The Effect of Discretion on Procurement Performance*

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Abstract

We assemble a large database for public works in Italy and use a regression discontinuity design to document the causal effect of decreasing discretion over auction format choice. Works with a value above the threshold must be allocated through an open auction that leaves little discretion to the buyer in terms of who will bid and win. Works below the threshold can more easily be allocated through a restricted auction, where the buyer has some discretion in terms of who (not) to invite to bid. We find that works with lower discretion have a lower probability that an incumbent firm wins again.We also find non-conclusive evidence about longer delay and lower number incorporated firm. Number of bidders, winning rebate and probability that the contract is awarded to non-local firms are not affected. When we try to disentangle the relationship between delay and firm characteristics (using fixed effect, propensity score matching e propensity score reweighting) we find that large, incumbent firms deliver with shorter delay, particularly below the threshold.

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1 Introduction

In this paper we analyze a large database for public procurement works in Italy to estimate the causal effect of limiting discretion in using restricted rather than open auctions on both *ex-ante* (number of bidders, winning rebates, and type of winners) and *ex post* outcomes (completion time, delays in delivery, cost overrun). We then try to identify the presence and effects of repeated procurement relationships allowed by the higher discretion left to public buyer by restricted auctions.

The benefits from using open auctions in public procurement are well known and go well beyond economists' praise for increased competition (Bulow and Klemperer, 1996). Besides being seen as a way to achieve higher value for taxpayer money, open auctions are also widely perceived as a way to limit public buyers' discretion in the choice of contractors, to increase competition and with it reduce political favoritism and corruption. International institutions (The World Bank, the OECD, etc.) therefore propose open auctions as the most effective procurement instruments for most situations.

This widespread view suggests that open auctions should lead to higher welfare thanks to more competition among suppliers, hence more bids submitted and lower awarding prices, and to lower corruption or local political favoritism. Removing discretion however may not always be effective in limiting corruption and may come at the cost of limiting a civil servant ability to establish productive relational contracts with suppliers.[1] Moreover, the removal of *ex-ante* discretion often is coupled with the absence of *ex-post* performance control, which risks to simply relocate the corruption problem from the selection stage to the contract enforcement one. A supplier planning to bribe civil servant to allow for lower performance standards at the contract execution stage will bid much more aggressively and win the selection process even in a transparent and well designed open auction. Controlling for *ex-post* performance is therefore crucial to understand the quality of the provided good or service.

The rest of the paper is organized as follows. In Section 2, we review the related

[1]For example, Bandiera, Pratt and Valletti (2009) showed recently that for acquisition of good and services corruption is not higher for public buyers with higher discretion, while the prices they pay are lower than average. This goes in the direction of Banfield (1975) and Kelman (1990), who argued that some discretion coupled with ex post performance checks is essential to good public management. See Spagnolo (2012) for a more thorough discussion.

literature. In Section 3 and Section 4, we describe the institutional framework and the data respectively. In Section 5, we present the Regression Discontinuity Desing. In Section 6, we present the empirical analysis and the results. Then in Section 7, we test the robustness of our results. In Section 8, we report addtional results on firm characteristics and ex post peformance. In Section 9, we draw the conclusions.

2 Related Literature

When contracts are highly incomplete, open auctions may perform poorly in terms of purely economic outcomes. Spulberg (1990) for example, focussing on the construction industry, showed how incomplete contracting may intensify problems of moral hazard hazard and ex post opportunism leading to rather poor outcomes. Manelli and Vincent (1996) reached an even more extreme conclusion, showing that when the crucial dimension on which gains from trade are concentrated is not contractible, open auctions that induce bidders to compete on contractible dimensions (e.g. price) may be the worst among the all conceivable procurement mechanisms, as they maximize the damages from adverse selection. Bajari and Tadelis (2001) showed that even bilateral negotiations may be better than competition for highly complex projects, as completing the contract is the more costly and flexibility the more valuable the more complex the project procured is.

Restricted auctions leaving the buyer some discretion on whether to invite or not invite some bidders, as it is often the case for restricted auctions in public procurement, can be seen a compromise between open auctions and bilateral negotiations, as they may limit but not eliminate supplier competition. In a dynamic framework, auctions with a choice of participant depending on past performance may allow the buyer to take into account reputational forces and establish long term relationships that may enforce corruption but also improve performance (Kim 1988, Doni 2006). Restricted auction may then be the optimal procurement mechanism even when discretional bonuses are allowed for or with suppliers collusion (Calzolari and Spagnolo 2012).

Whether the use of restricted auction damages tax-payers by reducing competition and value for money and increasing corruption, or they instead reduce transaction costs linked to incomplete contracting and allowing public buyers the discretion necessary to effectively use reputational/relational forces is fundamentally an empirical question.

Several empirical studies tried to identify before the effects of the selection procedure in procurement. Crocker and Reynolds (1993), for example, investigated how the US Air Force selects the contract type in the jet engine market. They test the trade-off between two factors: providing an ex-ante incentive using binding contract and the cost of drafting the contract. They shows how the degree of contractual incompleteness is endogenous to the characteristics of the good procured and of the contractors. In the first stages of the production process, when there is a certain degree of technology uncertainty, the buyer is inclined to use a incomplete contract arrangement in order to guarantee the producer to recover the cost of R&D and the relation-specific investments. As long as the relation proceeds, and the technological uncertainty decrease, the contractual arrangement tends to be more stringent, pushing then on increasing the cost saving incentives.

Bonaccorsi et al. (2000) investigate the determinant of the choice between auction and bargaining on a dataset of Italian medical procurement device. They find that when there is a substantial influence of the medical staff (that cares more about quality) on procurement decisions bargaining is used more often. When the cost (value) of quality is low (high), bargaining is also used more often. If the potential market is narrow (few suppliers) auction is instead preferred because the price competition is not too intense and thus it does not affect too much the quality.

Bajari, McMillan and Tadelis (2006) analyze the key factors that lead the choice between auction and bargaining. They tested three hypothesis: first, a complex project is more likely to award with a negotiation; second, if the potential market is large the auction is more likely to be pick; third, in a complex project it is expected that the most reputable procurers will be selected as counterpart in a negotiation. The results of the empirical model support the previous hypothesis. 1) Complexity (contract value and duration) induces more discretionary award mechanism. 2) Controlling for the business cycle, they find that in case of boom negotiation is widely used (narrow market). Viceversa, during slump auction is more likely to be use (larger market). 3) They find that in a negotiation reputable contractors are more likely to be selected. They also consider the policy implications of their result. They suggest there is room is using different award mechanism to improve the efficiency of procurement leaving to costly monitoring the anticorruption transparency task.

More recently, Lalive and Schmutzler (2008) and (2011) investigate how introducing competition affect the railway service in Germany, in particular the cost (price) and the frequency of the service (contractible quality). In the former paper (2008) they perform an explorative analysis. Using a diff-in-diff approach they find a positive relation between competition and frequency of the service. However, in this explorative study they do not develop a proper framework to deal with the endogenous selection of the award mechanism between negotiation (with the incumbent) and auction. Also, they do not have any procurement price data making impossible the identification of any casual relation between competition and service frequency. Lalive and Schmutzler (2011) address these substantial issues. In their reduced form analysis they find that the cost of the lines auctioned is one fourth less than of those negotiated for a given level of service. They the build a model of the decision of whether to negotiate with the incumbent or auction of the line and proceed a structural analysis to deal with endogeneity issues. Among other things, they find that negotiation harms consumer surplus mainly on the ground of higher price rather than lower quantity, due to the bargaining power of the incumbent.

Related to our study is also the literature on reputation and long term relationships in procurement.

Banejeree and Duflo (2000) first study how contract incompleteness can affect the choice of the contract form. They exploit data from the Indian software industry. Their model shows that a reputable firm tends to be contracted with a cost-plus. The empirical results confirm the theoretical suggestion, even if with some shortcomings in the model underlined by the authors (i.e. the lack of data about reputation of the buyer), that a stronger reputation leads to use a cost-plus contract.

Corts and Sigh (2004) analyze the effect of repeated interaction on the choice of contract form in the market of the offshore drilling. The empirical findings show that the repeated interaction (measured by past stock of inter action) reduces the use of high incentives contracts, suggesting a relation in which repeated interaction can be a substitute for high incentive contracts. One of the main shortcomings, of the previous empirical results, is the proxy of the repeated interaction used: the stock of the past relations. It does not consider the shadow of future interactions.

Gil and Marion (2009) try to address this issue measuring the continuation value of

the relationship. They analyze the effect of repeated in market subcontractors for the California Highways. Their model has two main testable implications. First, higher past interaction leads to lower bids due to the decreasing coordination costs, thus increasing the probability of win the auction. Second, higher continuation value leads to a lower bids due to the decrease of the moral hazard problem, and therefore increasing the probability of winning the auction. The empirical results confirm these suggestions, nevertheless they show that the effect of repeated interaction has an impact on the bidding behavior only if there are future business chances. This result shows that the use of past interaction as a proxy of future repeated interaction may lead to wrong conclusions.

Shi and Susarla (2010) focus on information technology outsourcing contracts, finding that a vendor with high reputation capital in fair bargaining (cost-cutting) is more likely to be awarded a fixed-price (cost-plus) contract. They also find that lower reneging temptation when accommodating changes, measured by mature technology and process, favors relational fixed-price contracts. Finally, and consistent with theory, they find that fixed-price contracts become less complete with relational contracting.

3 The Institutional Framework

The Italian procurement law has undergone great transformation following the political scandal known as *"Mani Pulite"*, in the early 1990s. A new law, the 109/94 (know as *"Merloni"*), introduced a pronounced emphasis on transparency and competition.[2] This law strongly pursued the use of auctions as a means to promote competition and transparency.

There are three principal types of award mechanisms for public procurement auctions: the *Pubblico Incanto*, where participation is open to every firm certified for this project; the *Licitazione Privata*, where authorities invite a number of certified bidders;[3] and the *Trattativa Privata*, where the contracting authority invites a restricted number of bidders,

[2]Several amendments have been made over time. The main amendments are *"Merloni-bis'* in 1995 and *"Merloni-ter'* in 1998. Major legislative changes were introduced in 2006, but they do not concern our sample(2000-2005)

[3]An excluded certified firm can ask to be included in the list of the invited bidders and the contracting authority cannot refuse access.

at least 15.[4] [5]

The firms participating in the auction bid the price at which they are willing to undertake the project. They submit a percentage reduction (a rebate) with respect to the auction's starting value (the reserve price). The reduction from the original reserve price is the final price paid by the public administration, the cost of procurement. An engineer employed by the municipal administration estimates the value of the project and sets the reserve price, according to a menu of standardized costs for each type of work.

The winner of the auction is determined by a mathematical algorithm.[6] After a preliminary trimming of the top/bottom 10% of the collected bids, the bids that exceed the average by more than the average deviation (called the "anomaly threshold") are also excluded. The winning rebate is the highest of the non-excluded rebates below the anomaly threshold.[7]

This auction mechanism is somewhat unconventional.[8] Conley and Decarolis (2011) however, show theoretically that, in the presence of collusion, there is a positive correlation between the number of bidders and the winning rebate.[9] Consistent with the theoretical prediction, in the data we find a positive and significant relationship between the number of bidders and the rebates.

Contractual conditions (e.g., deadlines and possibility of subcontracts) are described in the call for tender. Some terms of the contract (the time of delivery and the cost of the project) might be partially renegotiated in cases of unforeseen or extreme meteorological events.[10] Subcontracting part of the works is permitted by law, but requires the approval

[4]To be valid a *Trattativa Privata* does not need 15 bids. Paradoxically, it may be sufficient that one bidder makes a bid to have a valid *Trattativa Privata*.

[5]There is also *Appalto Concorso* that is restrict to works with an extreme degree of complexity and high values.

[6]This mechanism is not used in two sets of procurement auctions: First, auctions with a reserve price above the European Community threshold that are administrated under the European Community common law, *"Merloni-quater"* in 2002. Second, the municipality of Turin managed to change the procurement law and from 2003 introduced first-price auctions.

[7]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 (in the form of a rebate over the starting value): 10, 14 and 16. The average bid is thus 13.33. The average difference of the bids above this average bid is 1.12. Thus the "anomaly threshold" is 14.44. It turns out that in this case the winning bid is 14, which is above the average, even if 16% is the highest bidden rebate.

[8]Decarolis (2011) shows the similarities between this auction mechanism and the mechanisms of countries like China, Taiwan, Japan, Switzerland, Florida DoT, NYS Proc. Ag., etc.

[9]See Proposition 3 in Conley and Decarolis (2011)

[10]Floods, storms, earthquakes, landslides, and mistakes of the engineer are the reasons for renegotiations

of the public administration. We consider whether works are delivered with delay or subjected to cost overrun as measures of the *ex-post* execution of the contract.

The likelihood to use a *Trattativa Privata* is partially a function of the auction starting values. With starting values below 300,000 euros, the contracting authorities may decide to use this award mechanism. Two conditions must hold: there should be a particular technical contingency or emergency reasons; previous procedures were run without results. However, these conditions are often relaxed, and contracting authorities tend to find it quite easy to use *Trattativa Privata*. Above 300,000 euros, it can be used only in a case of disaster or other emergency conditions.[11]

4 Data and Descriptive Statistics

We exploit a unique administrative database collected by the Italian Authority for the Surveillance of Public Procurement (*A.V.C.P.*). We gained access to all the public works auctioned in Italy between 2000 and 2005 with a greater or equal value of 150,000 euros. For each contract, we observe the number of bidders, the winner's rebate, the auction's starting values, the identity of winning bidder, the type of work, the final cost, the date of delivery, and the type and the location of the public administration.

Further, we integrate this data with demographic information (ISTAT)[12], social capital (Guiso et al. (2004)). [13]

4.1 Descriptive Statistics

In Table 1 we report the summary statistics for the sample of auction. We focus on a sub sample of works between 200,000 and 500,000 euros to avoid any other legal change.

prescribed by the Italian Civil Code.

[11]The contracting authority have to notify and justify to the Authority of Public Procurement the use of this procedure

[12]Wehave the population, the surface and the density at the provincial level for years 2000-2005

[13]Weconsider two measures of social capital at provincial level: the blood donation and the electoral turnout, Giuso et al. (2004).

[14] The data base amounts to 12,136 public works.[15] 88% of the auctions were open.[16] 52% of projects fall below the private negotiation threshold of 300,000 euros. The average value of a public works in our sample is 310,00 euros. More than 60% of the projects were roads or constructions, respectively 33 % the former and 29% the latter. Municipalities are responsible for about one half of the auction in the sample. Projects from the north of the country represent 58% percent of our sample.[17]

The average number of bidders is about 26 and the mean winner's rebate is roughly 14%. In 50% of the cases the contractor was registered inside the province of the contracting authority. The average expected completion time for a project was 217 days with a delay of 136 days. On average, the contracting authorities pay 12% more than the awarding price in terms of cost overrun. The probability to award a contract to a firm with whom the contracting authority has a past experience is 10%. 49% are incorporated as limited liability company and 10% as unlimited liability company.

5 Regression Discontinuity Design

We implement a Regression Discontinuity Design (RDD) to avoid the potential bias in the OLS estimates of the causal effect of discretion generated by the non-random assignment to the treatment. In Section 3 we discussed that public works are more likely to be awarded by open auction (the *treatment*) if the auction starting value is above 300,000 euros. Lee (2008) shows that in these cases, RDD can identify estimates which are as valid as those resulting from a randomized experiment. In this section we discuss the main characteristics of the RDD design and its assumptions.[18]

We define y as the threshold in the auction's starting value, which determines a discontinuity point in the support of the awarding mechanism function, as established by the

[14] Below 200,000 euro the Contracting Authorities can use a more simplified Award Procedure *Cottimo Fiduciario*; above 500,000 euros there is a change in the publicity requirement for the public works, Coviello and Mariniello (2012)

[15] In this sample we consider the winner for which a reliable identifier is present, either registration number or fiscal code.

[16] In this category we include either open (*Pubblico Incanto*) or partially restricted (*Licitazione Privata*).

[17] This is mainly due to incomplete and corrupted data about works' termination for auction coming from the south of the country.

[18] See Imbens and Lemieux (2008) and Lee and Lemieux (2010) for detailed toolkits on RDD. Closer to the spirit, Choi et al. (2011) is a novel application of the RDD to identify the causal effect of the reserve price on entry and auctions' outcomes.

law. The discontinuity point separates two different levels of discretion in selection of the awarding mechanism, which are imposed on public administrations. We can identify the casual effect of this change in discretion on the parameters of interest by concentrating on projects in a neighborhood around the discontinuity point. Y is the auction starting value (also called running variable) and T be the indicator of whether the contract is above the threshold.

O are the auction outcomes: the number of bidders, the winning rebate, the probability that the winner comes from inside the province, the cost overrun, the expected completion time, the days of delays, the probability of an incumbent winner and the probability of a limited liability winner or unlimited liability winner.[19] O_l and O_h are the values of O just below and above the discontinuity y. The identification of the casual effect of limiting discretion requires the respect of the following continuity conditions:

$$E\{O_t|Y = y^+\} = E\{O_t|Y = y^-\} \tag{1}$$

y_t^+ and y_t^- represent the right and left limits of the reservation price at the cutoff point. As in Hahn et al. (2001), if the continuity condition holds, for a a project in neighborhood of the cutoff point, the average effect of being above the threshold $T = h$ (rather than a lower $T = l$) is:

$$E\{O_t|Y = y^+\} - E\{O_t|Y = y^-\} \tag{2}$$

6 Empirical Analysis

6.1 Testing continuity assumption in the pre-treament variables and in the running variable

The compliance to the continuity assumption is necessary to retrieve a reliable inference from an RDD. We use two graphical methods to inspect the continuity assumption, McCrary (2008) and Lee (2008). These two methods are in some ways complementary.

[19] In Italy the are a number of different forms of company. Here we show the result only for two principal form. *Società Responsabilità Limitata* (SRL) is the most common form of limited liability company. *Società Nome Collettivo* (SNC) is most common form of unlimited liability company. The person in charge of the company will be responsive with his wealth in case of default. The residual population is compose by Public Company, Cooperative and Individual Firm.

In Figure 1, we focus our attention on a neighborhood around the threshold. In the four boxes, we plot the overall distribution of our sample, the road works, the construction works and the remaining works. Constructions do not raise issue of continuity. However, the overall distribution and roads subsample seem to be affected by a problem of continuity or sorting around the threshold. With this respect, we proceed with additional investigation on this issue we follow McCrary (2008). First, we draw a very under-smooth histogram of the running variable distribution. The bins are defined so that no bin will include points on the left and on right side of the threshold. Second, we run a local linear smoothing of the histogram. The midpoints of the histogram are the regressors and the normalized counts of the number of observations are the outcomes variables.

Figure 2 shows the results for the same subsample of Figure 1.[20] There is a clear problem of sorting for three our samples, in particular for the roads sample.[21] For the construction sample, the hypothesis of discontinuity of the running variable shows more ambiguous results. This is likely as splitting a building is more difficult than splitting a road in two different contracts and sort below the threshold.

We also report the formal parametric version of the McCrary test. Table 2 displays the estimated coefficient of the jump for each category in each year. The overall distribution of the full and road samples has a statistically significant jump at the cut-off point. In particular for the overall distribution in the year 2004 and 2005 , the jump is also statistically significant. The constructions at the overall level seems to not be affect by jumps in the distribution, despite a jump in 2005. Therefore, we focus the analysis on the construction sample.

Lee (2008) suggests an alternative procedure to investigate on the continuity condition by analyzing the behavior of the pretreatment variables around the threshold. We define a set of pretreatment variables from the information available to the researchers. A pretreatment variable should respect two conditions: it should not be affected by the level of treatment, and it may depend on the unobservable that should affect the auction outcomes. The identification would not be possible in case of jumps in the distribution of

[20] On request, the test on yearly basis are available.

[21] Running the test on the roads sample, sorting for different categories of contracting authority, does not seem to change the result. Nevertheless it raises some doubts about a systematic manipulation of the auction starting value in order to be below the threshold. This is particularly evident for ANAS.

the pretreatment variables, since the auctions assigned to open auction Z_h would not be comparable with the auctions not assigned to open auction Z_l.

In Figure 3, we graph non-parametric estimates of a sample of pretreatment variables (Contracting Authority is in Lombardy or Piedmont, Contracting Authority is a municipality, Length of Civil Trials, Population and Social Capital) against $y_d = (Y - y)$, the distance of the auction starting value from the cut-off point. We estimate these via a locally weighted smoothing average, separately on the left and on the right of the threshold. Some variables, like Length of Civil Trials or Municipality, may raise doubt about the validity of the continuity assumption. We also report a parametric version of this test. Table 3 shows that we can reject the hypothesis of violation in the continuity assumption.

6.2 Graphical Analysis

In this section we report the graphical evidence of the change in discretion on our variables of interest on $y_d = (Y - y)$.[22]

Figure 4 shows that at the threshold there is a positive jump in the frequency of awarding a project using open auction. We have an initial evidence that open auction is more likely to used above the threshold. Figure 5 shows a jump for expected completion time, probability of incumbent winner, the probability of a limited liability winner or unlimited liability company. In particular, the figure shows that there is a negative effect on the probability of incumbent winner, the probability to as a winner limited liability. Conversely, there seems to be a positive effect on the expected completion time and the probability of a unlimited liability winner. Indeed, the winning rebate, number of bidders, the provincial winner, days of delay do not show any effect of being on one side or on the other of the cutoff point.

6.3 Parametric Analysis: The RDD model

In this section we compute point estimates and standard errors of the casual effect of limiting discretion on auction outcomes. We consider a fully parametric approach and consider various specifications of this equation:

$$O_i = \alpha + \beta T_i + \epsilon_i \tag{3}$$

[22]The figure refers to constructions, see Section 6.1.

In case of a nonrandom assignment, it is likely that endogeneity bias may exist in the estimation of β deriving from the correlation between T_i and ϵ_i. When $E(\epsilon_i|T_i) \neq 0$, any OLS estimate of the equation 3 will be inconsistent.

Exploiting an RDD, we can benefit from the additional information about the selection rule in the treatment. Comparing a sample of individuals within a very small neighborhood around the threshold, we can identify and estimate the casual effect of of limiting discretion. It is possible because these observations are essentially identical, aside from the different discretion in choice of the auction format. Van Der Klaauw (2002) remarks how an increasing interval can bias the estimated effect especially if the assignment variable is related to the outcome variable conditional to the treatment status. To disentangle this relation, we follow the approach suggested by Angrist and Lavy (1999), Van der Klaauw (2002). We specify and include the conditional mean function $E(\epsilon_i|T_i, Y_i)$ as control function in the outcome equation. Hence, we implement an RD strategy that keeps all the data available in the sample and incorporates the variations far from the threshold controlling for a flexible specification of the reservation price. We assume that $E(\epsilon_i|T_i, Y_i)$, the conditional expectation of the unobserved component in O given the starting value of the auction is a continuous variable. Thus, we are able to approximate it by a polynomial $g(Y)$, of order k. This approximation will become arbitrarily precise as far as $k \to \infty$. Finally, we can rewrite the equation 3 as:

$$O_i = g(Y_i) + \beta T_i + \delta_t X_i + \omega_i \tag{4}$$

We identify $g(Y_i)$ as a third order degree polynomial in Y_i, T_i is the treatment, δ_t is a year indicator and is $\omega = O_i - E(\epsilon|T_i, Y_i)$. Within this model $E(\omega|Y_i) = 0$, thus if it is possible to properly identify $g(Y_i)$, the equation 4 can be correctly estimated through OLS because T will no longer be correlated with the errors. If the continuity assumption holds (as we have show in section 6.1), the OLS are consistent estimates of the causal effect of limiting discretion in the selection of auction mechanism. [23]

[23]There is an alternative interpretation of our analysis. We could think of the open auction as the treatment. However, we have shown that both legally (sec. 3) and in practice (sec. 6.2) there is not full enforcement of open auction above the threshold. Therefore, the former regression would identify the effect of the theoretical treatment or Intention-to-Treat. Following Angrist et al (2000), we would also be able to identify the casual effect of an open auction implementing a *Fuzzy Regression Discontinuity Design*. This would require two additional conditions to hold: exclusion restriction and the monotonicity

6.4 Parametric Analysis: Results

In this section we report the results of the parametric analysis on the outcomes of interest. Table 4 reports the estimates and the standard errors on the a sample selected using the Optimal Bandwidth procedure as suggested by Imbens and Kalyanaraman (2012). In the third row we report the average in the estimation sample and in the fourth row we report the size of the optimal bandwidth.

We first report the results on the number of bidders and winning rebate. Column 1 (2) reports the estimated coefficient for the winning rebate (the number of bidders). Both coefficients are not statistically significant. From the results, there seems to be no evidence of increase in entry or competition busting effect due to decreasing discretion.

Columns 3 to 5 display the estimated coefficients when we consider as outcomes the proxies for the design of the contract and the ex-post performance: expected completion time, days of delay, cost overrun. Also in this case there is not statistically significant evidence of an effect of limiting discretion.

In Column 6, we focus the effect on the probability of having an incumbent winner. The estimated coefficient is negative and statistically significant at 5% level. Limiting discretion reduces the probability of an incumbent winner of about 90% (on an average of 9.6%).[24] Columns 7 and 8 report the estimated coefficient on the type of the winning firm. The former is the effect on the probability of having a limited liability winner, which turns out to be not statistically significant. The latter is the effect on the probability of having an unlimited liability winner, which turns out to be positive and statistically significant at 10% level. Above the threshold there is 67% higher probability of having an unlimited liability winner (on an average of 10%). In particular this kind of firms are likely to be smaller compare to limited liability companies and riskier in case of default as the person in charge of the company responds with is wealth. Column 9 reports the estimated coefficient on the probability of a provincial winner, which is not statistically significant.

condition. Graph 4, however, shows that this approach is not feasible in this application as the later condition is likely be violated.

[24]We test this result with different specification of the model, considering the number of time the firm wins in the past, and different time lag, two and three years. Forsake of brevity, we do not include these results, that are substantially concordant with what report in the paper. They are available under request.

Overall, the results suggest that limiting discretion does not have direct effects on entry and the winning rebate (i.e., the direct costs of procurement) or ex-post efficiency. However, it has an effect on the type of winners (potentially riskier and less frequent).

7 Robustness Check and Falsification Analysis

In this section we consider three possible concerns of the apparently discontinuous relationship between auction outcomes and limiting discretion. First, we consider different specification to verify if results are driven by a particular specification of the empirical model. Second, we consider the robustness of the local results. In particular we want verify if the discontinuity problem highlighted in section 6.1 may invalidate the estimate. Thirdly, we want to verify the robustness of results with a placebo test.

We start analyzing a model with a large set of controls. Table 5 displays the results of the baseline model adding controls such as 110 provincial fixed effects, contracting authority type fixed effects and length of the civil trials and population size at the provincial level. The display of the results is alike Table 4. The results does not change compare to the baseline results. There is still a negative effect on the probability of a incumbent winner and a positive effect on the probability of an unlimited liability winner. Additionally, the coefficient on the days of delay is statistically significant at a 10% level. Work above the threshold have on average less days of delay by 21% (on an average of 138 days).

We also verify if the choice of the polynomial $g(Y)$ affects the results. Table 6 reports the results of the baseline model estimated with a quartic polynomial. Results are similar to the of Table 4. The only differences are in the coefficient for the unlimited liability winner that is not anymore significant and the coefficient on the delay that become statistically significant at 10% level.

Tables 7 and 8 report the estimated coefficients for the linear and quadratic polynomial when we interact the polynomial and the treatment (Local Linear and Quadratic Regressions). The odd columns display the linear specification and the even columns displays the interacted specification. Panel A of each table displays the result for winning rebate, number of bidders, expected completion time, days of delay and cost overrun. For this set of variables only the coefficient for the days of delay in the quadratic model with interaction is statistically significant at 10%. Panel B of each table displays the variables

about the identity of the bidder: probability of an incumbent winner, probability of a limited liability winner, probability of an unlimited liability winner and probability of a provincial winner. For all the specifications the coefficient for the incumbent winner is statistically significant between 5% and 10%. The size of the effect is comparable only for the quadratic polynomial specification interaction; in the other specification is between 47% and 50%, about half of the baseline specification. Additionally, we find a negative effect on the probability of limited liability winner in the linear specification; the coefficient is statistically significant at 10%. Under limited discretion there is an increase by 7% of probability of having a limited liability winner (on an average of 47%).

An additional sanity check would be verify the robustness of our results under different bandwidth specification. In Section 6.4, we have already covered the optimal bandwidth case. We also estimate the baseline regression starting with a bandwidth from 5,000 euro and to 100,000 euro with increment of 5,000 euro. In Graph 6, we display the effect of the forcing the use of open auction over this wider set of bandwidth for our variables of interest. We report also the confidence in interval at 95 %. The result on the incumbency are robust to a number of different bandwidth either closer or farer from the threshold. The results on the delay and nature of the firm are not robust to bandwidth closer to the threshold (until 60,000 euros). Additionally, we find that for bandwidth closer to the the expected completion time is longer for the works above the threshold (below 60,000 euros). The average effect is between 10% and 40%. These results are coherent with the graphical intuition delivered by Graph 5. In the end, we also find also below 45,000 euros a statistically significant positive effect on the number of the bidders. The size of the effect is increasing with the closeness to the threshold raising from the 85% to the 36% of the average. Also in this case the graphical intuition was suggesting this result.

The functional form of the model is an additional concern. A linear specification may be bias with respect to the outcome that are binary. For this reason, we estimate a probit model for the probability of a provincial winner, the incumbency of the winner and the nature of the winner. Table 9 shows the marginal effect of the threshold. In Panel A,we report the result of the specification of the baseline model (Table 4). They confirm the previous results, with the incumbency decreasing by 14%. The effect is statistically significant at 5%. Panel B displays the results of the specification including further controls

(Table 5). The effect of incumbency still statistically significant at 1%, reducing the incumbency of the winner by 17%. Additionally also there is an increase by 70% in the probability of an SNC winning the auction. The coefficient is significant at 10%.

Then, we address a possible violation of the continuity assumption for the 2005, as show in Section 6.1. We reestimate the baseline model, cubic polynomial in the running variable and year indicator. Table 10 reports the estimated coefficients; the display of the results is alike Table 4. The result on the probability of an incumbent winner are alike the baseline model, the coefficient is statistically significant at 10% and the magnitude of the coefficient is similar. Also the coefficient on the days of delay is statistically significant at 5%. The magnitude of the effect is on the same size of the previous specification.

In the end, we want to asses the robustness of our (local) result with a placebo test, to do so we simulate a threshold at 400,000 euros. Table 11 reports the estimated coefficients for this simulated threshold using the baseline model as in Table 4. We do not find evidence of statistically significant effect of the simulate threshold. This supports the argument that the results are not driven by the chance.

8 Firm Characteristics and Contract Execution

In this Section, we try to address some open issues regarding the firm identity and the ex-post performance. In particular, we focus on three characteristics of the firm: incumbency, limited liability and unlimited liability. We want to check if these characteristics have any effect on the efficiency in the execution of the contract. These winner characteristics are likely to be endogenous, however, especially because under restricted auction the contracting authority has some discretion in selecting the firms. To address this issue we pursue three strategies. First, we exploit the panel nature of the data, estimating a fixed effects model to measure the impact of winner incumbency. Second, we use a propensity score matching estimator. [25] Third, we also implement a propensity score reweighting.[26] We analyze the samples above and below the 300,000 euros separately. This way, we can

[25] We follow Rosenbaum and Rubin (1983) and we estimate the Average Treatment on the Treated (ATT). We use 4 neighbors matching.

[26] The goal of this approach is to match the distribution of the observables of the control group with respect of the treated group, as in Di Nardo et alt. (1996). We use as weighting variable the propensity score. For a complete exposition of the method please refer Brunel and Di Nardo (2004). We estimate the ATT.

determine if these firm characteristics have different effects when the contracting authority has the more discretion in selecting the bidders.

In Tables 12, 13 and 14, we display the results of the analysis. The two dependent variables used as proxy of efficiency in contract execution are the cost overrun and the days of delay. We include controls for the provincial fixed effect, year fixed effects, award mechanism dummies, 2^{nd} order polynomial in the reservation price, contracting authority type fixed effects, lengths of civil trial and number of bidders. In Columns 1 and 4, we report the estimates of the fixed effect model. Columns 2 and 5 report the estimates of the propensity score matching model. Finally, columns 3 and 6 report the estimates of the propensity score reweighting model. Panel A and B report respectively the estimates below and above the 300,000 euros threshold.

We find that incumbent winners unambiguously deliver public works with a shorter delay. On average an incumbent firm suffers 15% less days of delay for a public work below the threshold. The coefficients are statistically significant between 5% and 10%. Above the threshold the reduction is between 14% and 16%. All the coefficients are statistically significant at 1%. There is no effect on the cost overrun.

Limited Liability firm are less prone to delay, especially below the threshold. We observe a reduction in the average delay between 10% and 14%. The coefficients are statistically significant between 5% and 10%. Above the threshold even if negative, the effects are not statistically significant. Cost overrun have zero effect.

Unlimited liability seems to do not have any effect on the ex-post performance. Both cost overrun and days of delay display a non statistically significant effect.[27]

These results suggest a number of facts about the interaction between firm character-

[27]We try to shed additional light on the relationship between incumbency, limited liability and contract execution. We analyze the effect of having an incumbent winner again, but we split the sample considering an additional dimension, whether or not the winner is a limited liability firm or not. Table 15 display the results of this analysis. Looking to Panel A , there is no effect of incumbency on the delays when we restricted the sample only to the limited liability firm. This is true above and below 300,000 euros. Conversely, incumbency matters when we focus on the non-limited liability firm. For contract below (above) the threshold we observe a reduction in the delay from 23% to 26% (from 13% to 14%) when the winner is incumbent. We should notice that the coefficient for the matching estimator are not statistically significant. We also run an additionally analysis focusing the on the correlation between incumbency and limited liability. Following the same matching procedures we estimate the change in the probability of observing a limited liability winner when the winner is an incumbent. We do not find evidence of correlation between the two phenomena. For the sake of brevity we do not include the results. They are available under request

istics and efficiency in contract execution. Incumbent firm seems to deliver public work with a sizable reduction in the day of delay with no any renegotiation on the cost side. In the same fashion, limited liability firms incur in shorter delay, but this is true particularly below 300,000 euros. Additionally we find that incumbency is more important when the winning firm is not a limited liability. This result may help to rationalize why we observe an higher number of incumbent winner or limited liability firm in restricted auctions.The contracting authority may exploit the higher degree of discretion to invite more reliable firms, in term of past relation or legal structure. [28]

9 Conclusion

Open auction has been widely advocated as performance and transparency enhancing mechanism in public procurement. The most reliable firm is more likely to be selected and there is a reduction of that grey area where corruption use to lay. Nevertheless, various scholars argue that in presence of imperfect contracting leaving an higher degree of discretion for the contracting authority may lead to better performance, allowing the enforcement of relational contracts. Empirical research rationalizes these different theoretical predictions.

In this paper, we analyze the effects of a stricter implementation of the open auction mechanism. Using a large dataset of public constructions in Italy, we estimate the causal effect of limiting the discretion of contracting authorities in the selection of the auction format. We exploit a threshold present in the Italian procurement law that exogenously reduces the ability of the contracting authorities to use restricted auction. This feature allowed us to implement a Regression Discontinuity Design.

We found that when open auction is strictly enforced different firms are selected. First, there is a unambiguous drop in the probability of an incumbent firm of winning the contracts. Second, there is some evidence of selection of more unlimited liability and less limited liability company. These results may somehow suggest that the contracting authorities exploit the increasing discretion of restricted auction to select more reliable firms. However, there is not decisive evidence on this point, instead we found a contrasting

[28] Clearly in these result does not control for any source of unobserved heterogeneity that may induce bias in the estimates.

results. When open auction is "compulsory" there is some evidence of a reduction in the average number of delay.

We also try to disentangle the relationship between firm characteristics and ex-post performance. Given the importance of the restricted auction in selecting the winner, we compare subset of auction in which the contracting authority has different degree of discretion in the selection of the auction mechanism. There is clearly endogeneity in the winner characteristics. We address this issue using two different approaches. First, exploiting the panel structure of the data we estimate a fixed effect model. Second, we use the observables of each observation, implementing two complementary methods the propensity score matching and the propensity score reweighting. We find that an incumbent firm and limited liability firm tend to deliver public work with a shorter delay. These results are uniform across the different estimation methods. We also observe that the effect of incumbency is more important when the firm is not a limited liability.

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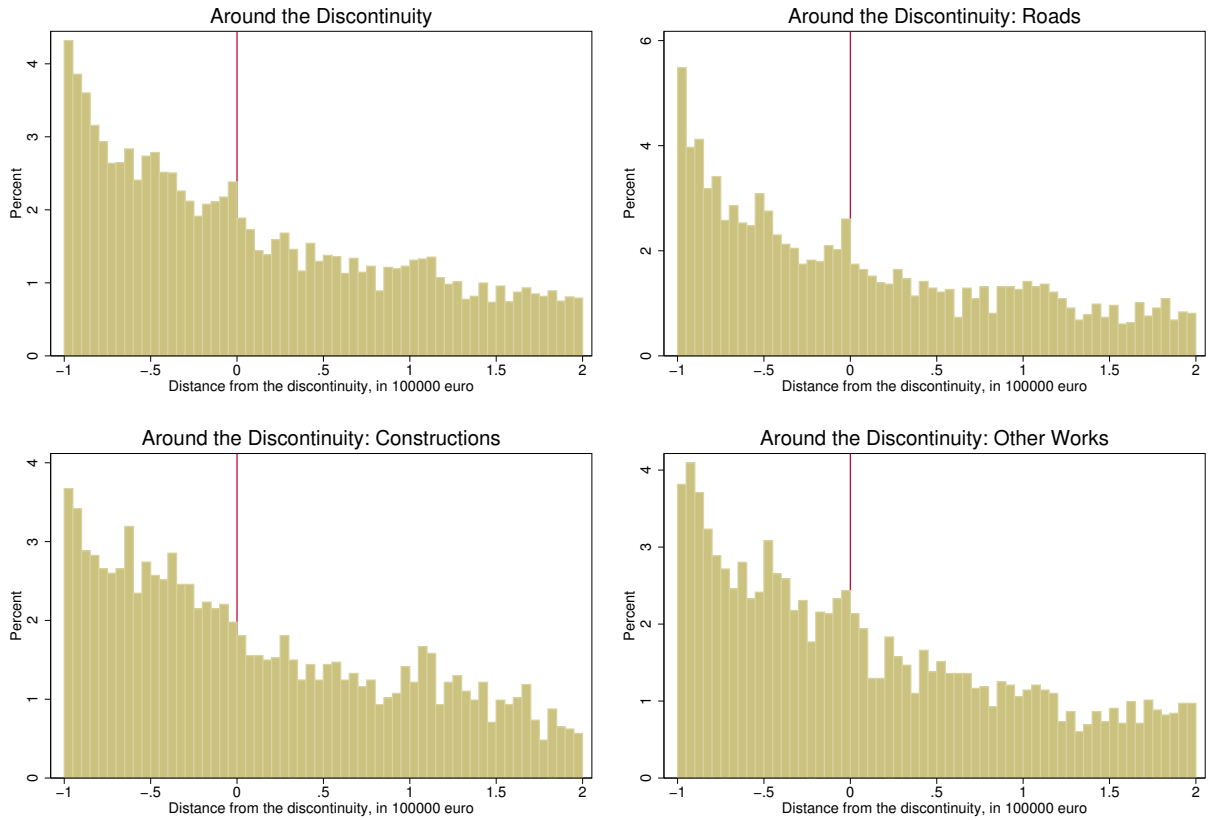
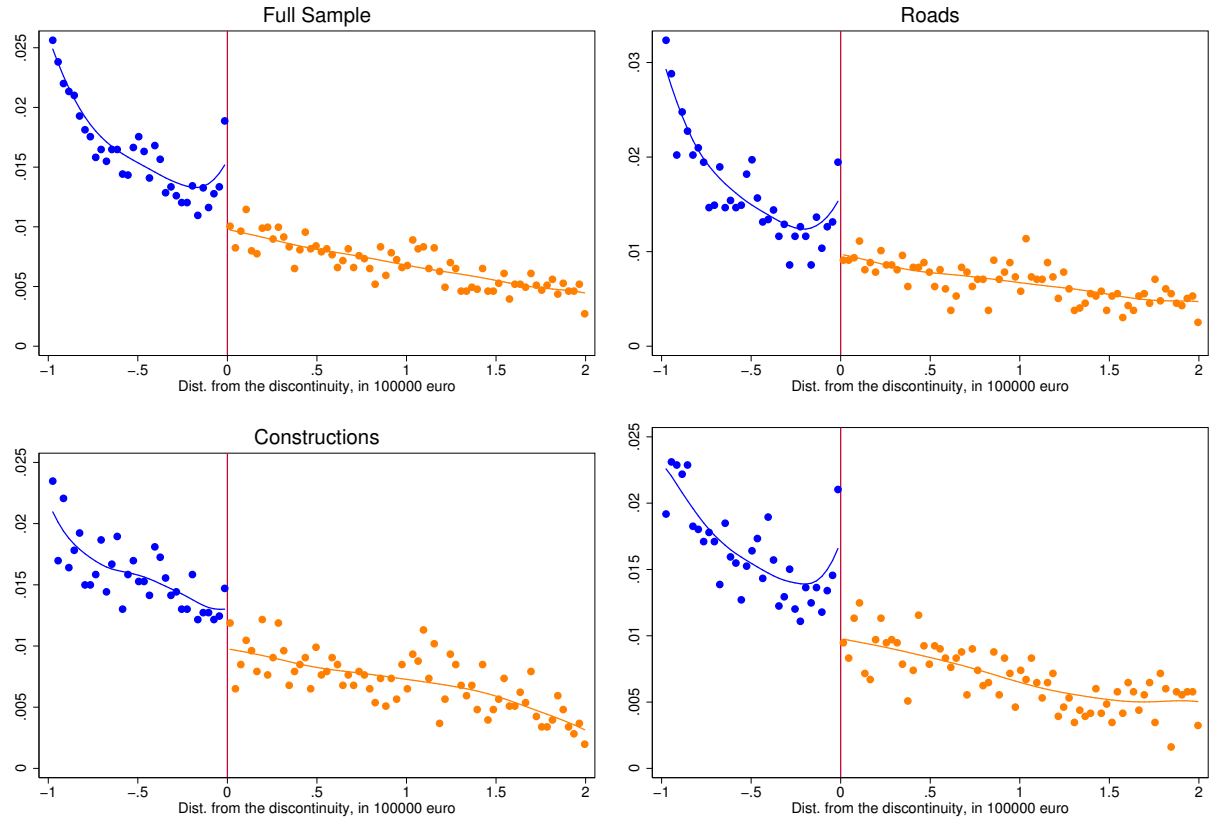
Figure 1: Auction Starting Values Distribution



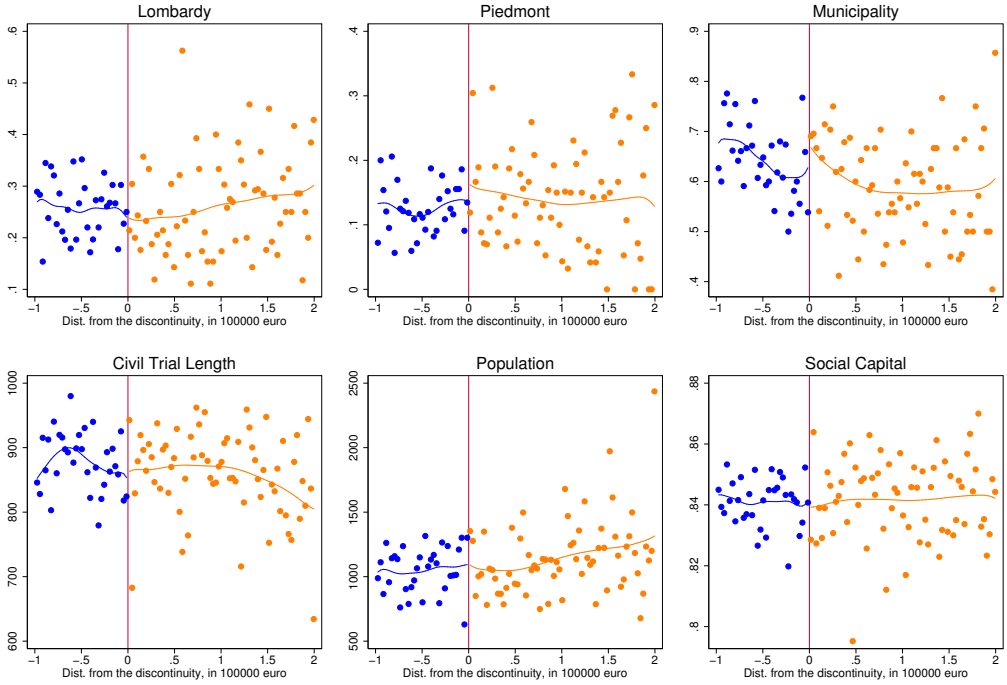
Source: Statistics for public works awarded between 2000 and 2005

Figure 2: Discontinuity Test



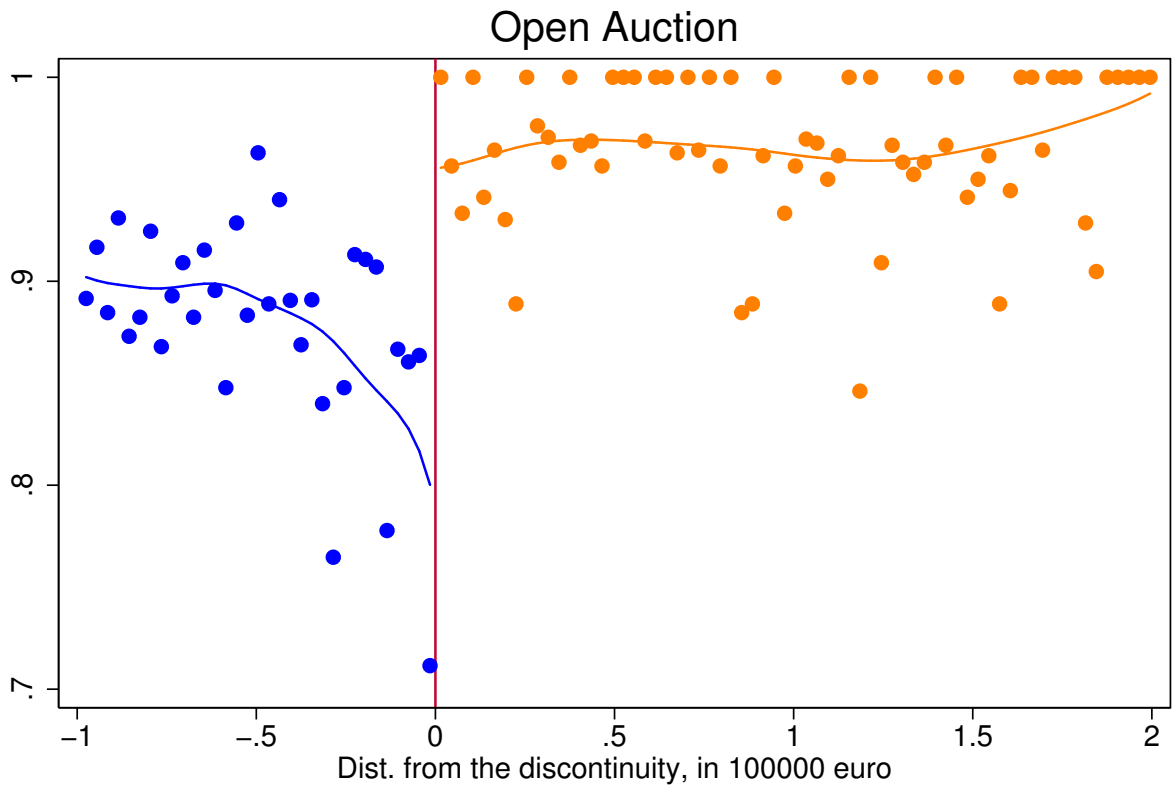
Source: Statistics for public works awarded from 2000 to 2005

Figure 3: Pretreatment Graphical Analysis



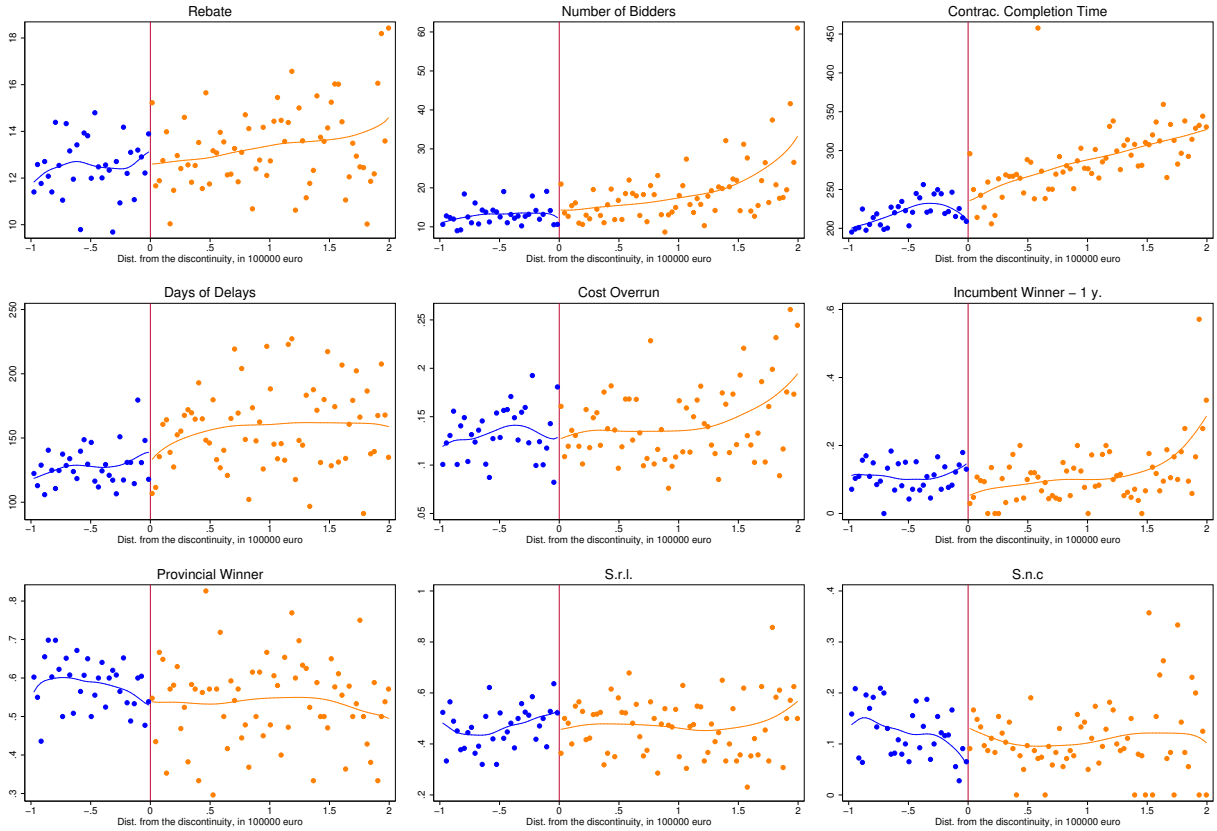
Source: Statistics for public works (constructions) awarded from 2000 to 2005

Figure 4: Graphical Analysis: Open Auction



Source: Statistics for public works (constructions) awarded from 2000 to 2005

Figure 5: Graphical Analysis: Outcomes



Source: Statistics for public works (constructions) awarded from 2000 to 2005

Figure 6: Different Bandwidths

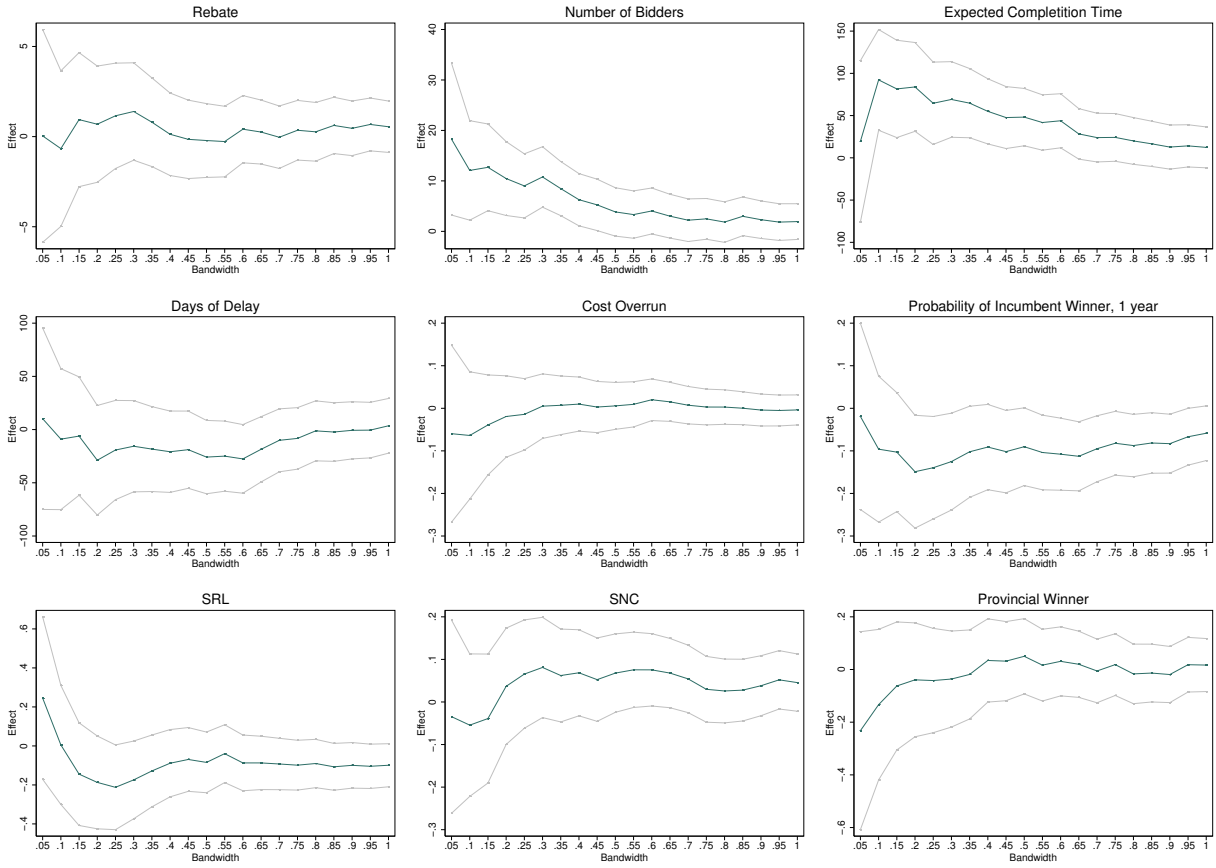


Table 1: Descriptive Statistics

VARIABLES	(1) N	(2) Mean	(3) SD	(4) Median	(5) MIN	(6) MAX
Reservation Price	12,136	0.0988	0.886	-0.0855471	-1	2
Number of Bidder	12,136	26.373	29.214	16	1	340
Rebate	12,136	14.131	8.652	13.110	0.003	54
Expected Completion Time	12,136	217.736	134.571	180	20	1,717
Days of Delay	12,136	136.471	144.769	101	-194	1,188
Cost Overrun	12,136	0.122	0.166	0.068	0	1.983
SRL	9,392	0.494	0.500	0	0	1
SNC	9,392	0.104	0.305	0	0	1
Provincial Winner	11,443	0.501	0.500	1	0	1
Winner is an incumbent: one year lag	10,040	0.102	0.303	0	0	1
Above 300,000 Euros	12,136	0.457	0.498	0	0	1
Open Auction	12,136	0.891	0.312	1	0	1
Ministry	12,136	0.037	0.188	0	0	1
Province	12,136	0.143	0.350	0	0	1
Municipality	12,136	0.548	0.498	1	0	1
North	12,136	0.583	0.493	1	0	1
Centre	12,136	0.266	0.442	0	0	1
South	12,136	0.151	0.358	0	0	1
Roads	12,136	0.326	0.469	0	0	1
Constructions	12,136	0.292	0.455	0	0	1
Environmental	12,136	0.063	0.243	0	0	1
Other	12,136	0.319	0.466	0	0	1
Central Government	12,136	0.038	0.190	0	0	1
Local Government	12,136	0.704	0.456	1	0	1
External Body	12,136	0.074	0.262	0	0	1
Other Category of C.A.	12,136	0.184	0.388	0	0	1
Social Capital	12,136	0.838	0.063	0.860	0.630	0.920
Length Judicial Trial	12,136	885.318	290.992	843	252	2,221
Population	12,136	999,878	1028345	601,072	89,832	3854127

Table 2: McCrary Discontinuity Test

SAMPLE	(1) Overall distribution	(2) Roads	(3) Constructions	(4) Other Works
Full Sample	-0.201***	-0.249**	-0.149	-0.155*
se	0.0642	0.107	0.123	0.0837
t_test	-3.123	-2.327	-1.217	-1.856
2000	-0.0654	-0.418	-0.222	0.0892
se	0.179	0.416	0.284	0.224
t_test	-0.366	-1.005	-0.783	0.399
2001	-0.0629	-0.0112	0.128	-0.378
se	0.137	0.258	0.227	0.239
t_test	-0.458	-0.0434	0.565	-1.578
2002	-0.227*	-0.0540	-0.229	-0.279
se	0.125	0.204	0.216	0.194
t_test	-1.814	-0.265	-1.064	-1.442
2003	-0.0600	-0.205	-0.268	0.0539
se	0.125	0.225	0.281	0.163
t_test	-0.479	-0.911	-0.954	0.331
2004	-0.307**	-0.346	-0.276	-0.404
se	0.145	0.226	0.247	0.191
t_test	-2.119	-1.531	-1.119	-2.117
2005	-0.417**	-0.380	-0.548*	-0.314
se	0.188	0.336	0.325	0.291
t_test	-2.213	-1.130	-1.686	-1.080

Notes: Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents).

Table 3: Pretreatment Variables

	(1) Lombardy	(2) Piedmont	(3) Municipality	(4) Judicial Efficiency	(5) Population	(6) Social Capital
ITT	-0.0291	0.000894	0.0816	40.91	-9.133	-0.00363
	(0.0440)	(0.0355)	(0.0498)	(31.18)	(127.0)	(0.00606)
Average	0.250	0.130	0.629	879.1	1045	0.841
Bandwidth	1.046	1.078	0.995	0.834	0.775	1.056
Observations	2,869	2,902	2,806	2,310	2,148	2,883

Notes: Coefficient (and SE in parenthesis) of the effect of being above the Open Auction Threshold (300,000 euros). The third row reports the Average value of the dependent variable. The fourth row reports the value of the optimal bandwidth calculated as in Imbens and Kalyanaraman (2012). All the regressions include the 3^{rd} order polynomial in the difference of the starting value from the threshold, and five year indicators. In column 1 the Dependent Variable is the probability that the contracting authority is located in Lombardy. In column 2 the Dependent Variable is the probability that the contracting authority is located in Piedmont. In column 3 the Dependent Variable is the probability that the contracting authority is a municipality. In column 4 the Dependent Variable is the length of judicial trials measure in days. In column 5 the Dependent Variable is the population of the province measured in 100,000. In Column 6 the Dependent Variable is the a measure of social capital voter turnout at the province level for all the referenda before 1989, for additional information see Guiso (2004). These include data referenda on the period between 1946 and 1987. For each province turnout data were averaged across time. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because here we restrict the analysis the Optimal Bandwidth sample, as in Imbens and Kalyanaraman (2012).

Table 4: Baseline Model

	(1) Rebate	(2) Number of Bidders	(3) Expected Completion Time	(4) Days of Delay	(5) Cost Overrun	(6) Incumbent Winner 1 year	(7) SRL	(8) SNC	(9) Provincial Winner
ITT	0.606	2.061	13.74	-26.73	0.00316	-0.0867**	-0.0847	0.0696*	0.0164
	(0.798)	(1.796)	(13.39)	(16.78)	(0.0202)	(0.0375)	(0.0657)	(0.0410)	(0.0522)
Average	12.70	13.92	237.2	137.6	0.136	0.0960	0.473	0.104	0.568
Bandwidth	0.849	1.044	0.891	0.557	0.822	0.790	0.739	0.662	0.974
Observations	2,350	2,868	2,470	1,528	2,267	1,885	1,703	1,533	2,733

Notes: Coefficient (and SE in parenthesis) of the effect of being above the Open Auction Threshold (300,000 euros). The third row reports the Average value of the dependent variable. The fourth row reports the value of the optimal bandwidth calculated as in Imbens and Kalyanaraman (2012). All the regressions include the 3^{rd} order polynomial in the difference of the starting value from the threshold, and five year indicators. In column 1 the Dependent Variable is the Winning Rebate as percentage of discount over the reservation price. In column 2 the Dependent Variable is the number of bidders. In column 3 the Dependent Variable is the Expected Completion Time measured in days. In column 4 the Dependent Variable is Delay in the completion of the work measured in days. In column 5 the Dependent Variable is the size of the Cost Overrun measure as the difference between the final cost and the winning price over the winning price. In Column 6 the Dependent Variable is the probability of having an incumbent winner in the past year. In column 7 the Dependent Variable is the probability of having a limited liability firm as a winner. In column 8 the Dependent Variable is the probability of having an unlimited liability firm as a winner. In column 9 the Dependent Variable is the probability of having a winner coming from the same province of the contracting authority. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because here we restrict the analysis the Optimal Bandwidth sample, as in Imbens and Kalyanaraman (2012).

Table 5: Robustness and Sensitivity Analysis: Control Variables

	(1) Rebate	(2) Number of Bidders	(3) Expected Completion Time	(4) Days of Delay	(5) Cost Overrun	(6) Incumbent Winner 1 year	(7) SRL	(8) SNC	(9) Provincial Winner
ITT	0.0728	1.075	17.41	-28.55*	0.00217	-0.0951**	-0.0929	0.0744*	0.00554
	(0.604)	(1.627)	(13.25)	(16.74)	(0.0200)	(0.0384)	(0.0649)	(0.0422)	(0.0487)
Average	12.70	13.92	237.2	137.6	0.136	0.0960	0.473	0.104	0.568
Bandwidth	0.849	1.044	0.891	0.557	0.822	0.790	0.739	0.662	0.974
Observations	2,350	2,868	2,470	1,528	2,267	1,885	1,703	1,533	2,733

Notes: Coefficient (and SE in parenthesis) of the effect of being above the Open Auction Threshold (300,000 euros). The third row reports the Average value of the dependent variable. The fourth row reports the value of the optimal bandwidth calculated as in Imbens and Kalyanaraman (2012). All the regressions include the 3^{rd} order polynomial in the difference of the starting value from the threshold, five year indicators, provincial fixed effects, contracting authority type fixed effects and lengths of civil trial. In column 1 the Dependent Variable is the Winning Rebate as percentage of discount over the reservation price. In column 2 the Dependent Variable is the number of bidders. In column 3 the Dependent Variable is the Expected Completion Time measured in days. In column 4 the Dependent Variable is Delay in the completion of the work measured in days. In column 5 the Dependent Variable is the size of the Cost Overrun measure as the difference between the final cost and the winning price over the winning price. In Column 6 the Dependent Variable is the probability of having an incumbent winner in the past year. In column 7 the Dependent Variable is the probability of having a limited liability firm as a winner. In column 8 the Dependent Variable is the probability of having an unlimited liability firm as a winner. In column 9 the Dependent Variable is the probability of having a winner coming from the same province of the contracting authority. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because here we restrict the analysis the Optimal Bandwidth sample, as in Imbens and Kalyanaraman (2012).

Table 6: Robustness and Sensitivity Analysis: Quartic Polynomial

	(1) Rebate	(2) Number of Bidders	(3) Expected Completion Time	(4) Days of Delay	(5) Cost Overrun	(6) Incumbent Winner 1 year	(7) SRL	(8) SNC	(9) Provincial Winner
ITT	0.531	1.809	7.839	-29.19*	0.000657	-0.0927**	-0.0970	0.0600	0.0106
	(0.809)	(1.817)	(14.11)	(16.97)	(0.0205)	(0.0370)	(0.0669)	(0.0417)	(0.0532)
Average	12.70	13.92	237.2	137.6	0.136	0.0960	0.473	0.104	0.568
Bandwidth	0.849	1.044	0.891	0.557	0.822	0.790	0.739	0.662	0.974
Observations	2,350	2,868	2,470	1,528	2,267	1,885	1,703	1,533	2,733

Notes: Coefficient (and SE in parenthesis) of the effect of being above the Open Auction Threshold (300,000 euros). The third row reports the Average value of the dependent variable. The fourth row reports the value of the optimal bandwidth calculated as in Imbens and Kalyanaraman (2012). All the regressions include the 4^{th} order polynomial in the difference of the starting value from the threshold, and five year indicators. In column 1 the Dependent Variable is the Winning Rebate as percentage of discount over the reservation price. In column 2 the Dependent Variable is the number of bidders. In column 3 the Dependent Variable is the Expected Completion Time measured in days. In column 4 the Dependent Variable is Delay in the completion of the work measured in days. In column 5 the Dependent Variable is the size of the Cost Overrun measure as the difference between the final cost and the winning price over the winning price. In Column 6 the Dependent Variable is the probability of having an incumbent winner in the past year. In column 7 the Dependent Variable is the probability of having a limited liability firm as a winner. In column 8 the Dependent Variable is the probability of having an unlimited liability firm as a winner. In column 9 the Dependent Variable is the probability of having a winner coming from the same province of the contracting authority. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because here we restrict the analysis the Optimal Bandwidth sample, as in Imbens and Kalyanaraman (2012).

Table 7: Robustness and Sensitivity Analysis: Linear Interacted Polynomial

Panel A: Entry, Competition and Ex-Post Performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Rebate		Number of Bidders		Expected Completion Time		Days of Delay		Cost Overrun	
	No Int.	Int.	No Int.	Int.	No Int.	Int.	No Int.	Int.	No Int.	Int.
ITT	0.374	0.318	1.098	1.070	8.767	6.019	-0.126	-3.725	-0.00697	-0.00753
	(0.600)	(0.605)	(1.361)	(1.382)	(9.825)	(10.03)	(13.05)	(13.07)	(0.0151)	(0.0150)
Average	12.70	12.70	13.92	13.92	237.2	237.2	137.6	137.6	0.136	0.136
Bandwidth	0.849	0.849	1.044	1.044	0.891	0.891	0.557	0.557	0.822	0.822
Observations	2,350	2,350	2,868	2,868	2,470	2,470	1,528	1,528	2,267	2,267

Panel B: Firm Identity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Incumbent Winner 1 year		SRL		SNC		Provincial Winner	
	No Int.	Int.	No Int.	Int.	No Int.	Int.	No Int.	Int.
ITT	-0.0474*	-0.0448*	-0.0848*	-0.0756	0.0190	0.0252	-0.0229	-0.0270
	(0.0278)	(0.0271)	(0.0494)	(0.0505)	(0.0312)	(0.0322)	(0.0388)	(0.0398)
Average	0.0960	0.0960	0.473	0.473	0.104	0.104	0.568	0.568
Bandwidth	0.790	0.790	0.739	0.739	0.662	0.662	0.974	0.974
Observations	1,885	1,885	1,703	1,703	1,533	1,533	2,733	2,733

Notes: Coefficient (and SE in parenthesis) of the effect of being above the Open Auction Threshold (300,000 euros). The third row of each panel reports the Average value of the dependent variable. The fourth row of each panel reports the value of the optimal bandwidth calculated as in Imbens and Kalyanaraman (2012). Panel A displays the following Dependent Variables: columns 1 and 2 the winning rebate, columns 3 and 4 the number of bidders, columns 5 and 6 the expected completion time, columns 7 and 8 the days of delays and columns 9 and 10 the percentage of cost overrun. Panel B displays the following Dependent Variables: columns 1 and 2 the probability of an incumbent winner, columns 3 and 4 the probability of an limited liability winner, columns 5 and 6 the probability of an unlimited liability winner and columns 7 and 8 the probability of a provincial winner. All the regressions include the 1^{st} order polynomial in the difference of the starting value from the threshold, and five year indicators. The odd columns report the result for the linear model. The even columns report the coefficients for the model with the interaction between discontinuity and polynomial. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because here we restrict the analysis the Optimal Bandwidth sample, as in Imbens and Kalyanaraman (2012).

Table 8: Robustness and Sensitivity Analysis: Quadratic Interacted Polynomial

Panel A: Entry, Competition and Ex-Post Performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Rebate		Number of Bidders		Expected Completion Time		Days of Delay		Cost Overrun	
	No Int.	Int.	No Int.	Int.	No Int.	Int.	No Int.	Int.	No Int.	Int.
ITT	0.295	0.691	1.143	2.349	7.394	14.72	-3.337	-34.88*	-0.00676	0.00357
	(0.605)	(0.915)	(1.391)	(2.043)	(9.983)	(16.12)	(13.14)	(18.74)	(0.0151)	(0.0233)
Average	12.70	12.70	13.92	13.92	237.2	237.2	137.6	137.6	0.136	0.136
Bandwidth	0.849	0.849	1.044	1.044	0.891	0.891	0.557	0.557	0.822	0.822
Observations	2,350	2,350	2,868	2,868	2,470	2,470	1,528	1,528	2,267	2,267

Panel B: Firm Identity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Incumbent Winner 1 year		SRL		SNC		Provincial Winner	
	No Int.	Int.	No Int.	Int.	No Int.	Int.	No Int.	Int.
ITT	-0.0449*	-0.103**	-0.0727	-0.102	0.0286	0.0665	-0.0255	0.0180
	(0.0273)	(0.0408)	(0.0506)	(0.0747)	(0.0321)	(0.0467)	(0.0399)	(0.0597)
Average	0.0960	0.0960	0.473	0.473	0.104	0.104	0.568	0.568
Bandwidth	0.790	0.790	0.739	0.739	0.662	0.662	0.974	0.974
Observations	1,885	1,885	1,703	1,703	1,533	1,533	2,733	2,733

Notes: Coefficient (and SE in parenthesis) of the effect of being above the Open Auction Threshold (300,000 euros). The third row of each panel reports the Average value of the dependent variable. The fourth row of each panel reports the value of the optimal bandwidth calculated as in Imbens and Kalyanaraman (2012). Panel A displays the following Dependent Variables: columns 1 and 2 the winning rebate, columns 3 and 4 the number of bidders, columns 5 and 6 the expected completion time, columns 7 and 8 the days of delays and columns 9 and 10 the percentage of cost overrun. Panel B displays the following Dependent Variables: columns 1 and 2 the probability of an incumbent winner, columns 3 and 4 the probability of an limited liability winner, columns 5 and 6 the probability of an unlimited liability winner and columns 7 and 8 the probability of a provincial winner. All the regressions include the 2^{nd} order polynomial in the difference of the starting value from the threshold, and five year indicators. The odd columns report the result for the linear model. The even columns report the coefficients for the model with the interaction between discontinuity and polynomial. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because here we restrict the analysis the Optimal Bandwidth sample, as in Imbens and Kalyanaraman (2012).

Table 9: Robustness and Sensitivity Analysis: Probit

	(1) Incumbent Winner 1 year	(2) SRL	(3) SNC	(4) Provincial Winner
	Panel A: Baseline Model			
ITT	-0.0776**	-0.0843	0.0719	0.0169
	(0.0307)	(0.0653)	(0.0450)	(0.0517)
Average	0.096	0.473	0.104	0.568
Bandwidth	0.790	0.739	0.662	0.974
Observations	1,885	1,703	1,533	2,733
	Panel B: Model with Controls			
ITT	-0.0981***	-0.102	0.0841*	0.0115
	(0.0321)	(0.0692)	(0.0484)	(0.0555)
Average	0.111	0.478	0.119	0.590
Bandwidth	0.790	0.739	0.662	0.974
Observations	1,622	1,670	1,332	2,613

Notes: Coefficient (and SE in parenthesis) of the effect of being above the Open Auction Threshold (300,000 euros). The third row reports the Average value of the dependent variable. The fourth row reports the value of the optimal bandwidth calculated as in Imbens and Kalyanaraman (2012). All the regressions include the 3^{rd} order polynomial in the difference of the starting value from the threshold, and five year indicators. n Column 1 the Dependent Variable is the probability of having an incumbent winner in the past year. In column 2 the Dependent Variable is the probability of having a limited liability firm as a winner. In column 3 the Dependent Variable is the probability of having an unlimited liability firm as a winner. In column 4 the Dependent Variable is the probability of having a winner coming from the same province of the contracting authority. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because here we restrict the analysis the Optimal Bandwidth sample, as in Imbens and Kalyanaraman (2012).

Table 10: Robustness and Sensitivity Analysis: 2005 Excluded

	(1) Rebate	(2) Number of Bidders	(3) Expected Completion Time	(4) Days of Delay	(5) Cost Overrun	(6) Incumbent Winner 1 year	(7) SRL	(8) SNC	(9) Provincial Winner
ITT	0.332	2.264	16.32	-35.18**	-0.00159	-0.0665*	-0.0846	0.0202	0.00979
	(0.801)	(1.917)	(14.11)	(17.44)	(0.0215)	(0.0355)	(0.0675)	(0.0410)	(0.0638)
Average	12.43	13.38	237.2	135.8	0.133	0.101	0.470	0.110	0.562
Bandwidth	0.890	1.037	0.884	0.556	0.822	1.024	0.779	0.757	0.729
Observations	2,225	2,581	2,215	1,373	2,039	2,168	1,597	1,542	1,813

Notes: Coefficient (and SE in parenthesis) of the effect of being above the Open Auction Threshold (300,000 euros). The third row reports the Average value of the dependent variable. The fourth row reports the value of the optimal bandwidth calculated as in Imbens and Kalyanaraman (2012). All the regressions include the 3^{rd} order polynomial in the difference of the starting value from the threshold, and five year indicators. In column 1 the Dependent Variable is the Winning Rebate as percentage of discount over the reservation price. In column 2 the Dependent Variable is the number of bidders. In column 3 the Dependent Variable is the Expected Completion Time measured in days. In column 4 the Dependent Variable is Delay in the completion of the work measured in days. In column 5 the Dependent Variable is the size of the Cost Overrun measure as the difference between the final cost and the winning price over the winning price. In Column 6 the Dependent Variable is the probability of having an incumbent winner in the past year. In column 7 the Dependent Variable is the probability of having a limited liability firm as a winner. In column 8 the Dependent Variable is the probability of having an unlimited liability firm as a winner. In column 9 the Dependent Variable is the probability of having a winner coming from the same province of the contracting authority. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2004, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because here we restrict the analysis the Optimal Bandwidth sample, as in Imbens and Kalyanaraman (2012).

Table 11: Robustness and Sensitivity Analysis: Placebo Test

	(1) Rebate	(2) Number of Bidders	(3) Expected Completion Time	(4) Days of Delay	(5) Cost Overrun	(6) Incumbent Winner 1 year	(7) SRL	(8) SNC	(9) Provincial Winner
ITT	0.432	-0.0618	-16.23	5.770	0.00479	0.0184	0.0692	-0.000709	0.0551
	(0.702)	(2.453)	(15.49)	(18.46)	(0.0175)	(0.0500)	(0.0872)	(0.0364)	(0.0488)
Average	12.95	17.20	277.8	152.1	0.137	0.0972	0.474	0.109	0.558
Bandwidth	1.665	0.893	0.989	1.231	1.207	0.749	0.684	1.477	1.719
Observations	2,942	1,542	1,727	2,123	2,082	1,121	966	2,105	3,044

Notes: Coefficient (and SE in parenthesis) of the effect of being above a Simulated Threshold (400,000 euros). The third row reports the Average value of the dependent variable. The fourth row reports the value of the optimal bandwidth calculated as in Imbens and Kalyanaraman (2012). All the regressions include the 3^{rd} order polynomial in the difference of the starting value from the threshold, and five year indicators. In column 1 the Dependent Variable is the Winning Rebate as percentage of discount over the reservation price. In column 2 the Dependent Variable is the number of bidders. In column 3 the Dependent Variable is the Expected Completion Time measured in days. In column 4 the Dependent Variable is Delay in the completion of the work measured in days. In column 5 the Dependent Variable is the size of the Cost Overrun measure as the difference between the final cost and the winning price over the winning price. In Column 6 the Dependent Variable is the probability of having an incumbent winner in the past year. In column 7 the Dependent Variable is the probability of having a limited liability firm as a winner. In column 8 the Dependent Variable is the probability of having an unlimited liability firm as a winner. In column 9 the Dependent Variable is the probability of having a winner coming from the same province of the contracting authority. Panel A report the OLS estimation. Panel B report the estimate of the Propensity Score Matching. Panel C report the Estimates for the Propensity Score Reweighting. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because here we restrict the analysis the Optimal Bandwidth sample, as in Imbens and Kalyanaraman (2012).

Table 12: Incumbency and Contract Execution

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Below 300,000 Euros					
	Days of Delay Avrg:128			Cost Overrun Avrg: 0.138		
Incumbent Winner 1 year	-20.09**	-19.90*	-20.16**	0.00213	-0.00602	-0.000712
	(8.883)	(11.11)	(8.080)	(0.0127)	(0.0154)	(0.0121)
Observations	1,636	1636	1,636	1,830	1830	1,830
	Panel B: Above 300,000 Euros					
	Days of Delay Avrg:193			Cost Overrun Avrg: 0.153		
Incumbent Winner 1 year	-28.65***	-30.59***	-27.76***	0.00341	0.00419	0.00340
	(8.486)	(9.973)	(8.093)	(0.00865)	(0.00990)	(0.00834)
Observations	4,031	4031	4,031	3,904	3904	3,904

Notes: Coefficient (and SE in parenthesis) of the effect of being an incumbent winner in the past year. We include controls for the provincial fixed effect, Year fixed effects, Award Mechanism dummy, 2^{nd} order polynomial in the reservation price, contracting authority type fixed effects, lengths of civil trial and number of bidders. Columns 1 and 4 reports the estimates of the fixed effect model. Columns 2 and 5 reports the estimates of the propensity score matching model. Columns 3 and 6 reports the estimates of the propensity score matching model. Panel A report the estimates below the 300,000 euros threshold. Panel B report the estimates above the 300,000 euros threshold. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because we restricted the analysis to the work between 200,000 euros and 500,000 euros.

Table 13: Limited Liability Firm and Contract Execution

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Below 300,000 Euros					
	Days of Delay Avrg:130			Cost Overrun Avrg: 0.141		
Limited Liability	-12.91*	-18.22**	-12.83*	0.00458	-0.00112	-0.00266
	(6.777)	(8.018)	(6.715)	(0.00968)	(0.0104)	(0.0105)
Observations	1,649	1649	1,649	1,797		
	Panel B: Above 300,000 Euros					
	Days of Delay Avrg:204			Cost Overrun Avrg: 0.153		
Limited Liability	-1.137	-7.130	-3.272	-0.00412	-0.00395	-0.00441
	(6.176)	(7.094)	(6.106)	(0.00539)	(0.00622)	(0.00586)
Observations	4,004	4004	4,004	3,917	3917	3,917

Notes: Coefficient (and SE in parenthesis) of the effect of being a limited liability firm We include controls for the provincial fixed effect, Year fixed effects, Award Mechanism dummy, 2^{nd} order polynomial in the reservation price, contracting authority type fixed effects, lengths of civil trial and number of bidders. Columns 1 and 4 reports the estimates of the fixed effect model. Columns 2 and 5 reports the estimates of the propensity score matching model. Columns 3 and 6 reports the estimates of the propensity score matching model. Panel A report the estimates below the 300,000 euros threshold. Panel B report the estimates above the 300,000 euros threshold. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because we restricted the analysis to the work between 200,000 euros and 500,000 euros.

Table 14: Unlimited Liability Firm and Contract Execution

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Below 300,000 Euros					
	Days of Delay Avrg:127			Cost Overrun Avrg: 0.137		
Unlimited Liability	6.957	1.907	5.090	-0.00931	-0.00589	-0.00963
	(9.790)	(11.29)	(9.232)	(0.0111)	(0.0133)	(0.0100)
Observations	1,444	1444	1,444	1,639	1639	1,639
	Panel B: Above 300,000 Euros					
	Days of Delay Avrg:192			Cost Overrun Avrg: 0.153		
Unlimited Liability	-5.131	-0.576	-2.615	0.000163	-0.000939	-0.00165
	(10.44)	(12.27)	(9.485)	(0.00859)	(0.00997)	(0.00810)
Observations	3,804	3804	3,804	3,676	3676	3,676

Notes: Coefficient (and SE in parenthesis) of the effect of being an unlimited liability firm. We include controls for the provincial fixed effect, Year fixed effects, Award Mechanism dummy, 2^{rnd} order polynomial in the reservation price, contracting authority type fixed effects, lengths of civil trial and number of bidders. Columns 1 and 4 reports the estimates of the fixed effect model. Columns 2 and 5 reports the estimates of the propensity score matching model. Columns 3 and 6 reports the estimates of the propensity score matching model. Panel A report the estimates below the 300,000 euros threshold. Panel B report the estimates above the 300,000 euros threshold. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because we restricted the analysis to the work between 200,000 euros and 500,000 euros.

Table 15: Limited Liability Firm, Incumbency and Contract Execution

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Below 300,000 Euros & Limited Liability					
	Days of Delay Avrg:110			Cost Overrun Avrg: 0.133		
Incumbent Winner 1 year	-12.52	-21.39	-17.81	0.00763		0.000826
	(15.21)	(19.11)	(12.91)	(0.0218)	(0.0268)	(0.0198)
Observations	528	528	528	542	542	542
	Panel B: Above 300,000 Euros & Limited Liability					
	Days of Delay Avrg:184			Cost Overrun Avrg: 0.158		
Incumbent Winner 1 year	-19.86	-26.97	-18.89	0.0174		0.0165
	(13.49)	(16.57)	(12.89)	(0.0139)	(0.0162)	(0.0131)
Observations	1,289	1289	1,289	1,242	1242	1,242
	Panel C: Below 300,000 Euros & No Limited Liability					
	Days of Delay Avrg:133			Cost Overrun Avrg: 0.143		
Incumbent Winner 1 year	-31.17**	-8.817	-33.99***	0.0166	-0.00821	0.0150
	(14.06)	(17.21)	(12.91)	(0.0237)	(0.0297)	(0.0235)
Observations	534	534	534	648	648	648
	Panel B: Above 300,000 Euros & No Limited Liability					
	Days of Delay Avrg:197			Cost Overrun Avrg: 0.154		
Incumbent Winner 1 year	-27.67*	-12.01	-26.23*	-0.00686	0.00682	-0.00460
	(15.03)	(16.73)	(13.82)	(0.0133)	(0.0148)	(0.0121)
Observations	1,341	1341	1,326	1,278	1278	1,278

Notes: Coefficient (and SE in parenthesis) of the effect of being an unlimited liability firm. We include controls for the provincial fixed effect, Year fixed effects, Award Mechanism dummy, 2^{rnd} order polynomial in the reservation price, contracting authority type fixed effects, lengths of civil trial and number of bidders. Columns 1 and 4 reports the estimates of the fixed effect model. Columns 2 and 5 reports the estimates of the propensity score matching model. Columns 3 and 6 reports the estimates of the propensity score matching model. Panel A report the estimates below the 300,000 euros threshold. Panel B report the estimates above the 300,000 euros threshold. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 5]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 1, because we restricted the analysis to the work between 200,000 euros and 500,000 euros.