A: Discontinuity 1			
OLS	-.42	-1.1	-.43	-1.2	-1.2
(se)	.3	.22	.3	.22	.22
IV	6.2	6.7	5.6	4	5.5
(se)	4.4	2.7	4.6	2.1	2.7
N	5983	11434	5983	11434	11434
		Panel B: Discontinuity 2			
OLS	-1.3	-1.1	-1.3	-1	-1
(se)	.28	.17	.28	.17	.17
IV	6.9	2.5	8	2.8	2.2
(se)	4.1	2	4.6	2.1	2.1
N	1495	3528	1495	3528	3528
		Panel C: Discontinuity 3			
OLS	1.8	-.18	1.6	-.093	-.1
(se)	.65	.18	.65	.18	.18
IV	12	9.9	20	13	12
(se)	16	4.7	50	6.7	6.8
N	209	2374	209	2374	2374

Note: Each coefficient (and robust standard error in parenthesis) is an estimate of β obtained from the regressions of the form: $R_i = g(Y_i) + \beta P_i + \gamma X_i + \delta_t + \omega_i$ where R is the winning rebate and P is the actual level of publicity, X_i a vector of observable characteristics and $g(y_i)$ is the polynomial in the starting value. Odd rows report OLS while even rows IV-LATE estimates using the theoretical publicity as instrument for observed publicity. δ_t are year indicators. In columns 4-5 the LARGE info-set includes indicators on the nature of the good (roads, culture, education) the administrative nature of the contracting authority (Municipality or Province), technical and financial characteristics required by the contracting authority to the bidders (RSOA, and OG). Statistics for all the public procurements works tendered between 2000 and 2005.

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Figure 2.7: **Competition and Time to Accomplish the Works: Kaplain-Meier Estimates for Roads**

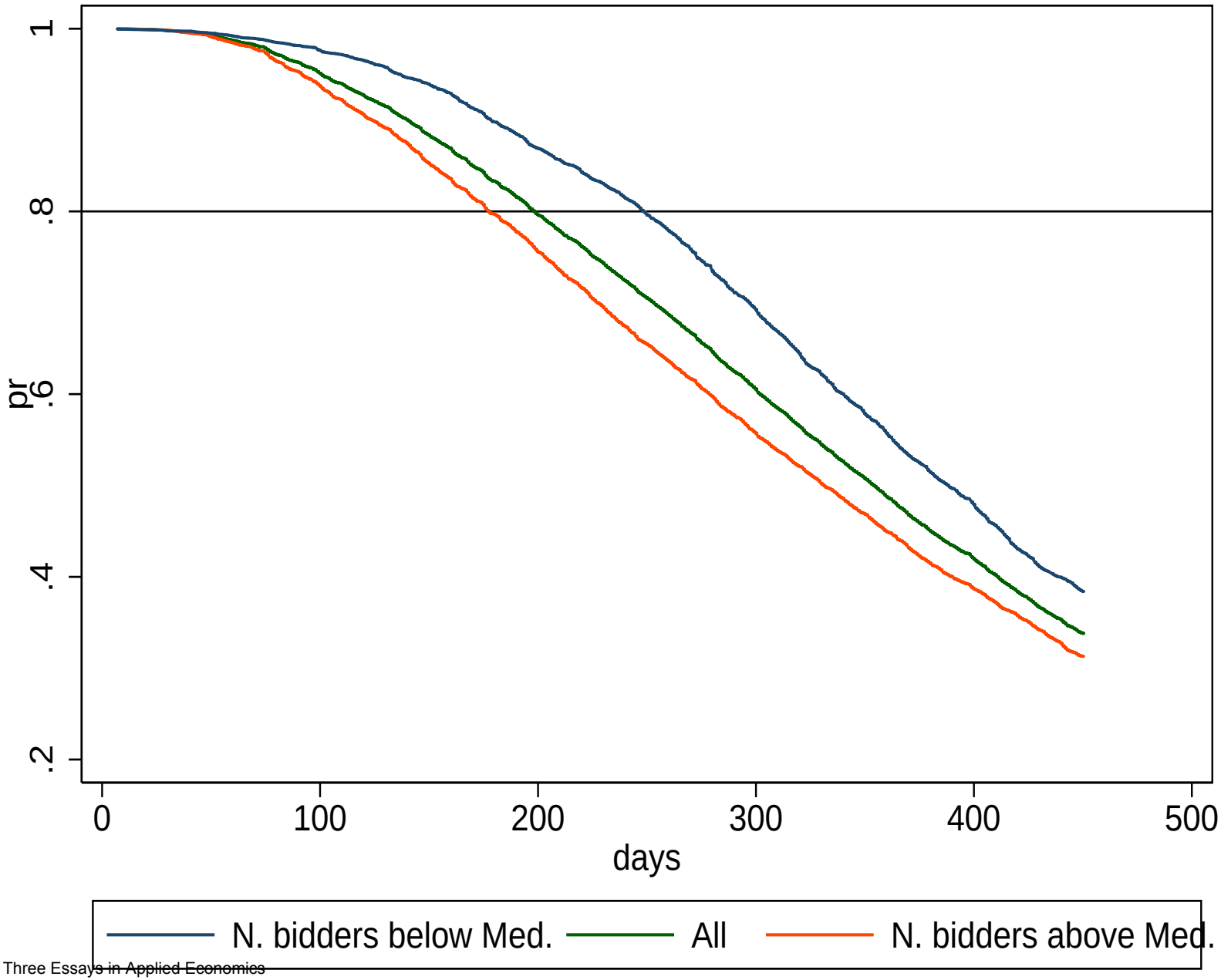

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Table 2.8: **Works' Duration, Estimated Hazard Ratios from Cox-PH Models**

Information Set	Number of bidders above median	Winning rebate above median
MEDIUM	.17	.054
(se)	.016	.016
LARGE	.12	.1
(se)	.018	.019
N	20214	20214

Note: Each coefficient (and standard error below) is an estimate of the β obtained from the regressions of the form: $\mathrm{h}_i(t|x,\beta) = h_0(t)e^{(g(y_i)+\beta C_i+\delta X_i)}$ where h_i is the hazard function (i.e. the instantaneous probability of accomplish the works at t given survival until t) and h_0 the baseline hazard. $g(y_i)$ is the third order polynomial in the starting value. The columns report the effects considering separately the 2 proxies for competition (C_i). The MEDIUM information set includes as regressors the third order polynomial in the starting values. The LARGE information set includes indicators on the nature of the good (roads, culture, education) the administrative nature of the contracting authority (Municipality or Province), technical and financial characteristics required by the contracting authority to the bidders (RSOA, and OG) and 21 regional indicators.

Source: Statistics for all the public procurements works tendered between 2000 and 2005.

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Chapter 3

Political Longevity and Competition in Public Procurement Auctions

Synopsis

In this paper we investigate the relationship between the time politicians remain in power and the functioning of public procurement auctions. To this purpose, we use a dataset on the Italian municipal governments and all the public tenders they administered between 2000 and 2005. Identification is obtained through the introduction of a two-term limit in March 1993: since the reform was not retroactive, mayors appointed right before the implementation could be potentially re-elected for two additional terms, while the others for one only. Assuming no manipulation of election timing, we use the year of election (before or after 1993) as an instrument for the accumulated longevity in office. Our primary finding is that political longevity deteriorates public spending. In fact, it decreases the number of bidders and the winning rebate, while it increases the probability of renegotiating the terms of the contract in favor of the winning firm. We interpret these figures as evidence that leaving politicians in office longer increases their probability of collusion with local firms. Accordingly, we also find that the effect of political longevity is weaker at higher levels of government (i.e., provincial authorities), where it is more difficult to establish personal connections.

3.1 Introduction

Political authorities commonly use public contracting to realize works in outsourcing[1], the objective for the contractor being the minimization of public expenditure under

[1]It has been estimated that the average total expenditure for government procurement, less compensation and defence, accounts for the 7.57 % of the GDP of OECD Members (Audet, 2002).

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the provision of a certain quality. However, the miss-practice of using public contracts to strategically allocate public funds to interest groups is widespread, and it renders public contracts a powerful tool for incumbent politicians to consolidate their political consensus through favoritism, and eventually to get bribes.

While there is evidence that political connections drive the allocation of procurement contracts (Goldman, Rocholl and So, 2008a), even in the case this is done through public tenders e.g. competitive procurement auctions, (Hyytinen, Lundberg, and Toivanen, 2007), little is known, however, about their process of making over time.[2] If it takes time for bidders to establish a preferential relationship with the political authority, a periodic replacement of the person who is in charge for the assignment might indeed break collusion, thus improving the efficiency of auction mechanisms. If instead connections could be instantaneously build up at the beginning of each electoral term, or if candidates already have established acquaintances at the time of election, one should observe no effect of political longevity on the level of collusion. Other than collusion, there might also be a process of skills accumulation through which politicians learn how to design and administrate the procurement mechanism, and finally improve public spending. Whether there is an effect of political longevity over the functioning of public procurement remains, therefore, an empirical question.

In this paper we address this question using a dataset on the Italian mayoral terms, and all the public procurement auctions they administered between 2000 and 2005. The institutional framework is particularly suited for the analysis because all municipal procurement auctions are sealed-bid, which reduces the possibility of complex strategic behaviors, and single-attribute (price only), which instead simplifies the identification of deceitful behaviors. For identification purposes, we exploit the introduction of a two-term limit in 1993. Since the term-limit applied to the terms elected after 1993, mayors appointed right before could be then reelected for two additional terms, while those elected after 1993 for one only. Under the assumption that the timing of election could not be manipulated, but it was the result of an historical and idiosyncratic scheduling, we use the year of election (before or after 1993) as an instrument for the time spent in office, and analyze the impact on a series of outcomes characterizing the functioning of public tenders.

To correct for the simultaneous implementation of another reform –the introduction of the mayor's direct election– that might have affected the quality of the treated and

[2]More generally, there is a wide empirical evidence showing that political connections bust firms' performance (Cingano and Pinotti, 2009 in an application to Italy; Dombrovsky, 2008; Faccio, 2006; Ferguson and Voth, 2008; Fisman, 2001; Goldman, Rocholl and So, 2007b), and that politicians benefit from control over firms (Sukhtankar, 2008).

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the control group differently, we further implement a fuzzy Regression Discontinuity Design (Card and Lee, 2008): while the term limit applied sharply after the reform, the introduction of individual-ballot elections was instead more resilient, because of the initial difficulty for parties to recruit candidates more suitable to the new electoral system. If so, focusing on elections right before and after the 1993 reform will remove any additional bias due to the different selection mechanism for the treated and the control group.

The main results show that when the same politician remains in power for a long period, there is a progressive reduction in the number of bidders participating in the auctions (between -5.4% and -14.8% for each additional term in office) and, more importantly, a reduction in the price at which the auction is assigned (between -1.7.% and -4.3%), although the last result is not always statistically significant. At the same time, we also find that having the same mayor in power for another term almost doubles the probability that there will be a disadvantageous renegotiation of the work, both in terms of delaying the delivery and in terms of the final cost incurred by the contracting authority. We interpret these figures as evidence that longevity, as opposed to political turnover, comes with an increasing collusion between the incumbent mayor and some of the bidding firms.

Since the 1993 reform also applied to the provincial governments (the administrative level just above the municipalities), we finally investigate whether the effect of political longevity depends on the government level at which auctions are administered. We find that, contrarily to municipalities, when the tenders are held at province level political longevity has a positive and significant effect on both the number of bidders and the winning rebate. These findings are in line with the conjecture that the most corrupt governments seem to be at the local level, where governments are often under the control of narrow elites that use it for personal gain (Rose-Ackerman, 1999).

The rest of the paper is organized as follows. In Section 3.2, we review the related literature and outline the theoretical background that we will use to interpret the data. In Section 3.3, we describe the details of the estimation strategy. In section 3.4, we describe the Italian institutional framework. In Section 3.5 we explain the data. In Section 3.6, we present the results. We conclude with Section 3.7.

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3.2 Background and conceptual framework

3.2.1 Related literature

The empirical literature on corruption recently moved to consider direct measures of shadow behaviors, like the unlawful administration of public goods or the amount of bribes, rather then subjective opinion surveys.[3] Examples include Bandiera et al. (2008), Di Tella and Schargrodsky (2003), and Ferraz and Finan (2008). In particular, Bandiera et al. (2008) study the introduction in Italy of a centralized purchasing authority (*Consip*) and find that the waste of public funds is mostly generated by red tape rather then bribes; and that there are sizeable cost reductions in centralizing the purchase of standardized goods because providers compete in an environment with higher potential competition. Interestingly, Ferraz and Finan (2008) consider random audits of local governments together with the two-term limit rule to identify the causal effects of lack of accountability on corruption.

Within this framework, our paper closely relates to recent studies on the relationship between political stability and corruption. Among the others, Gamboa-Cavazos et al. (2008) use firm-level data for Mexico on extra-official payments made by firms to show that the political clout exerted on a state government affects corruption in a non-linear manner. Specifically, they find that corruption is more intense over long and short political horizons, and less intense over intermediate ones, because of a combination of "horizon" and "capture" effects. Similarly, Campante et al. (2008) use cross-country data and find a U-shaped relationship between corruption and political stability, while Besley and Prat (2004) find a positive and linear correlation between political longevity and several measure of corruption.

More broadly, there is an increasing interest in analyzing the way political competition affects economic outcomes. Some authors argue that the lack of political competition may lead to policies that hinder economic growth, this because dominant parties have less incentives to appeal to swing voters, who are not committed to one party and are prepared to vote against candidates pursuing distorted policies (Besley, Persson and Sturm, 2007; Polo, 1998). Others have argued instead that as far as political leaders are constrained by the threat of entry, regimes with no challengers may nonetheless implement policies in the public interest and carry out long-term reforms without the need to please small but pivotal interest groups (Mulligan and Tsui, 2008).

At theoretical level, we borrow from a wide literature which analyzes the way the principal can manipulate an auction to favor one of the bidders in exchange for a bribe.

[3] See Rose-Ackerman (1999) for the early studies.

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Some authors have emphasized the importance of specific weighting rules to help reducing the importance of manipulative attributes (Laffont and Tirole, 1991; Burguet and Che, 2004). However, Compte, Lambert-Mogiliansky and Verdier (2005) show that, even in the case of single-attribute sealed-bid procurement auctions, bureaucrats may still provide an opportunity for bid readjustments, in which case a tighter control is the only solution.[4] Our paper also relates to the recent applied literature that analyzes the procurement of construction contracts and contractual adjustments. Examples are Guasch, Laffont, and Straub (2008) where they examine the ex-post contractual renegotiations of procurement contracts for utility concessions in a group of Latin American countries. Bajari and Tadelis (2001) and (2006), Bajari, McMillan and Tadelis (2008) and Bajari and Lewis (2009) examine both theoretically and empirically the procurement of construction contracts and argue that procurement contracts are often incomplete because the initial plans and specifications are changed and refined after the contract is awarded resulting in a final cost that may involve significant renegotiation costs. In general, these analyses ignore the fact that the bidders in these auctions might have a preferential relationship with the auctioneer and collusion can leave room for some degree of ex-post adjustment of the awarded contract. On this line, Engel et al. (2006) consider a model where the auctioneer is also an elected politician, within a framework where the ex-post renegotiations of the concession contracts, awarded through competitive public tenders, are used as a tool of the political incumbent to increase the probability of winning the upcoming election.

Compared to this literature, the contribution of our paper is twofold. First, we use the introduction of the two-term limit rule to bring new empirical evidence on the causal link between the political longevity, which may be seen as one realization of lack of competition, and the way public procurement auctions are administered. Second, we highlight a new mechanism to mitigate favoritism, i.e., the political turnover.

3.2.2 Conceptual framework

In this section we outline a stylized mechanism through which political longevity can reduce the competitive tension within procurement auctions. We conjecture some testable predictions without formalizing an auction model, and interpret the estimation results withdrawing from both the empirical industrial organization and the practical auction design literature. In the spirit of Klemperer (2002), we will assume that what really

[4] Another strand of literature has focused instead of the collusion among bidders (the so called bidding rings). Among the others, Robinson (1985), Graham and Marshall (1987), and McAfee and McMillian (1992).

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matters in auction design are the standard tools generally used to spur competition. That is, in auctions with lower entry barriers there is less collusion, more competition, and consequently the price payed by the contracting authority is lower. In what follows, we assume that entry is a costly activity, as there are large bureaucratic bidding preparation costs, and that the auction game can be severely biased by the presence of systematic *ex-post* deviations from the awarding price, e.g. monetary and time renegotiations, approved by an auctioneer that wants to favor just some specific bidders. The possibility of renegotiations favors some firms, the *insiders*, that can bid more aggressively below their marginal costs, and win the auction with a probability that is higher than the one of equally competitive *outsiders* that will finally not show up in the auction as they will waste the bidding preparation and participation costs. Potential bidders, after solving a profit maximization problem and knowing the probability distribution of others' valuations, decide whether to take part in the auction if their expected profits are above the endogenous entry threshold and how much to bid. We argue that when a new mayor is elected there are no or few political connections and every bidder faces the same ex-ante probability of renegotiations. For this reason, the number of bidders is high and competitive pressure rises the final rebate.

Throughout the term, political connections are formed, which are not reversible and grow until they reach an upper bound as collusion between politicians and bidders is illegal. The probability distribution of political connections is not common knowledge, but bidders infer about it by looking at both the outcomes of each auction and the identity of the winning bidder that are public knowledge. When a bidder is drawn, he or she will pay a bribe to the mayor in exchange for a higher renegotiation probability. For the same reason, those who are not drawn will update downward their expected renegotiation probability and thus increase their entry threshold. In this way, by the end of the first term all political connections are revealed: only connected bidders participate in the auctions, rebates are lower because of the reduction in the competitive pressure, and the probability of renegotiation is higher as are used to increase entry barriers. If the mayor is reelected for a second term, unlucky bidders leave the stage to connected bidders only.[5] If instead the mayor is not reelected, political connections are reset and competition in public contracting follows the same pattern as before. One important alternative to the outlined framework regards the process of making of political connections. If, instead of growing over time, all connections were instantaneously formed at the beginning of each term (or, alternatively, if every candidate already had a set of

[5] We assume that colluded bidders cannot influence electoral voting, such that the outcome of elections is orthogonal to favoritism in public procurement.

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connections at the time of election), we should not observe any change in the outcome of public procurement auctions. This is because bidders know that if they are not drawn first, they will never have the chance of being assigned an auction. This stylized model deliver the following two alternative hypotheses for the effect of a change in the mayor on public procurement auctions:

Hypothesis 1: If the process of making political connections is slow, we should observe a reduction in competition, an increase in the winning rebate, and a higher probability of renegotiation followed as far as political longevity increases.

Hypothesis 2: If the process of making political connections is instantaneous, we should observe no effect on competition, on the winning rebate, and on the probability of renegotiation as far as political longevity increases.

An alternative hypothesis is that there might also be a learning process on the part of mayors. Abstracting from possible collusive behaviors, mayors might acquire skills, through practice, and learn how better design and administrate the procurement auctions, attract more and efficient bidders, and finally improve public spending. Along this line, Dal Bó and Rossi (2008) exploit a natural experiment in the Argentine House of Representatives where term lengths were assigned randomly and reporot evidence that that longer terms enhance legislative productivity in the Argentinian Parliament, as measured by attendance, committee activity, and the number of legislative achievements, while Padró i Miquel and Snyder (2006) find that productivity, as measured by surveying legislators, lobbyists, and journalists in North Carolina about the effectiveness of the members of the House of Representatives, rises sharply with tenure. Recently, Conconi et al. (2009), find that in the U.S. Congress trade liberalization reforms are more easily undertaken when politicians serve longer terms and explain it by considering the possible divergence between the political and the reform horizons. Adapted to the case of procurement auctions, It is easy to think of a new mayor who does not have any expertise in public procurement and, after election, could only endure previous practices. However, if really motivated in reducing public spending and gain electoral consensus, he or she might soon take control of the procurement process and learn how to improve the overall efficiency of the procurement contract using efficiently the procurement law. For instance, Coviello and Mariniello (2008) in the same framework of public works in Italy, report evidence that contracting authorities that strictly comply with the public procurement law and advertise public tenders, thus are open to a large set of potential competitors, benefit from higher actual competition-i.e. more bidding firms- and of a reduction in the final prices payed by the contracting authorities after taking into

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account the extra costs of advertisement. If this is the case, we could then formulate another hypothesis:

Hypothesis 3: If the process of skills accumulation prevails over the process of making connections, we should observe a higher competition, a reduction in the winning rebate, and a lower probability of renegotiation as far as political longevity increases.

Finally, we form our three testable hypothesis within an auction framework where an overall reduction of entry barriers, by reducing bidders' entry costs, increases actual entry and consequently stimulate a fierce price competition. This relation is theoretically not unquestioned and should be interpreted with a careful consideration of both the mechanism behind the auction in consideration and the regularities displayed in the data. In our sample, we report evidence of a positive correlation between the number of bidders and the winning rebate which is typical of competitive auctions. We use this fact to contrast the theoretical findings of a recent paper that analyzes the italian case and to support our hypothesis.[6] More in general, both the sophistication of the averaged-average selection mechanism and the empirical findings allow us to reject the main predictions of average bid models.[7] The sizable correlations between the number of bidders and the winning rebate, that range from 0.35 to 0.44 and are statistically different from zero, are suggestive of a competitive component left in the averaged-average method.[8] Even if the italian selection mechanism that rewards only bidders getting closer to the averaged-average from below and excludes from competition the ones above it, is neither a first price nor a pure average bid method auction we frame our hypothesis within a framework that, in presence of both collusion between the auctioneer and the bidders and among bidders, leaves some competitive pressure. Given the uniqueness of the Italian mechanism a formal proof of the equilibrium properties of the selection mechanism goes beyond the scope of this paper and leave it for further research.

[6]See Lemma 2 and 3 and footnote 38, at pg. 20-22 of Decarolis (2008). In this paper under the Independent Private Value assumption, it is showed that as the number of bidders grows asymptotically all the symmetric Bayesian Nash Equilibria converge toward the minimum evaluations of the bidders. Similarly under the pure Common Value assumption it is argued that, in equilibrium, no matter what is the number of bidders, all the players will bid a constant c that will be bounded between zero and y, the common value of the bidders. Under both assumptions the average bid model predicts a negative (or zero asymptotically) correlation between the number of bidders and the winning rebate.

[7]We leave for Section 3.4 a detailed description of the institutional set-up.

[8]These estimates are not reported but available on request.

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In what comes next, we describe the identification strategy that will allow us to bring these alternative hypotheses to the data.

3.3 Identification Strategy

We want to estimate whether the time spent in office by the same mayor affects the outcome of the procurement auctions administered in the city. Assume that the outcome of an auction i managed by a mayor m can be specified in the following linear form:

$$y_{im} = \alpha + \beta T_{im} + \delta_1 X_i + \delta_2 X_m + \nu_{im}, \tag{3.1}$$

where y_{im} is the outcome of the auction; T_{im} denotes the longevity in office of the mayor at the time of the bids' delivery; X_i is a vector of auction characteristics; X_m is a vector of mayor, electoral, and city characteristics; and ν_{im} represents the disturbance term composed by a mayor specific fixed effect η_m and ϵ_{im} the usual white noise random component left from the model specification. The coefficient of interest is β. If the collusion effect, induced by the political longevity of the mayor dominates over the positive skills acquisition effect (or it does not apply because connections form instantaneously after election), β should be estimated with a negative sign representing a systematic deterioration of the functioning of the auctions administrated by long-lasting mayors. An otherwise positive estimate of β will be interpreted as a predominance of the skill acquisition effect over the collusion effect, thus suggesting that the political turnover caused by the two-term limit may be inefficient.

We specify four different versions of Equation (3.1) to control for four possible sources of observable heterogenenity. The most parsimonious model (M1) includes the resident population in the municipality as of 2000 to proxy for the size of the construction sector[9], a full set of fixed effect for all the 104 provinces to control for time invariant characteristic of the local market, an indicator for the judicial efficiency index at year-region level, the budget percentage deficit over total revenues, and a set of indicators for the year of the delivery of the bid to control for possible time effects. Model two (M2), adds the set of observable characteristics of the auctioned good to the covariates of M1, including a second order polynomial of the starting value of the auction (i.e., the reservation price of the contracting authority) in 100 thousands euros and 2000 equivalents, three selection mechanism dummies, and five object dummies. Model three (M3), adds to M2

[9]The resident population is a proxy for the number of potential competitors and a preliminary way to control for size effects. We are currently collecting information at municipality level on the number of firms certified to compete in procurement auctions.

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the observable characteristics of the mayors (gender, age, four education dummies, four previous occupation dummies, whether the mayor was born in the city), while model four (M4), finally adds electoral characteristics, i.e., whether the mayor faces a term limit, the number of parties in the mayor's coalition, four dummies for the mayor's party, the longevity in power of the mayor's party in years, and a second order polynomial of the time from the next scheduled election to capture electoral cycles. We will comment estimated coefficients only for this fully specified model.

Models M1-M4 represent one possible way to control for observable heterogeneity. One generally adopted alternative is to exploit the longitudinal structure of our database that contain repeated observation-i.e. several auctions- for each mayor and report a fixed effect analysis. In the presence of enough within-mayor variability and time invariant unobservables factors determining both the outcomes of the auctions and the political longevity, the fixed effect estimator is a powerful solution for the omission of any auction-invariant characteristic like the propensity to collude of each mayor. Unfortunately, our database displays a within-mayor variation smaller than the between-mayor variation in the political longevity indicator, the main variable of interest. It is well known that any within-mayor analysis, like the fixed-effect, by exploiting this low within-mayor variation delivers un-precise estimates. Hence, we opted to perform a fully cross-sectional analysis and to find an exogenous variation in political longevity orthogonal to the unobservable omitted factors determining both political longevity and the outcome of the auctions.

3.3.1 Instrumental Variables

In this section we address the possible endogeneity of political longevity (T_{im}). More colluded mayors, in fact, might be able to manage re-election more easily, if the lack of competition induced by pro-collusive behaviors between auctioneers and bidders helps politicians to be re-elected. Conversely, colluded mayors might have hard time to get reelected if voters punish their unlawful or inefficient behavior in the ballot. The same argument applies if experience, rather than collusion, was the main determinant for both reelection and auctions' functioning.

To deal with this potential problem, we exploit the electoral reform that took place in 1993 and argue that it induced an exogenous variation in the political longevity of a particular group of mayors.

In March 1993 the Italian Parliament approved a wide reform of local administrations, Municipalities and Provinces, in response to the 1990-1992 political crisis generated by the harshest judicial campaign *"Mani Pulite"*[10], that for the first time started a

[10]The activism of the pool of Judges of Milan which started the first strong campaign to break

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dramatic investigation on the corruption of local administrators in the management of public tenders. This reform, among other things, introduced a new electoral system that constrained the number of new terms a mayor could stay in office to a maximum of two, leaving out the previous ones. The reform also aimed at increasing the participation of citizens in the selection of local administrators and introduced a voting system that allowed voters to directly elect mayors or presidents of the province-i.e. the individual ballot system. The new electoral system remained substantially unchanged until 2005, constrained the political horizon of newly elected mayors, and was implemented with non-retroactive effects.[11]

Interestingly, the introduction of the new rule in March 1993 was unexpected and determined potentially two groups of mayors at the time in office. In Figure 3.2 we graphically illustrate the potential effects of the reform for the two groups of mayors. The horizontal line represents the time line and reports the year of the reform, and the period that we observe data on procurement auctions. The continuos lines denote the terms already gained by the mayors around the reform, while the shadow lines the potential terms the two groups of mayors can have. The figure shows that mayors elected before 1993, the treatment group, had a potential political longevity of at most three terms plus their 1993 cumulated tenure in office. Mayors elected after the 1993, the control group, had a potential political longevity of at most two terms. We exploit this difference in the maximum number of potential terms in office before and after the reform to identify the causal effect of observed political longevity. Moreover, the limited availability of public tenders data will force the analysis on politicians actually in office between the period 2000-2005. Clearly, the political longevity observed during the period 2000-2005 depends partially on the distance from the elections at the date of the reform, and partially on other unobservable phenomena (e.g. ability of the incumbent mayors to be re-elected, local collusion, perverse incentives, left-censoring, or simply measurement error) that can potentially be correlated with the unobservable components of the outcome equation. We overcome the problem fully using the database on politicians that covers the period 1985-2007, to trace back the political career of these politicians, and use the extra theoretical longevity, determined by the random scheduling of the elections in the neighborhood of the reform, as a predictor for the extra observed longevity. In practice, we use the theoretical longevity within an instrumental variable framework to identify the causal effect of the exogenous variation in political longevity induced by the

collusion between politicians and firms in the construction sector leaded to a dissolution of the Christian Democratic Party and at the end of the so called "First Republic".

[11] In 2000, the duration of a legislative term was increased from four to five years.

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reform.[12] Hence, if the reform was unexpected thus a valid instrument, then reporting evidence that the mayors elected before March 1993 systematically benefited from the reform by being politically more longevous during the period of observation would be enough to argue that the 1993 reform determined higher observed tenure for mayors in office during the period 2000-2005.[13] We validate this hypothesis, estimating by how much the cumulated political longevity of mayors in office between 2000-2005 can be explained by the fact that they have been elected for the first time before March 1993. As a dependent variable of the first-stage regression, Equation (3.2), we use the indicator of longevity in power T_{im} and, as an exclusion restriction, an indicator of whether the mayor was elected before March 1993, plus a full set of available regressors as specified in model M4. The resulting first stage equation is as follows:

$$T_{im} = a + bPR_m + c_1 X_i + c_2 X_m + \varepsilon_{im} \tag{3.2}$$

where, PR_m indicates whether the date of the first election was before March 1993, and it is the excluded instrument in the Instrumental Variables (IV) estimation of Equation (3.1). To test for instrument relevance, and rule out the possibility of biasing estimates and confidence intervals because of weak instruments, we compare the first-stages *F-statistics* of the excluded instrument using the rule of thumb of being greater than 10.

Instrument relevance is only one of the two requirements to conclude that the instrument is good, and it is the testable one. The most difficult requirement is the validity of the exclusion restriction and its justification. To argue that the instrument is valid we need to discuss that the exclusion restriction is reasonable, and nothing eventually related with the scheduling of the elections is left in the error term ν_{im}. In a theoretical example, one may argue that more colluded politicians could have systematically resigned their mandate before the natural termination of the term and set the new elections right before the reform, to get advantage of a potential extra term. We report evidence of this possibility showing the frequency distribution of the time scheduling of elections, and highlight the date of the reform. We follow a simplified Mc Crary (2008) approach to graphically inspect the distribution of the timing of the election around March 1993 and search for any suspicious density accumulation-i.e. jumps- that can inform on some strategic anticipation of elections right before the reform. Finally, we selected the control group by considering mayors with a previous election between March 1993 but not after march 1997, such that the control group during the period 2000-2005

[12] Vella (1993) shows that this simple two stages least squares estimator is helpful to solve the problems generated by a censored endogenous regressor and consistently estimate the parameter of interest.

[13] We also performed the analysis considering the subsample of mayors elected for the first time around March 1993 and find the same results.

is formed by mayors that have been re-elected at least once after the introduction of the term-limit.

Other estimation strategies could be implemented. For example, in a related problem Ferraz and Finan (2008) in the spirit of Lee, Moretti and Butler (2004), use of close races where an incumbent looses or wins by a small margin to instrument the probability of the same mayor remaining in office for one additional term. However, within this alternative framework we would not be able to separately identify the effect of an additional term in office from the effect of the term limit.

3.3.2 Threats to validity

Another possible threat to the validity of the exclusion restriction, and thus of the identification, comes from the multi-dimensional nature of the 1993 reform. In addition to the term limit, the reform also changed the electoral system from party-ballot to individual-ballot.[14] After the reform, citizens were called to directly express their preference for the mayor. If so, within the new electoral framework, political parties may face different incentives in the selection of candidates and choose, for example, the ones that maximize the probability of winning the elections rather then just selecting the best candidate.

It is not obvious, however, which was the effect of the change in the electoral system on the selection of potential mayors at local level. On one side, the new individual ballot system may have lead to a selection of better candidates, as opposed to the party ballot, because citizens had now more chances to value the true quality of candidates. On the other side, if most of citizens were either ideological (i.e., they follow a party rather than a person) or non perfectly informed, the change in the electoral system would not have had any effect on the quality of the elected officials. No matter what was the selection effect of the new electoral system, one might realistically assume that, while the term limit applied sharply after the reform, the introduction of individual-ballot elections was instead more resilient, because of the initial difficulty for parties to recruit candidates more suitable to the new electoral system. If so, focusing on elections right before and after the 1993 reform will remove any additional bias due to the different selection mechanism for the treated and the control group.

We formalize this intuition within a Regression Discontinuity Design (RDD) Instrumental Variables approach (Van der Klaauw, 2008), which we will use to compare the outcome of the auctions in the neighborhood of the March 1993 electoral threshold. In particular we augment Equation (3.1) and (3.2) with a fully non parametric polynomial

[14] See Section 3.4.

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in the distance of bid delivery to the discontinuity threshold as follow:

$$y_{im} = \alpha + \beta_1 T_{im} + \beta_2 f(dist_m) + \delta_1 X_i + \delta_2 X_m + \epsilon_{im} \tag{3.3}$$

and,

$$T_{im} = a + b_1 PR_m + b_2 g(dist_m) + c_1 X_i + c_2 X_m + \nu_{im} \tag{3.4}$$

where $dist_m$ denotes the time distance, in months, of first election from the 1993 reform, and $f(.)$ and $g(.)$ are flexible functions of it. Since the running variable is not continuous (elections are held at specific points in time) we follow Card and Lee (2008) and specify $f(.)$ and $g(.)$ as a series of time dummies and properly correct the standard errors for the discreteness of the running variable. Under the assumption that there is no strategic sorting around the discontinuity threshold, β_1, from Equation (3.3) will be correctly estimated with the same Instrumental Variables estimator discussed above.[15]

As discussed in Lee (2007), the IV-RDD framework allows to test for the validity of the exclusion restrictions by considering a set of pre-intervention variables. These variables should meet the following two conditions: they should not be affected by the March 1993 electoral reform, but they may depend on the same unobservable characteristics (e.g. efficiency/collusion of mayors with participants), likely to affect the functioning of public procurement auction. To test this condition, also called the continuity condition, we reconstruct the information on both the characteristics and behaviors of mayors elected around March 1993 and test for the statistical difference in the sample averages across the treatment and the control group.

The tests for the balance of the observable characteristics of treatment and control mayors, together with the graphical evidence of no sorting around the March 1993 reform, are the tools to argue that the higher political longevity induced by the scheduling of the elections is not related to any of the behaviors, observable characteristics of politicians, auctions, and geographical locations that might affect both the ability of politicians to have longer tenure and the functioning of public procurement auctions. In other words, they can provide support to the assumption that the electoral scheduling was "random", and thus can be used as a valid instrument for political longevity.

[15] Another possible concern with this estimation strategy is that mayor elected right after and right before the reform might face a different political horizon. While the concept of political horizon differs from that of political longevity (the first one is the expectation of the time in office, while the second one is the actual realization), one might think that our estimates are broadly capturing the effect of a mayor organizing its political activity over a longer period of time.

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3.4 The Italian institutional framework

In the Italian municipal administration (*Comune*) the executive authority is represented by an elected Mayor (*Sindaco*), together with an Executive Committee (*Giunta*) which is appointed by the mayor himself. They are assisted by a Council (*Consiglio Comunale*), which is instead the legislative authority. In 1993 the mayoral electoral system was changed from a party-ballot to an individual-ballot, with some differences depending on the size of the city. Mayors are subject to a two-term limit, unless one of the two terms lasted for less than two years. In 2000 the statutory duration of the legislature was extended from four to five years. The functions of a municipal administration, besides contracting for public works, include the provision of public transportation, some welfare (like assistance to elderly people, nursery schools, and public housing), and managing public utilities (like water, electricity, and gas).

During the period of observation, public tenders in Italy were administrated under the *Legge 109/94*, and several amendments (*"Merloni-bis, -ter"*, as they were called), which regulated all the proceedings of the public procurement contracts. This set of laws contain the details of how public contracts should be assigned, and specifies the requirements of public tenders, the awarding criterion, and the *ex-post* procedures in case of non compliance to the original contract.

Specifically, public procurement auctions at municipal level are sealed-bid, and multi-attribute or single-attribute depending on the size and the complexity of the public work. For the sake of this exercise, during the period 2000-2005, we only observe single-attribute auctions, i.e., auctions for which the technical component of the offers plays no role in the assignment, provided that the winner satisfies some minimum quality standards which are set by the contracting authority. Firms bid within a time deadline the price for which they are willing to do the works, in the form of a percentage reduction (the rebate) with respect to the auction's starting value. Notice, however, that the winning rebate is not necessarily the highest bidden: in order to prevent firms from over-bidding (i.e. bidding a price which does not allow to recoup works' expenses) a complex mechanism is implemented (see Figure 3.1). According to this rule, after a preliminary mechanical trimming of the top (worst) 10 percent of the collected bids, the bids which exceed from above the average bid by more than the average deviation, are further excluded. Therefore, bidders have to guess this averaged-average "anomaly thresholds", trying to place a bid just below it.[16] The fact that the work is assigned

[16] As for illustration, consider this simple example. In a hypothetical auction, after the trimming of the tails there are three participants placing the following bids (rebates to the auction's starting value): 10, 14 and 16. The average bid is thus 13.33. The average difference of the bids above this average bid

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to the bid which is the closest to the anomaly thresholds from below is particularly important, because it guarantees some degree of competition among the bidders which otherwise. This is not the case, for example, in other similar auction mechanisms like a pure average bid auction, where the winning bid is the closest to the average no matter whether from above or from below.[17]

Each auction is administered by a manager who is in charge of all the proceedings, usually delegated by the mayor among the bureaucrats working in the technical office of each city administration.[18] He or she supervises the auction (coordinating the project, the advertisement and the invitation of the firms when there are auctions on invitation), administers the payments to the winning firm (upon initial approval of the city council), and monitors the realization of the work. In particular, the participation mechanism can be of three types: the *Pubblico incanto*, in which case the participation is open to any firm satisfying the technical requirements that are function of the reserve price of the auction; the *Licitazione privata*, in which case the contracting authority invites a number of firms to participate, provided a minimum number is satisfied; and the *Trattativa privata*, which is similar to the *Licitazione privata* except that the procedure is faster and the minimum number of firms to be invited is reduced.[19] Although the law prescribes the general cases in which each specific auction format has to be used, the municipal authority still retains large discretion in the final tailoring of the auction formats and requirements.

Finally, the law specifies the cases in which the terms of the procurement contract (the time of the work delivery, and the cost of the work) can be renegotiated. In particular, renegotiations are admitted only in cases of unforeseen natural events (like storms, earthquakes, landslides, etc.), and are conditional on approval by the auction manager only. However, when the renegotiation implies an increase in the cost of the work or a delay in the execution of the works, this does not need to be further approved by the city council, i.e., it is not subject (like the initial installment) to the control of the municipal council.[20]

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is 1.12. Thus the anomaly thresholds is 14.44. It turns out that in this case the winning bid is 14, well above the average, even if 16 percent is the highest bidden rebate.

[17]The properties of this awarding mechanism are not easy to prove and are beyond the scope outside this paper. For a detailed discussion, see Albano et al. (2006) and Decarolis (2008).

[18]For large municipalities the coordinator of the technical office is appointed by the mayor.

[19]Other formats include the *Licitazione privata semplificata*, which is similar to the *Licitazione privata*, and the *Appalto concorso*, which is used for works with a high architectural content staring from 300,000 euros.

[20]Engel et al. (2006) discuss the political economy of granting renegotiations in Latin America.

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3.5 The data

We use an administrative data set about all the Italian mayoral terms elected between 1985 and 2007, provided by the Italian Ministry of Interiors. The data set contains information on the identity, gender, age, highest educational attainment, political affiliation, and previous job of the elected mayor. It also contains information on the legislature, such as the exact duration and the reasons of early termination, and the electoral results. Finally, we also have yearly information at municipality level about the size of the resident population, total revenues expenditure, plus some demographic characteristics as of 2005, like the disposable income per capita, the labor force participation rate, the number of productive units per capita, the elderly index, and the population density and the resident population at the 1991 census.

We combine the mayoral information with a data set about the public procurement auctions, which is provided by the Italian Authority for Surveillance of Public Procurement (*"Autorità per la Vigilanza sui Lavori Pubblici", AVLP*), which collects data on the universe of public procurement auctions in Italy for public works with starting value greater or equal to 150,000 euros. For our analysis, we refer to the data collected between 2000 and 2005. The data set includes information at auction level about the number of bidding firms, the identity of the winning bidder, the typology of the works, the bidding behavior, and two measures of the *ex-post* performance of the public contracts: the extra time to accomplish the works, and the monetary renegotiation (if any) of the winning rebates. Each procurement auction is assigned the information of the mayoral term containing the date of bids delivery, although the realization of the public work might then go beyond that term.

3.5.1 Descriptive Statistics

The initial sample consists of all the cities for which we observe at least one auction, and without missing information.[21] In Table 3.1 we present summary statistics for the sample of municipalities over which we will run the estimation analysis.

The final sample is made of 4,144 cities for which we have no missing information, 40 percent of which are located in the North-West of Italy, 20 percent in the North-East, 15 percent in the Center, 22 percent in the South and only 4 percent in the Islands. The average municipality is relatively large, with almost 10,200 inhabitants (compared to an national average of 7,015). The total number of observed terms is 5,504 (see Table 3.2), for a total of 5,082 mayors. Only 8 percent of the mayors are women, the

[21] Of the 8,104 existing Italian municipalities, 4,506 had only one term overlapping between 2000 and 2005.

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average age is 50, the average political experience in the same city administration is 7.85 years, the average number of previous terms in office is 0.6 terms, 42 percent of the mayors face a term limit, and only half of the mayors were born in the city they administer. About 43 percent of the mayors have a college degree, while 44 percent have a high-school degree and 11 percent a lower-secondary degree. Almost 12 percent where not employed before being appointed, the majority being self-employed (41 percent), followed by entrepreneurs (33 percent), blue collars (4 percent) and the rest being clerks. Finally, 30 percent were elected with a center-left party, only 11 percent with a center-right party, 3 with a separatist party and all the rest were in a center-wing or independent party.

Note that these averages represent the mean value for the part of the term we observe. Some terms, however, may be right or left censored depending on whether they overlap with year 2000 or 2005, and this might introduce some measurement error. For the estimation strategy to hold, we will have to further assume that, although differences exists depending on whether the mayor can be reelected or not, there is homogeneity in the way public procurement auctions are administered within a term.

3.5.2 Defining the dependent variable

The data set contains a large number of measures that can help identifying the lack of competition in public procurement auctions, its costs in term of public spending, and, indirectly, to highlight the possible mechanisms linking the bidders to the political authority. Following the natural life-cycle of any procurement contract, we divide these characteristics in three sets: *Tailoring*, *Auction-Game*, and *Ex-post Renegotiations*.

The *Tailoring* vector includes an indicator for whether the selection mechanism of the auction was with private invitation of a selected group of bidders. The *Auction-Game* set includes measures of both the level and the nature of competition as the number of bidders: the final percentage rebate over the reserve price, whether the winning firm is coming from the same municipality of the contracting authority, and the maximum number of adjudications per term to the same firm, weighted by the average number of adjudications. Finally, the *Ex-post Renegotiations* set includes an indicator of whether the delivery of the public work crossed the original contractual deadline, and an indicator for the price of the work payed by the authorities being raised after assignment, and the amount of this renegotiation.

We are aware that some of these measures do not represent an exact indicator for the lack of competition, or for the presence of collusion. For example, if bidders were colluding among themselves, the fact that the number of bidders increases when a new

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mayor is elected would not necessarily be a signal of higher competition but just of higher collusion. At the same time, since the reserve price is set endogenously by the mayor (or the manager he or she had appointed), the final rebate would not necessarily capture the effect of an increase in competition. However, as outlined in Section 3.2.2, these measures, together with the choice of the auction format and with the probability of renegotiation, can provide some interesting insights about the way political longevity can affect the functioning of public procurement contracts.

Table 3.3 describes the average characteristics of the auctions. The total number of auctions we observe is 28,270. In 75 percent of the cases the selection criterion was the public participation (*Pubblico incanto*), the average number of bidders was 23.41, with a final rebate of 13.21 percent. The majority of the public works concern the construction of roads (23 percent), then schools (13 percent), public building (5 percent), public housing (1 percent), art (4 percent). In 79 percent of the auctions the price set at the time of the selection is then increased, and in 52 percent of the cases the contractual deadline is delayed.[22] Interestingly, the size of the public work tendered is quite small, varies from 130,000 to 19,100,000 euros and with an average value of 546,000 euros.[23]

3.6 Results

In this section we report the graphical evidence of the analysis, then the main estimation results on how political longevity affects the functioning of public procurement contracts, and discuss the evidence validating the assumptions required by the estimation method we implement. All the estimates are computed at auction level, using the exact longevity of the mayor at the time of the bid delivery, T_{im}.

In the graphical analysis we inspect the behavior of the number of bidders and the winning rebate in the neighborhood of a turnover of the mayor. To begin with, In Figure 3.3 we plot the average number of bidders and the final rebate by each year within the term (6, 7, 8, 9, and 10 and 1, 2, 3, 4, 5 for the second and the first term respectively), separating mayors in their second term (and binding term limit) from the mayor who are then elected for the first term. Both panels of Figure 3.3 suggest a preliminary evidence that, when a tenured mayor-i.e. the old mayor- is replaced by a new one, there is an immediate increase in the average number of bidders participating in the procurement auctions. This, in turn, translates into an increase in the average winning rebate. Inter-

[22] As discussed in Section 3.4, these figures are calculated for a limited number of regions that collected the data on ex-post renegotiations.

[23] Values reported at 2000 equivalents.

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estingly, the same figure holds when we consider cases of political turnovers not induced by the two term limit (see Figure 3.4).

In Tables 3.4 and 3.5 we move to present the baseline OLS estimates from fitting Equation (3.1) to the data for the four model specifications.[24] In order to control for local unobserved political, and institutional factors, we also include a set of province fixed effects in all the specifications.[25] Estimates confirm the descriptive evidence: there is a negative relationship between mayors' longevity in office and the number of bidders and the winning rebate in the public procurement auctions they administered. The effect appears to be both statistically and economically significant. Depending on the set of controls included in the regressions, an increase in one standard deviation in the years of political longevity (3.9 years) is associated with a decrease in the number of bidders by about 2.6-4.2 % with respect to the mean, and with a decrease in the final rebate by 2-3 %. Remarkably, the effect of longevity on the number of bidders is roughly two times bigger once the most generous model is specified (-.243). A back to the envelop calculation suggests that public works systematically cost 22,000 euros more in municipalities whit long-lasting mayors.[26] Even if the OLS estimates include a very large number of auction, mayor, and municipality observable characteristics, it is not difficult to imagine that the lack of competition induced by hidden collusive behaviors between auctioneers and bidders might still help politicians to be re-elected, and then bias severely the previous estimates. To take care of the potential endogeneity concerns, we present evidence of the 2SLS identification strategy discussed in Section 3.3, and report the estimated coefficients of the effect of a shift in political longevity induced by the March 1993 reform, on the three sets of outcomes described in Section 3.5.2.

Before presenting the 2SLS estimation results, we argue on the quality of our instrument. In in Section 3.3 we discussed the two requirements that an instrumental variable, the indicator whether the mayor has been elected for the first time before or after the 1993, has to satisfy to be a good instrument. We first report evidence on the non-testable assumption that the election timing was orthogonal to the introduction of the reform, by graphically inspecting, in a simplified Mc Crary (2008) fashion, the frequency distribution of the elections around March 1993. Figure 3.5 plots on the horizontal axis the time from January 1985 to January 2007, and on the vertical axis the frequency of the elections. The figure highlights the main four election events of Italian municipalities between the period 1999-2005, and generally supports the assumption

[24] See Section 3.3 for a detailed illustration of the models.

[25] On this spirit we follow the seminal work by Guiso et al. (2004) that reports evidence on the effectiveness of social capital and local institutions on economics activities.

[26] Calculations refer to public works with an average starting value of 548,267 euros.

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that elections were held with regular cycle, and with a timing determined by past events only. To check more carefully whether there is some mass distribution of early resignations around March 1993 that might threaten the identification strategy, we focus the graphical inspection on the neighborhood of the reform. Figure 3.6 plots the frequency of the elections between 1992 and 1994 only, and shows that there are actually a few elections that were held right after the reform because of an early termination. However, what is important to notice for the identification strategy to hold is that the early terminations did not serve the purpose of anticipating election to avoid the application of the reform, but actually the opposite. Municipalities that experienced an early termination went to election with the new electoral system, which is exactly what they would have done even in case of natural termination.

As discussed in Section 3.3, another potential threat to the identification of political longevity using the 1993 reform comes from the multi-dimensionality of the reform itself, which also introduced the individual-ballot election of the mayor. Mayors elected before and after the reform could then differ in their observable and unobservable characteristics because of the different selection process they went through. However, if the introduction of individual-ballot elections was somehow resilient, because of the initial difficulty for parties to quickly recruit candidates more suitable to the new electoral system, we should not observe significant differences between mayors elected right before and after the reform. In Table 3.6 we report the sample averages of mayors' characteristics and behaviors by treatment status around the 1993 reform. We consider three different time windows, and report *p-values* to test for the statistical difference of the following indicators: gender, age, whether born in the city, whether employed at a high occupational level, whether has a college degree, the budget deficit of the municipality, and the resident population as reported in the 1991 Census. In Panel A, we report the differences for a four years symmetric window (1989-1997): while we do not find differences in the characteristics of municipalities depending on the election scheduling, we do find that within the four years after the reform there were systematically more females, mayors were less likely to be born in the city, they were more educated, skilled and with a lower longevity then in the four years before the reform. Interestingly, in Panel B we reduce the time window to two symmetric years (1991-1995), and almost all the differences are no more statistically significant (except for the budget deficit that is higher after the reform). Finally, when we restrict the time window to one year (1992-1994), all the differences disappear. Importantly, the absence of any statistically significant difference between the two groups of mayors does not seem to be driven by the small sample in the one year window, as almost all the characteristics also equalize in terms of average magnitude, which is not the case when we use a four years bandwidth. This evidence

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seems to be more compatible with a long-run increase in the quality of the new elected mayors rather than a sharp change due to the 1993 reform. We thus include in any of our specifications the year fixed effects to account for the presence of this trend. The first column in Table 3.7 presents the first-stage estimates of the fuzzy-RDD model, where we also included a set of two-years dummies for the distance between the delivery of the bids and the 1993 reform. As expected, mayors elected before the reform accumulate, on average, 3.3 years more in office (almost one term). The first stage F-statistic suggests that the instrument is relevant-i.e. there is not a weak instrument problem- and is much larger than the usual rule of thumb of 10. In columns two and three of Table 3.7 we also report the second-stage estimates for the fully specified model.[27] We report evidence that an exogenous increase in political longevity, induced by the 1993 reform, causes a significant decrease between 7 % and 4 % in the number of bidders, and a reduction in the winning rebate, although the latter now is not statistically significant. Interestingly, the coefficient on the size of the municipality is positive and statistically different from zero for both outcomes, suggesting that the bigger the potential market, the higher the number of firms willing to compete. The coefficient on the reserve price is also positive and statistically different from zero, the square term being instead negative: the bigger the size of the public work the greater the willingness of potential bidders to enter, although this trend is reverted when the size of the work is too high, probably because of some production constraints. Finally, we report just a marginal evidence of a negative and significant effect, at 10 %, of being in a term that is binding on the winning rebate, while a strong and positive effect on the number of bidders and the winning rebate on the number of parties in the mayor's coalition. Overall our fully specified model explains 33.1 % (53.1 %) of the total variability of the number of bidders (the winning rebate).

To what concern the potential economic mechanism behind the reduction in the number of bidders, and consequently on the final rebate, in Table 3.8 we do not detect any increase in the discretion which is used to conduct public procurement (the use of less market driven auction formats, i.e., the *Trattativa privata*), although mayors have few degrees of freedom on this side (see Section 3.4). More interestingly, we report evidence that the increase of 3.256 induced by the 1993 reform increases the probability that there will be a later renegotiation of the terms of procurement, both in terms of time and in terms of money by 25 % and 16 % respectively . As outlined in Section 3.2.2, this might be a way for mayors to compensate colluded firms which got assigned the work because they were bidding more aggressively. We do not find instead any significant evidence that, political longevity affects the nature of competition as it is not

[27] See Section 3.3 for a detailed illustration of the models.

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changing the probability that the winners are coming from the same city.

We finally conclude in Table 3.9, where we merge the data set on municipalities with a similar data set for the provincial governments (the administrative level just above the municipalities), to which the same 1993 reform also applied.[28] In this case we interact a variable for the authority being a provincial government, rather than a municipality, in order to detect any heterogeneity in the effect of political longevity at different administrative levels. Estimates suggest that the difference in the number of bidders and the winning rebate is larger and statistically significant for municipalities with long lasting mayors compared to low tenure mayors, while in provinces the effect is reverted. These findings are in line with the conjecture that the most corrupt governments seem to be at the local level, where governments are often under the control of narrow elites that use it for personal gain (Rose-Ackerman, 1999).

3.7 Conclusions

In this paper we have shown that when politicians stay in power for too long, there is deterioration in the functioning of the public procurement auctions they manage. Specifically, there are less bidders participating in the auction, there is an increase in the cost of the public work, and an increase in the probability that the contract will be renegotiated, either in terms of costs or time to delivery. Accordingly, to previous studies we also find that the effect of political longevity weakens at higher levels of government, suggesting that it is more difficult to establish personal connections once bidders are competing in less de-localized environments. Our evidence is suggestive of a longevity effect in the process of diffusion of collusion between contracting authorities and bidders. These results point out another channel trough which political collusion could be eliminated and competition in public procurement restored, i.e., political turnover. This was not highlighted in the previous literature. Of course, we are aware that political turnover might have some drawbacks, especially when it creates instability and reduces the incentive for politicians to implement long-run policies. However, at least for what concerns the transparency of the policy making, institutional features like the term-limit prove to be effective in reducing collusion and helping to rationalize public spending at local level.

[28] The data on provincial auctions lacks information about the budget deficit and the number of parties in the governing coalition, which were then excluded from the set of controls in the estimations.

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Tables and Figures

Table 3.1: City characteristics

	Mean	St.Dev.	Min	p25	p50	p75	Max	N.
North-West	.40	.49	0	0	0	1	1	4,144
North-East	.20	.40	0	0	0	0	1	4,144
Center	.14	.35	0	0	0	0	1	4,144
South	.22	.42	0	0	0	0	1	4,144
Islands	.04	.18	0	0	0	0	1	4,144
Population	10,197	56,642	49	1,579	3,595	8,034	2,733,908	4,144
Judicial efficiency	89.49	56.86	30.20	51.60	82.10	98.20	462.50	4,144

Notes. *Population* is the number of resident inhabitants as of 2000. *Judicial efficiency* is the ratio (times 100) between settled and incoming cases, for each regional administrative court (TAR), for public works related disputes.

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Table 3.2: Mayor/Term characteristics

	Mean	St.Dev.	Min	p25	p50	p75	Max	N.
Female	0.08	0.27	0	0	0	0	1	5,504
Age	50.03	9.19	25.42	43.63	49.80	55.88	85.61	5,504
Born in the city	0.52	0.50	0	0	1	1	1	5,504
Municipal experience (years)	7.85	5.27	0.00	4.05	8.92	12.96	20.00	5,504
Previous terms in office (as mayor)	0.61	0.78	0	0	0	1	4	5,504
Previous years in office (as mayor)	5.32	3.99	0.00	2.27	4.72	7.37	20.09	5,504
Term limit binding	0.42	0.49	0	0	0	1	1	5,504
Education:								
Lower secondary	0.11	0.31	0	0	0	0	1	5,504
Upper secondary	0.44	0.50	0	0	0	1	1	5,504
College	0.43	0.49	0	0	0	1	1	5,504
Employment:								
Not employed	0.12	0.32	0	0	0	0	1	5,504
Self-employed	0.41	0.49	0	0	0	1	1	5,504
Entrepreneur	0.33	0.47	0	0	0	1	1	5,504
Clerk	0.05	0.21	0	0	0	0	1	5,504
Blue-collar	0.04	0.20	0	0	0	0	1	5,504
Political party:								
Center-right	0.11	0.32	0	0	0	0	1	5,504
Center	0.06	0.23	0	0	0	0	1	5,504
Center-left	0.30	0.46	0	0	0	1	1	5,504
Separatist	0.03	0.18	0	0	0	0	1	5,504
Others	0.49	0.50	0	0	0	1	1	5,504
Coalition:								
Parties in mayor's coalition	1.31	0.98	1	1	1	1	13	5,504
Seats (%) in mayor's coalition	68.53	8.35	57.57	66.67	66.67	66.67	100.00	4,923

Notes. Statistics on 5,082 mayors. *Municipal experience* in any office.

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Table 3.3: Auction characteristics

	Mean	St.Dev.	Min	p25	p50	p75	Max	N.
Outcome:								
N. bidders	23.41	27.61	0	5	14	32	550	28,270
Winning rebate (%)	13.21	8.68	0.00	6.90	12.50	17.44	49.99	28,270
Starting value	5.46	9.46	1.34	2.04	2.97	5.24	190.83	28,270
Time renegotiation	0.52	0.50	0	0	1	1	1	11,172
Money renegotiation	0.79	0.41	0	1	1	1	1	10,887
Selection mechanism:								
Open participation	0.75	0.44	0	0	1	1	1	28,270
Private invitation	0.15	0.35	0	0	0	0	1	28,270
Direct negotiation	0.09	0.29	0	0	0	0	1	28,270
Object:								
Road	0.23	0.42	0	0	0	0	1	28,270
School	0.13	0.33	0	0	0	0	1	28,270
Public building	0.05	0.22	0	0	0	0	1	28,270
Public housing	0.01	0.11	0	0	0	0	1	28,270
Art	0.04	0.19	0	0	0	0	1	28,270
Others	0.54	0.50	0	0	1	1	1	28,270
Year bid delivery:								
2000	0.16	0.37	0	0	0	0	1	28,270
2001	0.21	0.40	0	0	0	0	1	28,270
2002	0.21	0.41	0	0	0	0	1	28,270
2003	0.19	0.39	0	0	0	0	1	28,270
2004	0.15	0.36	0	0	0	0	1	28,270
2005	0.08	0.27	0	0	0	0	1	28,270

Notes. Public tenders for works with starting value greater or equal 150,000 euros (2000 equivalents). *Starting value* in 100,000 euros (2000 equivalents). *Time renegotiation* and *Money renegotiation* only available for the regions of Piemonte, Valle d'Aosta, Lombardia and Trentino Alto Adige.

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Table 3.4: OLS: political longevity on the number of bidders

	(1)	(2)	(3)	(4)
Mean outcome:		23.41		
Longevity (years)	-0.175**	-0.152**	-0.157**	-0.243***
	(0.079)	(0.075)	(0.075)	(0.079)
Population	0.164***	0.161***	0.160***	0.156***
	(0.020)	(0.020)	(0.020)	(0.020)
Starting value		0.796***	0.796***	0.782***
		(0.093)	(0.093)	(0.093)
Age			-0.001	-0.011
			(0.029)	(0.029)
Female			-0.177	-0.233
			(0.851)	(0.824)
Term limit binding				1.646**
				(0.684)
Time to next election (years)				-1.224
				(1.549)
Party longevity (years)				-0.105
				(0.102)
N. parties mayor's coalition				0.263
				(0.180)
Observations	28,270	28,270	28,270	28,270
R-squared	0.166	0.259	0.260	0.263
Province fixed-effects	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
City characteristics	yes	yes	yes	yes
Auction characteristics	no	yes	yes	yes
Mayor characteristics	no	no	yes	yes
Electoral characteristics	no	no	no	yes

Notes. Estimates computed on 4,796 mayors and 3,808 cities. *Number of bidders* is the number of bidding firms. *Population* is the resident population as of 2000, in 10 thousands. *Starting value* in 100,000 euros (2000 equivalents). When denoted with "yes", regressions additionally include *Province FE* (104 dummies); *Year dummies* (2000-2004); *City characteristics* (judicial efficiency at year-region level; budget deficit in percentage of the revenues at year level); *Auction characteristics* (squared term of the starting value, 5 object characteristics dummies, 3 selection mechanism dummies); *Mayor characteristics* (gender, age, 3 education dummies, 3 previous occupation dummies, a dummy for being born in the city); *Electoral characteristics* (number of parties in the mayor's coalition, squared term of the time to next election, 4 political party dummies). Standard errors robust to clustering at the mayor level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

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Table 3.5: OLS: political longevity on the winning rebate

	(1)	(2)	(3)	(4)
Mean outcome:		13.21%		
Longevity (years)	-0.084***	-0.076***	-0.083***	-0.047*
	(0.022)	(0.020)	(0.020)	(0.028)
Population	0.049***	0.048***	0.047***	0.045***
	(0.009)	(0.009)	(0.009)	(0.009)
Starting value		0.091***	0.090***	0.086***
		(0.012)	(0.013)	(0.012)
Age			0.021**	0.016*
			(0.009)	(0.008)
Female			-0.031	-0.048
			(0.248)	(0.226)
Term limit binding				-0.251
				(0.251)
Time to next election (years)				0.182
				(0.252)
Party longevity (years)				-0.090**
				(0.040)
N. parties mayor's coalition				0.153***
				(0.050)
Observations	28,270	28,270	28,270	28,270
R-squared	0.477	0.505	0.506	0.511
Province fixed-effects	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
City characteristics	yes	yes	yes	yes
Auction characteristics	no	yes	yes	yes
Mayor characteristics	no	no	yes	yes
Electoral characteristics	no	no	no	yes

Notes. Estimates computed on 4,796 mayors and 3,808 cities. *Final rebate* is the winning rebate in percentage of the starting value. *Population* is the resident population as of 2000, in 10 thousands. *Starting value* in 100,000 euros (2000 equivalents). When denoted with "yes", regressions additionally include *Province FE* (104 dummies); *Year dummies* (2000-2004); *City characteristics* (judicial efficiency at year-region level; budget deficit in percentage of the revenues at year level); *Auction characteristics* (squared term of the starting value, 5 object characteristics dummies, 3 selection mechanism dummies); *Mayor characteristics* (gender, age, 3 education dummies, 3 previous occupation dummies, a dummy for being born in the city); *Electoral characteristics* (number of parties in the mayor's coalition, squared term of the time to next election, 4 political party dummies). Standard errors robust to clustering at the mayor level in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

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Table 3.6: Mayors' characteristics and behavior by election scheduling

	Elected after 1993	Elected before 1993	
	Mean	Mean	p-value diff.
	Panel A: +/− 4 years bandwidth		
Female	0.063	0.034	0.000
Age (years)	45.723	45.983	0.102
Born in the same city	0.580	0.640	0.000
Empl. high skilled	0.759	0.736	0.001
Edu. college	0.406	0.339	0.000
Previous terms in office (as mayor)	0.430	0.409	0.033
Budget deficit	-0.002	-0.016	0.600
Population	7,237	7,035	0.782
Judicial efficiency	142.654	141.426	0.263
Observations	8,182	6,865	
	Panel B: +/− 2 years bandwidth		
Female	0.060	0.059	0.935
Age (years)	44.881	44.921	0.945
Born in the same city	0.632	0.658	0.389
Empl. high skilled	0.812	0.804	0.748
Edu. college	0.524	0.515	0.772
Previous terms in office (as mayor)	0.204	0.191	0.611
Budget deficit	0.003	-0.016	0.000
Population	13,433	11,085	0.614
Judicial efficiency	142.829	141.790	0.828
Observations	2,285	304	
	Panel C: +/− 1 year bandwidth		
Female	0.065	0.060	0.817
Age (years)	44.867	44.392	0.506
Born in the same city	0.630	0.628	0.946
Empl. high skilled	0.818	0.821	0.920
Edu. college	0.509	0.563	0.152
Previous terms in office (as mayor)	0.228	0.191	0.251
Budget deficit	-0.011	-0.017	0.269
Population	13,557	13,708	0.982
Judicial efficiency	145.516	144.571	0.875
Observations	1,611	199	

Notes. *Population* is the resident population as reported in the 1991 Census. *Budget deficit* is the percentage budget deficit over total revenues. *Judicial efficiency* is the ratio (times 100) between settled and incoming cases, for each regional administrative court (*TAR*), for public works related disputes.

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Table 3.7: Fuzzy-RDD: political longevity and competition

	(1)	(2)	(3)
	first-stage	*second-stage*	
Dependent variable:	Longevity	Number of bidders	Winning rebate
Mean outcome:	7.65	22.10	12.19%
Longevity (years)		-0.666**	-0.106
		(0.269)	(0.134)
1993 reform	3.256***		
	(0.108)		
Population	0.002***	0.219***	0.041***
	(0.001)	(0.013)	(0.002)
Starting value	-0.000	0.887***	0.118***
	(0.000)	(0.143)	(0.032)
Age	0.005***	0.043	0.011
	(0.001)	(0.041)	(0.009)
Female	0.023*	-0.030	0.063
	(0.012)	(0.621)	(0.306)
Term limit binding	1.733***	0.850	-0.709*
	(0.081)	(0.895)	(0.394)
Time to next election (years)	-0.289***	-0.156	0.987***
	(0.045)	(0.557)	(0.127)
Party longevity (years)	0.015***	-0.142	0.009
	(0.005)	(0.112)	(0.019)
N. parties mayor's coalition	-0.017	0.463***	0.348***
	(0.014)	(0.132)	(0.052)
Observations	9,823	9,823	9,823
R-squared	0.937	0.331	0.531
F-test exc. inst.	911.1		
Distance from the 1993 reform	yes	yes	yes
Province fixed-effects	yes	yes	yes
Year dummies	yes	yes	yes
City characteristics	yes	yes	yes
Auction characteristics	yes	yes	yes
Mayor characteristics	yes	yes	yes
Electoral characteristics	yes	yes	yes

Notes. Estimates computed on 1,766 mayors and 1,749 cities. Only mayors elected at some point between March 27 1988 and March 27 1997. *N. bidders* is the number of bidding firms. *Rebate* is the winning rebate in percentage of the starting value. *Population* is the resident population as of 2000, in 10 thousands. *Starting value* in 100,000 euros (2000 equivalents). Only mayors elected at some point between March 27 1988 and March 27 1997. When denoted with "yes", regressions additionally include *Distance from the 1993 reform* (6 two-year dummies); *Province FE* (104 dummies); *Year dummies* (2000-2004); *City characteristics* (judicial efficiency at year-region level; budget deficit in percentage of the revenues at year level); *Auction characteristics* (squared term of the starting value, 5 object characteristics dummies, 3 selection mechanism dummies); *Mayor characteristics* (gender, age, 3 education dummies, 3 previous occupation dummies, a dummy for being born in the city); *Electoral characteristics* (number of parties in the mayor's coalition, squared term of the time to next election, 4 political party dummies). Standard errors robust to clustering at the biannual level (see Card and Lee, 2008) in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

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Table 3.8: Fuzzy-RDD: political longevity on the mechanism

	(1)	(2)	(3)	(4)
	second-stage			
Dependent variable:	Money renegotiation	Time renegotiation	Private invitation	Winner from the city
Mean outcome:	0.81	0.53	0.09	0.13
Longevity (years)	0.041**	0.038*	-0.009	0.003
	(0.020)	(0.022)	(0.007)	(0.003)
Population	0.001	0.001	0.001	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Starting value	0.003**	-0.000	-0.005***	-0.002**
	(0.001)	(0.002)	(0.002)	(0.002)
Age (years)	0.001	0.002***	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Female	-0.050***	-0.016	-0.025***	0.034***
	(0.009)	(0.015)	(0.007)	(0.008)
Term limit binding	0.491***	0.323***	0.033*	0.029*
	(0.019)	(0.013)	(0.017)	(0.017)
Time to next election (years)	0.011	-0.014	-0.003	0.006
	(0.009)	(0.014)	(0.030)	(0.015)
Party longevity (years)	-0.020***	-0.017***	0.003***	0.002
	(0.005)	(0.003)	(0.001)	(0.002)
N. parties mayor's coalition	-0.000	-0.008***	-0.001	0.001
	(0.003)	(0.001)	(0.001)	(0.004)
Observations	3,891	3,991	9,823	9,823
R-squared	0.372	0.118	0.193	0.171
Distance from the 1993 reform	yes	yes	yes	yes
Province fixed-effects	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
City characteristics	yes	yes	yes	yes
Auction characteristics	yes	yes	yes	yes
Mayor characteristics	yes	yes	yes	yes
Electoral characteristics	yes	yes	yes	yes

Notes. Only mayors elected at some point between March 27 1988 and March 27 1997. *Private invitation* is a dummy for whether the auction was held with private invitation. *Winner from the city* is a dummy for whether the winning firm was local. *Money/time renegotiation* is a dummy for whether there was any renegotiation of the contract. *% Money renegotiation* is the percentage increase in the awarding price. *Population* is the resident population as of 2000, in 10 thousands. *Starting value* in 100,000 euros (2000 equivalents). When denoted with "yes", regressions additionally include *Distance from the 1993 reform* (6 two-year dummies); *Province FE* (104 dummies); *Year dummies* (2000-2004); *City characteristics* (judicial efficiency at year-region level; budget deficit in percentage of the revenues at year level); *Auction characteristics* (squared term of the starting value, 5 object characteristics dummies, 3 selection mechanism dummies); *Mayor characteristics* (gender, age, 3 education dummies, 3 previous occupation dummies, a dummy for being born in the city); *Electoral characteristics* (number of parties in the mayor's coalition, squared term of the time to next election, 4 political party dummies). Standard errors robust to clustering at the biannual level (see Card and Lee, 2008) in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

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Table 3.9: Fuzzy-RDD: heterogeneous effects

	(1)	(2)
	second-stage	
Dependent variable:	Number of bidders	Winning rebate
Mean Outcome	23.51	12.35%
Longevity (years)	-1.120***	-0.344**
	(0.161)	(0.175)
Longevity*Province	4.687***	1.412***
	(1.188)	(0.472)
Province	-31.898**	-10.041**
	(12.977)	(5.055)
Population	0.095	-0.003
	(0.073)	(0.025)
Starting Value	0.927***	0.119***
	(0.134)	(0.025)
Age	0.057	0.015*
	(0.058)	(0.008)
Female	-0.789***	-0.390
	(0.254)	(0.312)
Term limit binding	-1.700	-1.820***
	(2.697)	(0.474)
Time to next election (years)	0.936**	1.053***
	(0.370)	(0.180)
Party longevity (years)	0.142*	0.088***
	(0.083)	(0.025)
Observations	11,696	11,696
R-squared	0.313	0.429
Distance from the 1993 reform	yes	yes
Province fixed-effects	yes	yes
Year dummies	yes	yes
Authority characteristics	yes	yes
Auction characteristics	yes	yes
Chief characteristics	yes	yes
Electoral characteristics	yes	yes

Notes. Estimates computed on 1,841 chiefs and 1,584 authorities. Only chiefs elected at some point between March 27 1988 and March 27 1997. *N. bidders* is the number of bidding firms. *Rebate* is the winning rebate in percentage of the starting value. *Province* is a dummy for whether the contracting authority is a province rather than a municipality. *Population* is the resident population as of 2000, in 10 thousands. *Starting value* in 100,000 euros (2000 equivalents). When denoted with "yes", regressions additionally include *Distance from the 1993 reform* (6 two-year dummies); *Province FE* (104 dummies); *Year dummies* (2000-2004); *Authority characteristics* (judicial efficiency at year-region level); *Auction characteristics* (squared term of the starting value, 5 object characteristics dummies, 3 selection mechanism dummies); *Chief characteristics* (gender, age, 3 education dummies, 3 previous occupation dummies); *Electoral characteristics* (squared term of the time to next election, 4 political party dummies). Standard errors robust to clustering at the biannual level (see Card and Lee, 2008) in parentheses. Significance at the 10% level is represented by *, at the 5% level by **, and at the 1% level by ***.

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Figure 3.1: The awarding mechanism

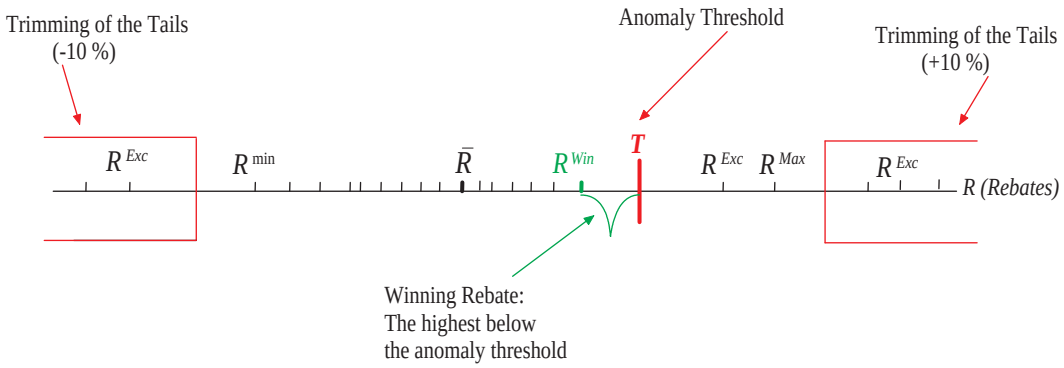
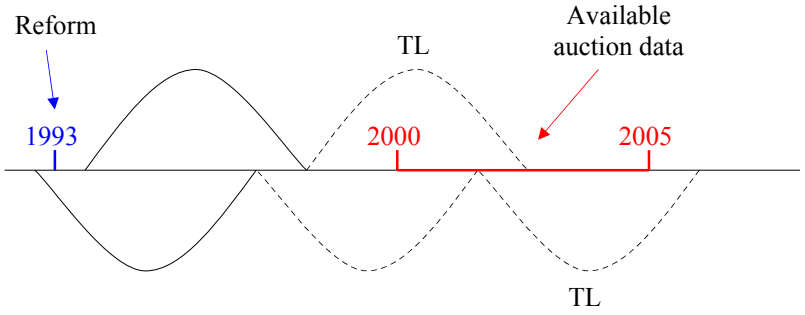


Figure 3.2: The electoral reform



Notes. *TL* stands for the term limit being binding. Shadow lines mean potential following terms.

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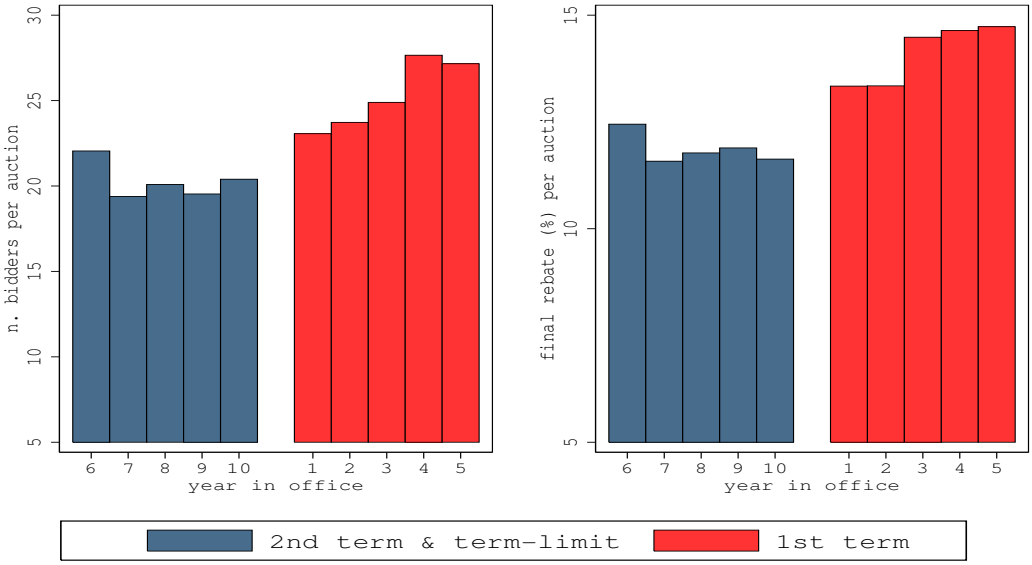
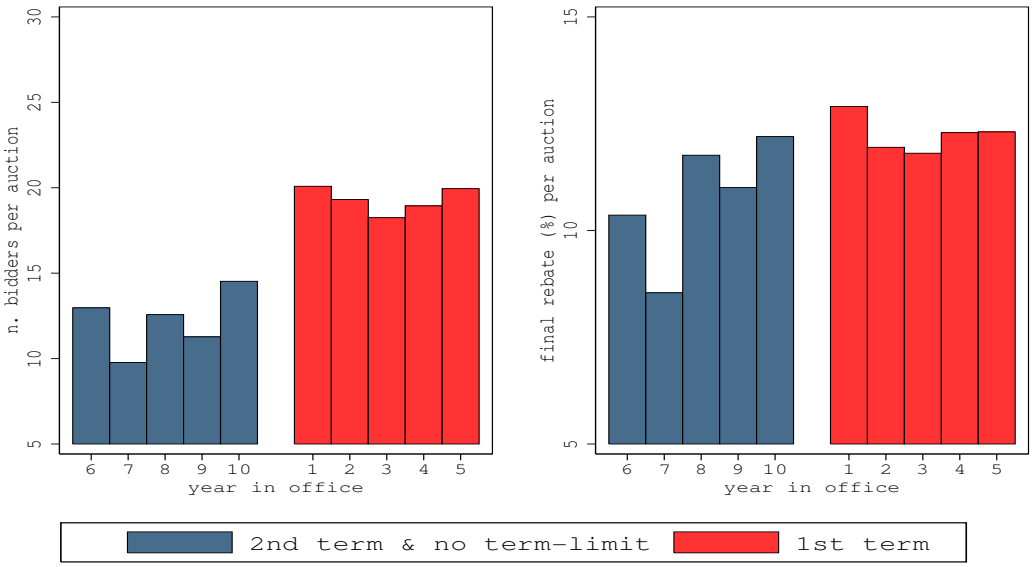
Figure 3.3: Political turnover on entry: term-limit binding



Notes. *N. bidders* is the number of bidding firms. *Final rebate* is the winning rebate in percentage of the starting value.

Figure 3.4: Political turnover on entry: no term-limit



Notes. *N. bidders* is the number of bidding firms. *Final rebate* is the winning rebate in percentage of the starting value.

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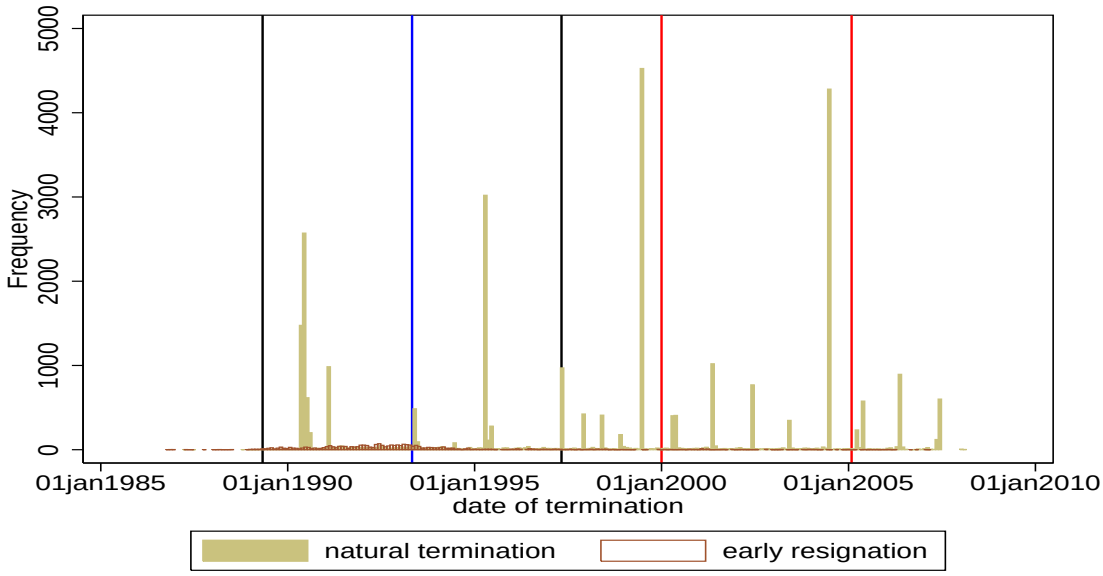
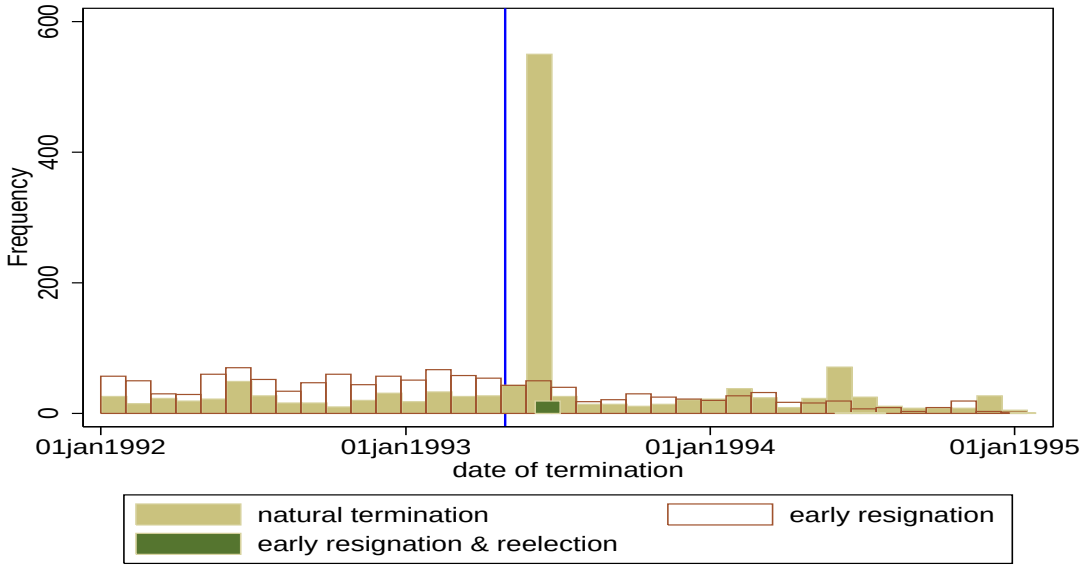
Figure 3.5: Election timing and early termination



Notes. In blue: the 1993 reform. In red: the period over which we have auction data.

Figure 3.6: Election timing and early termination: focus around the 1993 reform



Notes. In blue: the 1993 reform. *Early resignation* before the end of the fourth year in office because of: mayor's resignation, vote of no confidence by 50% of either the council or the executive committee.

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Chapter 4

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