Publicity Requirements in Public Procurement: Evidence from a Regression Discontinuity Design*

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Abstract

We document the effect of publicizing a public procurement auction on entry and the costs of procurement within a regression discontinuity design framework. We analyze a large database of Italian procurement auctions. Auctions with a value above the threshold must be publicized in the Regional Official Gazette and two Provincial newspapers. We find that the increased publicity requirement induces more entry, higher winning rebates, and a distribution of the bids shifted toward higher rebates. The evidence suggests that the number of bidders is the channel through which publicity affects rebates. Increased publicity also selects winners: it increases the likelihood that the winner is a large company. Such companies tend to win repeated auctions and deliver works with less delays. The effect of publicity is stronger among local municipalities because they number ten thousand, too many to keep track of the upcoming auctions. Estimates are robust to alternative measures of publicity, alternative model specifications, different sample selections, to a falsification exercise, and to the possibility that firms learn about auctions from a for-profit information provider.

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1 Introduction

Policy makers believe that public procurement auctions need to be publicized more. Regulators, both at the national and at the supranational level, have therefore moved to mandate publicity. These regulations typically take the form of enhanced publicity requirements for auctions exceeding a certain value threshold. The EU mandates such advertising requirements, as does the US Federal Government.[1] Lack of publicity is seen as a sign of insufficient transparency, and possibly of corruption.[2]

Despite this widespread regulatory intervention, there is, to date, no empirical evidence showing that publicity increases bidder participation, nor that increased participation lowers procurement costs. In fact, the academic literature seemingly casts doubt on the first channel: surprisingly, lowering entry costs for bidders is predicted to decrease entry. The data utilized in the literature (e.g., Li and Zheng, 2009; Marmer et al., 2011; Roberts and Sweeting, 2011), it should be stressed, do not feature variation in entry costs, and so their predictions are out-of-sample counterfactuals coming from a structural model.[3]

This paper attempts to provide direct evidence about whether, and how, publicity affects entry and the costs of public procurement, in the context of Italian procurement auctions. This paper identifies the effect of increased publicity, a proxy for the increase in the number of (potential) entrants that are more likely to be informed about upcoming auctions, from a discontinuity in publicity requirements. Auctions with a value (reserve price) that exceeds 500,000 euros, are required by law to be publicized more broadly

[1] Directive 1159/2000 European Commission. In the U.S., the Federal Acquisition Regulation (5.101) mandates all procurement agencies to publicize the procurement contracts with a value exceeding $25,000 on the Commerce Business Daily, while those with a value below the threshold need only be publicized in a public place, or on any appropriate electronic mean.

[2] The WTO and the OECD recently published two documents describing how publicity increases transparency and accountability, and prevents corruption in procurement. Bandiera et al. (2009) and Ferraz and Finan (2011) document the incidence of corruption on public spending analyzing public procurement data for Italy and Brazil, respectively.

[3] Despite the fact that Li and Zheng (2009) and Marmer et al. (2011) use the same data set, the two papers disagree on whether the costs of procurements are reduced with a reduction of entry costs. Roberts and Sweeting (2011) find the same effect as Marmer et al. (2011), using data on USFS timer auctions. The discrepancy is due to different modelling assumptions.

in the Regional Official Gazette and in two provincial newspapers, while those below the threshold may be publicized only on the notice board in the premises of the public administration. By carefully comparing outcomes in auctions around this threshold, we are able to directly identify the causal effect of publicity on entry and the costs of procurement.

We find that an increase in publicity increases the number of bidders participating in the auctions by 13%, and increases the winning rebate by 6.1%. A back-of-the-envelope calculation suggests that holding other things equal, the average public work costs the government about 31,000 euros more if it is publicized at the local level compared to the regional level.[4] This finding seems to lend support to the regulator's view that procurement entities need to be forced to advertise.

A caveat. The auction mechanism we study is somewhat unconventional. It has some "beauty contest" features whereby the highest bidder does not necessarily win.[5] This mechanism is used in procurement auctions around the world. Decarolis (2011) shows that the specific features of the mechanism raise the theoretical possibility that increased participation in the auction need not result in greater competition. If so, then an increase in publicity need not have any effect on the cost of procurement. However, Conley and Decarolis (2012) show theoretically that in such an auction increased participation may indeed result in more aggressive bidding.[6] Their theoretical result is consistent with Figure 2 in this paper, which documents a positive and significant relationship between the number of bidders and the rebates submitted by these bidders (i.e., their bidding strategies). Taken together, the theory and the evidence suggest that, despite the fact that the auction mechanism is unconventional, greater participation is good for the auctioneer just as in a conventional auction.

Our empirical results are obtained relying on two building blocks. First, we rule out the possibility of perfect manipulation of an auction's value (reserve price) around the discontinuity threshold, using graphical and statistical tests discussed by McCrary (2008) and

[4]Net of the costs of publicizing on the average Regional Official Gazette and in two average provincial newspapers.

[5]See Section 2 for institutional details.

[6]In their Proposition 3 this outcome is the result of competition among cartels and independent bidders.

Lee (2008). This procedure supports the assumption that the publicity requirements (the treatment) are quasi-experimentally assigned across auctions. Second, the institutional setting is such that no another policy (i.e., a change in the adjudication mechanism) changes around the threshold, which could confound the estimates of the causal effect of publicity.

Our findings suggest that local procurement authorities do in fact underinvest in publicity. This underinvestment may reflect collusive relationships between the auctioneer and some favored bidders, increasing the costs of procurement. [7] Such collusion has been found in other aspects of Italian procurement auctions (Conley and Decarolis, 2012; Coviello and Gagliarducci, 2011). Our paper is the first, to our knowledge, to provide empirical support for mandatory publicity as a regulatory tool to increase transparency.

The paper proceeds as follows. In Sections 2 and 3 we present the institutional framework and the data. In Sections 4 and 5 we illustrate the regression discontinuity design analysis and present the evidence.

In Section 6 we present extensions. In Section 6.1 we explore whether the magnitude of the effects is stronger in situations where being aware of an upcoming auction is costly. We find that publicity matters more when the public administration is a local municipality rather than a centralized administration.

Sections 6.2 to 6.4 look at novel effects which arise when we consider the effects of publicity requirements on other auction outcomes and the *ex-post* execution of the works. We find that an increase in the level of publicity increases the minimum rebate, the anomaly threshold and the maximum rebate by 6.46%, 6.4%, 6.5%, respectively. Publicity also increases the number of excluded rebates above the anomaly threshold by 12%,[8] and the probability that the contract is awarded to a small firm by -9.3%, to the same firm

[7] In our data, one standard deviation increase in corruption is associated with a 7.3 % increase in the probability that the call for tender is not published. We measure corruption at provincial level using the Golden Picci (2005) Index. This index measures the differences between the expenses in public infrastructures and the availability of infrastructures. This correlation is not reported but available on request.

[8] The anomaly threshold represents the average augmented by the average deviations of the bids above the threshold after the elimination of the best 10% of the rebates. The auction mechanism is illustrated in Section 2.

repeatedly by 12.6%, and that works are delivered after a contractual deadline, with delay, by -7.8%.

In Section 7 we assess the robustness of the results by redefining the treatment, experimenting with different specifications, selecting different bandwidths around the threshold (Imbens and Kalyanaraman, 2011), including characteristics of the works and the public administration managing the auction, and by running placebo tests at simulated thresholds above and below the original threshold. Estimates confirm the effects of publicity.

In Section 7.1 we analyze whether firms learn about an upcoming auction from a for-profit information provider rather than only from government publicity. We collect a dataset of auctions published on the web page of an information provider and build a second measure of publicity. We include the days a contract is published on the web page of the information provider as an additional control in the Regression Discontinuity Design (RDD). We find that the effect of the publicity requirements is unchanged.

In Section 8 we conclude that publicizing the procurement notice increases the overall level of competition and reduces the costs of procurement, selects different winners, and improves the *ex-post* execution of the works.

Related Literature. This paper contributes to two strands of the literature regarding empirical auctions. First, it contributes to the literature that studies the effects of entry costs on entry in auctions (Li and Zheng 2009; Marmer et al. 2010; Roberts and Sweeting 2011). We think of publicity as reducing entry costs. We find that exogenously publicizing the procurement notice increases entry and increases the winning rebate, which stands in contrast to the evidence of Li ad Zheng (2009) and Marmer et al. (2011). However, as in Marmer et al. (2011) and Roberts and Sweeting (2011), we find that publicity increases the winning rebate and *selects* winners.

Second, this paper contributes to the literature that looks at the effects of the provision of information by private information providers that collect and sell announcements about forthcoming auctions. Leslie and Zoido (2011) find evidence that the establishment of a for-profit information provider leads to a 2.9% reduction in the price of drug procurement

for public hospitals in Buenos Aires, Argentina. However, this paper does not consider the role of government publicity. We analyze the effects of the two different sources of publicity and find that both are important.

2 Institutional Framework

The applicable procurement law, during our sample period, requires auctions to be sealed-bid and single-attribute (i.e., technical and quality components of the offers are not evaluated).[9] We consider a sample of procurement auctions where participation is open.[10]

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 illustrated in Figure 1.[11] After a preliminary trimming of the top/bottom 10% of the collected bids,

[9]During the period covered by our 2000-2005 sample, Italian public administrations have to follow *"Legge Merloni"*: *Legge 109/94* and amendments (*"Merloni-bis"* in 1995, *"Merloni-ter"* in 1998, and *"Merloni-quater"* in 2002). Major legislative changes were introduced in 2006, but do not affect our sample. This changes are used in Decarolis (2011) to identify the effects auctions outcomes.

[10]*Pubblico incanto*, and *licitazione privata* are the two auctions formats that by law allow open participation. They are similar except that in the latter, the contracting authority allows all firms satisfying some technical requirements to bid. Call for tenders specify the technical and financial requirements that bidders must satisfy to take part in the auction. Requirements are determined by the law and are mainly based on firms' turnover and do not vary discontinuously with the publicity threshold. For example, if the construction of a road is put out to tender and the contracting authority estimates that the amount of work that has to be done is valued at 600,000 euros, the required category will be 3-OG3, where 3 refers to the size of the works and OG3 to the category "road constructions". Firms certified for 3-OG3 projects are allowed to bid for projects with a reserve price of at most 650,000 euros. In Italy, auctions with an invitation to a limited amount of bidders (i.e., restricted auctions) have to be used for urgent small works. We discard from our analysis the *trattativa privata*, where the contracting authority only *invites* a restricted number of firms, with a minimum of 15, and other restricted auction formats like the *licitazione privata semplificata* and the *appalto concorso*.

[11]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. We discard EU auctions from the data and

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.[12]

A caveat. The auction mechanism we study is somewhat unconventional. It has some "beauty contest" features whereby the highest bidder does not necessarily win.[13] This mechanism is used in procurement auctions around the world.[14] Decarolis (2011) shows that the specific features of the mechanism raise the theoretical possibility that increased participation in the auction need not result in greater competition.[15] If so, then an increase in publicity need not have any effect on the cost of procurement. However, Conley and Decarolis (2012) show theoretically that in such an auction increased participation may indeed result in more aggressive bidding.[16] Their theoretical result is consistent with Figure 2 in this paper, which documents a positive and significant relationship between the number of bidders and the rebates submitted by these bidders (i.e., their bidding strategies).[17] Taken together, the theory and the evidence suggest that, despite the fact that the auction mechanism is unconventional, greater participation is good for the auctioneer just as in a conventional auction.

Contractual conditions (e.g., deadlines and possibility of subcontracts) are described

also consider the results when do not include Turin in the sample.

[12]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.

[13]See Section 2 for institutional details.

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

[15]He shows that one Nash equilibrium of this game is that all the bidders bid the average.

[16]In their Proposition 3 this outcome is the result of competition among cartels and independent bidders. In particular, they show that if a colluding group of bidders is relatively small, then they will try to win by submitting higher rebates than other (independent) bidders in the auction. They also show that, on the other hand, if a colluding group is relatively large (e.g., if there are few independent bidders), they can win the auction by submitting lower bids.

[17]The figure reports the four moments available in our data on the distribution of the bids: minimum bid (circles), the winning rebate (triangles), the anomaly threshold (squares), and the maximum rebate (diamonds) on the number of bidders. Average rebates are computed for five bidders brackets. For each bracket, the vertical lines report the 95 % confidence intervals (vertical lines). The dashed line represents the sample average.

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.[18] Subcontracting part of the works is permitted by law, but requires the approval of the public administration. We consider whether works are delivered with delay or executed by sub-contractors as measures of the *ex-post* execution of the contract.

The procurement law specifies the requirements on how to publicize the procurement notice. Auctions with a starting value below 500 thousand euros have to be posted on the notice board in the premises of the public administration.[19] Auctions with a starting value between 500 thousand and one million euros have to be published at the regional level, in both the Regional Official Gazette (*BUR*) and at least two newspapers from the province where the public administration is based. Publishing in the BUR costs an average of 200-500 euros, while publishing in Provincial newspapers is proportional to the number of printed copies in each of the 110 Italian provinces and costs around 400 euros. In Table 1 we summarize the publicity requirements, the target population by different publicity requirement, and the costs of publication. Column 3 shows that an increase in publicity requirements from local to regional levels increases the potential readers from 13,000 residents of an average municipality to 3,031,322 residents of an average region.

3 Data and Descriptive Statistics

We analyze a unique database collected by the Italian Authority for the Surveillance of Public Procurement *(A.V.C.P)*. We have access to all the public works with starting values greater or equal to 150,000 euros auctioned in Italy between the years 2000-2005. For each auction, we observe the number of bidding firms, the winning rebate, the minimum rebate, the anomaly threshold, the maximum rebate, the number of excluded bidders with a rebate above the anomaly threshold, the starting value, the identity of the winning bidder, the

[18] Floods, storms, earthquakes, landslides, and mistakes of the engineer are the reasons for renegotiations prescribed by the Italian Civil Code.

[19] Procurement entities in Italy are Municipalities, Provincial Administrations, Regions, Hospitals, Mountain Communities, Universities and other public administrations.

type of the project, the observed level of publicity, the identity of the managers, the date of delivery of the bid, and the type and location of the public administration managing the auction. For a subsample of auctions, we also observe whether the works are executed with interruptions and realized by subcontractors.

3.1 Descriptive Statistics

In Table 2 we present summary statistics for the original sample of auctions. Our original database amounts to 31,610 auctions with open participation. The average number of bidders per auction is 36.1, and the mean winning rebate is 16.3%. The minimum rebate is 8.25%, while the maximum is 20%. The average anomaly threshold is 16.7 % and 9 bids that are above the anomaly threshold are excluded. The winner of the auction is registered outside the region of the public administration about 37.1% of the time.[20] In our sample, 44.4% of the winners are small companies (limited liability contractors), and, on average, the highest fraction of auctions won by the same firm in a year is 34%. 51% of the works are delivered with delay and 60% are completed by a subcontractor.

Most of the calls for tender (92%) are published on the notice board of the public administration, 25% in the Regional Official Gazette, about 18% in the National Official Gazette, and 2% in the European Official Gazette. The advertisement of the tender appeared in an average of 0.24 Provincial newspapers, 0.42 regional newspapers, and 0.61 national newspapers. The average starting value for a public work is 680,000 euros.[21] Column 4 of Table 1 reports the compliance rate to the publicity requirements of an average contract. 50% of the contracts are not respecting one of the regional requirements, suggesting that local procurement authorities underinvest in publicity. In our data, one standard deviation increase in corruption is associated with a 7.3 % increase in the probability that the call for tender is not published. [22]

[20] This is the case in the subsample of auctions for which we can reconstruct the information on the origin of the winners

[21] Monetary values in 2000 equivalents, using the OECD CPI index.

[22] We measure corruption at provincial level using the Golden Picci (2005) Index. This index measures the differences between the expenses in public infrastructures and the availability of infrastructures. This correlation is not reported but available on request.

The majority of the public works concern the construction of roads (31%), schools and educational buildings (11%), art-related construction (7%), Hospitals (7%), Trains and Airports (1.5%). In 28% of the auctions the required category is either Buildings (i.e., OG1), or Roads and Others (i.e., OG3). The public administrations managing the auctions are mostly municipalities (53% of the sample) and provinces (12%), health-care public bodies (ASL), and other public bodies or corporations. Public administrations are mostly located in the northern Italy (47%), while 20% are in central Italy and 24% are in the southern Italy, and 6% in the Islands.[23]

In the empirical analysis we focus on a subsample of 17,512 auctions with a starting value between 200,000 and 800,000 euros.[24] We do this for three reasons. First, Table 2 shows that the distribution of the starting value is very right skewed: 80% of the auctions have a starting value below 800,000 euros. Second, we rule out the possible confounding factors generated by the introduction in 2002 of first-price auctions for large works.[25] Third, we avoid the problem of comparing auctions which are close to the minimum level registered by the Italian Authority for the Surveillance of Public Procurement.[26]

4 Regression Discontinuity Design

We implement a Regression Discontinuity Design (RDD) to avoid the potential bias in the OLS estimates of the causal effect of publicity generated by the non-random assignment of auctions to publicity levels (e.g., corruption). In Section 2 we discussed 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. Lee (2008) shows that in these cases, RDD can identify effects which are as valid as those resulting from a randomized experiment. In

[23]For 8% of the sample we have missing information on the geographical location of the public administrations.

[24]The descriptive statistics in the subsample are similar to the full sample. In the estimation tables we report sample averages of the variables of interest.

[25]See Section 2

[26]The Italian Authority for the Surveillance of Public Procurement collects data on auctions with value above 150,000 euros.

this section we discuss the main characteristics of the RDD design and its assumptions.[27]

We define y as the threshold in the auction's starting value, which determines a discontinuity point in the support of the publicity function, as established by the law. The discontinuity point separates two levels of publicity, which are imposed on public administrations. We identify the causal effect of publicity on entry and auction outcomes by focusing on auctions in the neighborhood of the discontinuity point. Let Y be the auction's real starting value (the reserve price, also called running variable), and Z be the indicator of whether the contract is above the threshold.

Therefore, Z can be defined as the the theoretical level of publicity that the contractor should implement under perfect compliance to the assignment rule (law). We denote by P, a dummy for the level of publicity actually observed in the auction data, which is equal to one if the contract is published in the Regional Official Gazette and in two provincial newspapers. P may differ from its theoretical level if the public administration does not fully comply with the publicity requirements or because of measurement error. In Italy, it is very unlikely that a contracting authority would be punished if P differs from Z. The descriptive statistics suggest that the non-compliance is diffused in the publication on newspapers and correlated with a measure of corruption.[28]

We denote C to be one of the outcomes of the auction. To identify the causal effect of publicity on competition, we need the following continuity assumptions:

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

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

where, y^+ and y^- represent the left and the right limits of the starting value of the auction. The continuity assumption tells that in the counterfactual scenario, on average, both the outcomes and the treatment, (C_l, P_l) should be the same around the threshold. As in

[27]See Imbens and Lemieux (2008) and Lee and Lemieux (2010) for detailed toolkits on RDD. Closer to our 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.

[28]See Section 3.1.

Hahn et al. (2001), under the continuity conditions for an auction in the neighborhood of the cut-off point, the mean effect of being assigned to a higher level of publicity $Z = h$ (instead of the lower one $Z = l$) on the actual publicity level P is:

$$E\{P|y^+\} - E\{P|y^-\} \tag{3}$$

and on the auctions outcomes C is:

$$E\{C|y^+\} - E\{C|y^-\}. \tag{4}$$

Equations (3)and (4), are usually called the *intention-to-treat* (ITT) effects.[29]

Following Angrist et al. (2000), we can interpret the ratio of the two ITT effects from expressions (4) and (3), as the causal effect of P on C (of publicity on auction outcomes). 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, as the threshold is only affecting the level of publicity). 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 these three assumptions (i.e., continuity, exclusion restriction, and monotonicity) are satisfied, then the ratio:

$$\Pi(y) = \frac{E\{C|y^+\} - E\{C|y^-\}}{E\{P|y^+\} - E\{P|y^-\}} \tag{5}$$

identifies the average effect of a change in the actual level of publicity on the auction's outcomes at $Y = y$, for those auctions which are induced to show a higher level of publicity because their theoretical publicity increases from l to h.

[29]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.

4.1 Implementation of the RDD with Regressions

In this section we implement a parametric version of the RDD, discussed in the previous section, using regressions. The following is our main equation of interest

$$C_{it} = \alpha + \beta P_i + \delta_t + \epsilon_{it}. \tag{6}$$

When assignment to treatment is not random, endogeneity bias in the estimation of the β from equation (6) can arise due to the correlation between P_i and ϵ_i, $E[\epsilon|P] \neq 0$, and OLS estimates are inconsistent no matter how large the sample is.

We implement the RDD to take advantage of additional information on selection into treatment. We follow Imbens and Lemieux (2008) and Lee and Lemieux (2010), and implement a parametric RDD that retains all of the data in the discontinuity sample but absorbs variations coming from auctions that are not close to the publicity threshold using flexible controls for the starting value. Van der Klaauw (2002) shows that including the conditional mean function $E[\epsilon|P, Y - y]$ as a "control function" in the outcome equation allows us to use these observations. Under the assumption that $E[\epsilon|P, Y]$, the conditional expectation of the unobserved determinants of C, given that the starting value of the auction is continuous, we can approximate it by a polynomial of order k, $g(Y - y)$, and this approximation will become arbitrarily accurate as $k \to \infty$. Under this assumption we can rewrite equation (6) as:

$$C_{it} = g(Y_i - y) + \beta P_i + \delta_t + \omega_{it}. \tag{7}$$

We approximate $g(Y_i - y)$ with a fourth-order polynomial in $(Y - y)$. P is the observed level of publicity, δ is a year indicator, and $\omega = C_i - E[C_i|P_i, Y_i - y]$. Provided that we correctly specify $g(Y_i - y)$, we gain the property that $E[\omega|Y - y] = 0$, and thus equation (7) can be correctly estimated via OLS.

Section 2, we discussed the possibility that public administrations do not fully comply with the publicity law. Therefore, the assignment to treatment depends partially on the running variable Y, and partially on other unobservable phenomena (e.g., local corruption,

measurement error in publicity) that can potentially be part of the unobservable components of the outcome equation. We tackle this problem implementing a *fuzzy* Regression Discontinuity Design. As in Angrist and Lavy (1999) and Van der Klaauw (2002), we propose a fully parametric approach and we assume that the assignment to treatment status can be represented by the following equation:

$$P_{it} = g(Y_i - y) + \gamma Z_i + \delta_t + \nu_{it}. \tag{8}$$

The *fuzzy* Regression Discontinuity Design requires a valid exclusion restriction and the monotonicity assumption. The former may be violated because of the strategic non-compliance to the law (e.g., corruption). This assumption is not testable.

Therefore, to estimate the causal effect of publicity on auction outcomes we report two sets of results. First, we report the OLS-ITT estimates of equation (4), obtained by exploiting the quasi-experimental variation in the theoretical level of publicity $Z = \mathbf{1}\{(Y_i - y) \geq 0\}$.[30] Under the continuity assumption (of the unobservables and of the starting value around the threshold, both of which will be tested in the next section), the OLS-ITT are consistent estimates of the causal effect of theoretical publicity on auction outcomes. The OLS-ITT do not rely on the exclusion restriction and are useful to cross-validate the robustness of the effects. As discussed in Angrist (2005), the ITTs provide diluted estimates of the treatment effect because of the non-compliance with the procurement law. Second, we report the *fuzzy* RDD estimates obtained with a Two Stages Least Squares (TSLS, or IV-LATE) estimator using Z as the excluded instrument.

5 Empirical Evidence

5.1 Testing for the presence of discontinuities in the pre-treatments and jumps in the running variable around the threshold

In this section we report graphical evidence on the validity of the assumptions required by the RDD, discussed in Secion 4. We follow Lee (2008) and investigate the behavior of

[30] The theoretical level of publicity Z defined in section 4.

the pre-intervention variables around the threshold. 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/corruption of the public administrations with participants) that are likely to affect the auction's outcome C.

In Figure 3 we plot the four pre-intervention variables on $y_d = (Y - y)$. These estimates are obtained by separate locally-weighted smoothing regressions on the left and right of the cut-off points. First, in the top-left panel we plot the population of the city of the public administration; second in the top-right we plot the age of the manager in charge of the auction; third, in the bottom-left we plot whether the contracting authority is the municipality, and fourth in the bottom-right we plot whether the public administration is located in the South of Italy on $y_d = (Y - y)$. These variables are likely to be determined before the definition of the publicity levels and before the auction takes place, and hence they can be used as pre-intervention variables. The graphical test for the continuity assumption would suggest a discontinuity if the plots of these indicators against $y_d = (Y - y)$ showed a jump at the cut-off points. Identification would not be possible in those cases, since auctions assigned to a high theoretical level of publicity Z_h would not be comparable to auctions assigned to a low level of publicity Z_l. Figure 3 shows that there are no significant jumps.

We further inspect the validity of the continuity assumption looking at the distribution of the starting value around the threshold implementing the McCrary (2008) test. Figure 4 shows that the overall distribution of the auctions' starting value is right skewed in the original sample and has no significant mass probability around the threshold. Figure 5 implements the graphical version of the McCrary (2008) density test in the subsample of auctions around the discontinuity threshold.[31] Figure 5 suggests that there are no

[31] This test is constructed in two steps. First, we obtain a very under-smoothed histogram of the starting value's distribution, where the bins of the histogram are defined so that no one histogram bin includes both points to the left and right of the discontinuity point. Second, 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

graphical differences (jump) between the two separate estimates of the density around the threshold. In Panels A and B of Table 3, we report a parametric version of the McCrary (2008) test and statistically test the difference between the two densities around the threshold. The numbers are the point estimates (and standard errors) computed for the discontinuity sample (Panel A), a smaller subsample (Panel B), for each year (columns 1-6), and for each typology of good (rows 1-3). We find no statistical evidence of jumps in the density around the threshold.

The evidence in this section supports the validity of the continuity condition and rules out the possibility of perfect manipulation of the value of the auction (the reserve price that determines exposure to treatment). We conclude therefore, that theoretical publicity is quasi-experimentally assigned around the threshold.

5.2 Discontinuity Effects of Publicity on Entry and the Winning Rebate: Graphical Analysis

In this section we repeat the graphical analysis to document the discontinuity effects of publicity on entry and the winning rebate. In Figures 6 and 7, we plot the non-parametric estimates of the main variables of interest. These estimates are obtained using a separate locally-weighted smoothing regression on the left and right of the cut-off points. Jumps in the plots show the effect of the threshold on the variable of interest, offering a graphical interpretation of the ITTs as defined by equations (3) and (4).

In Figure 6, the box on the left plots the number of bidders on $y_d = (Y - y)$, while the box on the right pilots the winning rebate on $y_d = (Y - y)$. We observe a jump in the number of bidders and in the winning rebate at the right of the cut-off point. In particular, If we consider the 20,000 euros interval around the threshold and compute the sample means, we observe a jump by 5% in the number of bidders and by 4% in the winning rebate at the right of the cut-off point.

In Figure 7, the box on the left plots whether a contract has been published in the Regional Official Journal and two Provincial newspapers on $y_d = (Y - y)$, while the right

of the number of observations of the bins are the outcome variable.

box plots whether a contract has been published in the Regional Official Journal on $y_d = (Y - y)$. As can be seen, the figures show that the actual publicity is uniformly no lower than the theoretical publicity for the discontinuity to the left of the threshold no matter how it is measured. To the right of the threshold, we have problems of compliance with the law on publicity, but these violations are not large enough to violate the monotonicity condition required by the RDD.[32]

The graphical impact of publicity can be computed in two ways. First, by the ratio of the jump of the number of bidders or the winning rebate and the jump of the level of publicity (see equation 5). Second, by the differences in the means of the outcomes around the threshold. Using the two pictures, we can graphically conclude that the mean impact of publicity on entry and the winning rebate is positive.

To get a sense of the channel through which publicity affects rebates, it is helpful to look again at Figure 2. This figure depicts some key moments of the bids' distribution (including the winning rebate), controlling for the number of bidders. These moments are not significantly different between publicized and non-publicized auctions. This shows that publicity has no effect after controlling for the number of bidders. Put differently, the number of bidders is the unique channel through which publicity affects the winning rebate.

5.3 Discontinuity Effects of Publicity on Entry and the Winning Rebate: Regression Analysis

In this section we compute point estimates and standard errors, of the effects of publicity on entry and the winning rebate. Table 4 reports the estimated effects of publicity on the number of bidders and the winning rebate in the sample of auctions with a starting value between 200,000 and 800,000 euros.

Column 1 reports the ITT effect of theoretical publicity on the level of publicity observed in the data. As suggested in Imbens and Lemieux (2008) we compute standard

[32]In Figure 7 most of the circles are above right circles. Garibaldi et al. (2011) provide a detailed discussion and an example of violation of the monotonicity condition.

errors that are robust for the presence of an unknown form of heteroskedasticity.[33] The estimates indicate that an increase from a lower starting value bracket, say $2-5$ hundred thousand euros, to an higher one, say $5-8$ hundred thousand euros, shifts the actual publicity by 0.2 with a standard error of 0.02. These results identify a lack of full treatment compliance due to non-perfect law enforcement. This finding suggests that procurement authorities do in fact underinvest in publicity. This under investment may reflect collusive relationships between the auctioneer and some favored local bidder. Such collusion has been found in other aspects of Italian procurement auctions (Conley and Decarolis, 2012; Coviello and Gagliarducci, 2011) and might invalidate the validity of the exclusion restriction in the IV-LATE estimates.

We deal with the problem of non-compliance, and the possible violation of the exclusion restriction of the IV estimates considering the OLS-ITTs effects. Columns 2 and 4 report the OLS-ITT effects of theoretical publicity (i.e., the publicity requirements determined by the procurement law) on the number of bidders and the winning rebate, respectively. The estimates indicate that an increase in tenders' theoretical publicity from local to regional levels leads to an average increase of 4.5 bidders (relative to a sample average of 35.13), and an average increase in the winning rebate of 1 (relative to a sample average of 16.6%). These correspond to an increase in entry by 13% and the winning rebate by 6.1%.

Columns 3 and 5 report the Instrumental Variables Local Average Treatment Effects (henceforth, IV-LATE) estimates of the effect of publicity on the number of bidders and the winning rebate, respectively. The estimates indicate that an increase in tenders' publicity from local to regional levels leads to an average increase of 22 in the number of bidders, and an average increase in the winning rebate of 4.8. These correspond to an increase in entry by 63% and the winning rebate by 30%. Columns 3 and 5 also report that the first-stage F statistic is 197.8, which suggests that the IV-LATE estimates are not affected by the weak instruments problem. Both effects are statistically different from zero at a 5% significance level.

[33] As a robustness check in Section 7, we compute robust standard errors clustered at city level.

A back-of-the-envelope calculation suggests that the average public procurement project costs about 31,000 euros more,[34] if it is publicized at the local level compared to the non-local level.[35] We conclude that publicity increases entry and reduces the costs of procurement for the public administrations.

6 Extensions

6.1 Heterogenous effects of Publicity

Our results so far have shown a remarkable effect of publicity on entry and the costs of procurement. To learn more about the economic mechanism behind the effect of publicity, we explore whether the magnitude of the effects varies according to two dimensions of the procurement market.

First, we estimate the effects of publicity when the likelihood of being aware of an upcoming auction is potentially smaller. We consider whether the public administration running the auction is one of the thousands municipalities spread over the Italian territory rather than a centralized administrations (ministry, region, province, etc.).[36] The idea behind this test is the following. It might be that the effect of publicity is stronger among local municipalities because they number ten thousand, and contractors are less like to be informed of an upcoming auction. This is because it is costly to keep track of the many local upcoming auctions. Therefore, we expect an extra increase in the level of competition (i.e., entry) and the winning rebate when auction are publicized by municipalities. However, these public administrations procure public works that most of the time are of local interest (for example, small roads), hence too different from those administered by centralized administrations. This possibility, in principle, would invalidate our RD continuity assumptions. In Figure 3, left-bottom panel, we plot the behavior of the size of the project managed by municipalities around the threshold (i.e., the size). The figure shows

[34] Values are net of the costs of publicity summarized in Table 1.

[35] This estimate represents the 4.6% of the value of an average project with a starting value of 680,000 euros. The extra costs are 6,000 euros more for the OLS-ITT.

[36] Despite these public administration have different competences have to follow the same procurement law and the same publicity threshold discussed in Section 2.

that there are no significant jumps around the threshold and that municipalities are not running smaller auctions.[37]

In Table 5 we introduce, as a regressor, the product between the level of publicity and an indicator of whether the public administration is a municipality.[38] When the public administration is a municipality the effect of publicity is larger. Effects are positive but not statistically significant with regard to the number of bidders, while they are positive and significant on the winning rebate (7.3% in the OLS-ITT estimates and 25% in the IV-LATE).

Second, in Panel B of Table 5, we report the estimates of the effect of publicity on the number of bidders and the winning rebate, considering the resident population in the city of the public administration, in order to proxy for the potential bidders in the area. The idea behind this test is the following. It might be that the effect of publicity is stronger among cities with higher population density as more bidders are potentially informed. However, larger administrations procure public works that most of the time are of national interest (for example, larger roads), hence too different from those administered by small administrations. This possibility, in principle, would invalidate our RD continuity assumptions. In Figure 3, left-top panel, we plot the behavior of the size of the project managed by municipalities with different population density around the threshold (i.e., the size). This figure shows that there are no significant jumps around the threshold and that municipalities below and above the threshold have similar population density.[39] Overall, our results suggest a positive effect of publicity in larger cities. However, these estimates are not precisely estimated.

6.2 Distribution of the Bids and Excluded Bidders

In this section we consider whether publicity has an effect on other moments of the rebates. Despite we do not have individual bids for each auction, our date contains the minimum

[37] In Table 11 we perform the parametric version of this test and find no systematic differences.
[38] We also add to the model, the indicator of whether the public administration is a municipality
[39] In Table 11 we perform the parametric version of this test and find no systematic differences.

rebate, the anomaly threshold, the number of rebates excluded because they are above the threshold, and the maximum rebate.

In columns 1, 3, 5, 7 of Table 6, we report the OLS-ITT estimates, while in columns 2, 4, 6, 8 we report the IV-LATE estimates of equation (7). We find that an increase in the publicity requirements (publicity) increases the the minimum bid by 6.4% (32%); the anomaly threshold by 6.4% (31%); the number of excluded rebates by 12% (58%); and the maximum bid by 6.4% (31%). All the estimated coefficients are statistically significant at the 10-percent level. We conclude that an increase in publicity induces all the bidders to submit more competitive rebates. This induces an increase in the number of bidders who systematically bid above the *ex-ante* unknown anomaly threshold and who are automatically excluded by the awarding mechanism.[40]

6.3 Identity and Selection of the Winners

In this section, we consider whether the reduction in entry costs from additional publicity systematically selects different types of winning firms. As in Choi et al. (2011), we exploit the richness of our data to report more evidence on how publicity impact on the type of the winners of the auctions. From the fiscal identifiers of the winners, we construct indicators of whether the firm hails from a different region than the public administration managing the auction, whether the winner is a small firm (e.g., a limited liability company), and whether the same firm wins repeated auctions.

In columns 1, 3, and 5 of Table 7, we report the OLS-ITT estimates, while in columns 2, 4, and 6 we report the IV-LATE second-stage estimates of equation (7). We find that an increase in the level of publicity (theoretical publicity) increases the likelihood that the contract is awarded to a firm coming from outside the region by 26.2% (5.9%), decreases the probability of the contract being awarded to a small firm by 41% (9.3%), and increases the likelihood that the same firm wins repeatedly by 55.4% (12.6%). Estimated coefficients in columns 3 to 6 are statistically different from zero at a 10% significance level,

[40] These results support some of the theoretical predictions in Conley and Decarolis (2012)

while the coefficients in columns 1 and 2 are not. These estimates suggest that publicity systematically selects winners that gain market shares and win repeated auctions.

6.4 *Ex-post* Execution of the Works

In this section, we consider whether the reduction in entry costs associated with publicity has an effect on the *ex-post* execution of the works. So far, we have documented that publicity encourages entry and leads to more aggressive bidding; however, this may have two opposite effects. On the one hand, fierce competition may lead to *ex-post* renegotiations of the contracts, since the winner might not be able to live up to its commitment and therefore delays the execution of the works. On the other end, publicity may attract more efficient firms (larger) from outside the region, that win repeated auctions and do not need to delay the execution of the works to recover the costs. For a smaller sample of public administrations for which we have the data, we consider whether the contract is resold to a subcontractor and if the projects are delivered after the contractual deadline.

In Table 7, we report evidence that an increase in the level of publicity (theoretical) reduces the likelihood that the project is delivered with delay by 41.4% (7.8%), and the likelihood that the contract is resold to a subcontractor by 9.2% (1.7%), the latter being not statistically significant.[41]

7 Sensitivity Analysis and Robustness of the RDD analysis

In this section we consider three possible concerns of the apparently discontinuous relationship between auction outcomes and the publicity requirements. First we consider a different specification of the treatment variable publicity. Second we consider a different model specification, sample selection and possible omissions of relevant characteristics of public procurement auctions. Third, we consider the robustness of the local results. We

[41] To check the consistency of our main results within this subsample, we repeat our analysis on the number of bidders and the winning rebate. We confirm both size and significance of the effects of publicity. Results are not reported but available on request.

also report regressions-based tests on the pre-treatment variables presented in Section 5.2, to further assess the validity of the continuity assumption.

In Table 8, we repeat the analysis considering as a treatment variable the indicator for whether a call for tender has been published or not in the Regional Official Gazette.[42] The table reports the IV-LATE coefficients (and standard error in parenthesis) considering theoretical publicity as an instrument for publicity on the Official Gazette. The only striking difference in this table as compared to Table 4, is the higher compliance to the publicity requirements.[43] All the signs of the estimated coefficients on the number of bidders and auction outcomes have a similar sign and statistical significance as the ones reported in Table 4. However, the point estimates are systemically smaller as the effects are diluted by the larger first-stage estimates. This evidence reinforces the robustness of our results, as they are not driven by the specification of the treatment variable.

In Table 9, we report 8 different sets of estimates of the effect of theoretical publicity (OLS-ITT) and publicity (IV-LATE) on the number of bidders (Panel A) and the winning rebate (Panel B). The rationale behind this robustness check comes from the fact that our baseline model includes the fourth-order polynomial in the starting value and the year effects only. This specification may be too restrictive or not be sufficiently flexible to absorb all the auctions' characteristics that, so far, are left in the unobservables.

In columns 1-2 of Table 9, we estimate the baseline model but we add several observable pre-determined characteristics: The typology of the public works (whether they are roads, cultural buildings, schools, hospitals, rails, bridges, basins and damns, and airports); the administrative nature of the contracting authority (municipality or province); technical and financial characteristics required by the contracting authority to the bidders (OG1-OG3); 110 provincial dummies; and the resident population of the municipality of the public administration (in 10,000 inhabitants in 2001). In this latter specification, we compute standard errors (in parenthesis) allowing for within-cities correlation of the effect

[42] See Section 2 for details on publicity requirements.
[43] 47% against 20% in column 1 of Table 4.

of publicity on the number of bidders (Panel A) and the winning rebate (Panel B).[44] We find that an increase in publicity (theoretical publicity) increases the number of bidders by 50% (10.36%) and the winning rebate by 14.7% (3%). These estimates are, in magnitude, slightly smaller than the baseline estimates, but preserve the same sign and statistical significance.[45,46]

In columns 3-4 of Table 9, we approximate $g(Y-y)$, fitting a model with a third-order polynomial in the starting value and 5 year indicators. The effect of publicity (theoretical publicity) on the number of bidders (Panel A) is 48% (10.5%), and on the winning rebate (Panel B) is 22% (5%), which are similar in size and significance to the baseline result.

In columns 5-6 of Table 9, we approximate $g(Y-y)$, fitting a local linear regression model, according to Lee and Lemieux (2010). The effect of publicity (theoretical publicity) on the number of bidders (Panel A) is 27% (6.7%), and on the winning rebate (Panel B) is 15% (3.4%), which are similar in size and significance to the baseline result.

In columns 7-8 of Table 9, we fit the baseline model but we consider all the works with a starting value in the interval $y \in [2.66, 7.34]$, determined using the Imbens and Kalyanaraman (2011) optimal bandwidth criterion. The effect of publicity (theoretical publicity) on the number of bidders (Panel A) is 66% (13%), and on the winning rebate (Panel B) is 26% (5%), which are similar in size and significance to the baseline result.

In columns 9-10 of Table 9, we change the specification and fit a local linear regression model in the sample selected with the Imbens and Kalyanaraman (2011) optimal band-

[44]Donald and Lang (2007) suggest how to compute standard errors if the regressions have a set of controls that are fixed across groups of auctions.

[45]To account for some of the features of this peculiar auction method showed in Conley and Decarolis (2012), we repeat our analysis including in all the regressions 3,408 fixed effects for each public administration managing the public works and all the pre-determined characteristics considered in columns 1-2 of Table 9. We find that an increase in publicity (theoretical publicity) increases the number of bidders by 44% (9%) and the winning rebate by 26% (5%), effects statistically significant at 5%. However, given the limited sample size we can't add fixed effects for each public administration identity interacted with time effects to account for within-auctioneer variation. This would require to implicitly estimate 20,448 dummies in a sample of 17,512 auctions, which is impossible. The details of these estimates are available upon request.

[46]We also report similar estimates focusing on 6,767 auctions for the procurement of roads. We find that an increase in publicity (theoretical publicity) increases the number of bidders by 44% (8%) and the winning rebate by 65% (12%); effects statistically significant at 5%. Details of this estimates are available upon request.

width criterion. The effect of publicity (theoretical publicity) on the number of bidders (Panel A) is 38% (8.5%), and on the winning rebate (Panel B) is 18% (4.2%), which are similar in size and significance to the baseline result.

In columns 11-12 of Table 9, we estimate the baseline model but we consider all the works with a starting value in the interval $y \in [3.5, 6.5]$, determined by splitting the bandwidth of the original estimation window $y \in [2, 8]$ into two. The effect of publicity (theoretical publicity) on the number of bidders (Panel A) is 59% (11%), and on the winning rebate (Panel B) is 29% (5.3%), which are similar in size and significance to the baseline result.

In columns 13-14 of Table 9, we change the specification and fit a local linear regression considering all the works with a starting value in the interval $y \in [3.5, 6.5]$. This sample is obtained by dividing by two the original bandwidth. The effect of publicity (theoretical publicity) on the number of bidders (Panel A) is 13% (4%), and on the winning rebate (Panel B) is 12.4% (2.6%), which are not statistically significant.

Finally, in columns 15-16 of Table 9, we estimate a linear model considering works with a starting value 37,500 euro (7.5%) below and above the 500,000 euros threshold.[47] The effect of publicity (theoretical publicity) on the number of bidders (Panel A) is 46% (9%), and on the winning rebate (Panel B) is 24% (4.7%). These estimates are in a close neighbourhood of the publicity threshold and are similar in size and significance to the baseline result. This evidence reinforces the robustness of our results, as they are not driven by the specification of the empirical model, sample selection, or possible omissions of relevant characteristics that determine entry and auction outcomes.[48]

[47] We consider this estimation window following Angrist and Lavy (1999).

[48] To further assess the robustness of our results we report the same set of estimates, discarding the works managed after 2002 by the municipality, and the county of Turin. Results do not show systematic differences and are available upon request. Finally, as discussed in Decarolis (2011) we consider the sample of first price auctions managed by the municipality, and the county of Turin after the 2002. We repeat our analysis in the sample of 371 auctions for public works with open participation and with a starting value between 200,000 and 800,000 euros for which we have the data. The sub-sample of first price auctions have lower participation (26 bidders) and higher winning rebate (18%). When we repeat our RDD analysis estimating a linear model we find that an increase in publicity (theoretical publicity) increases the number of bidders by 41% (29%) and the winning rebate by 60% (8%); effects statistically significant at 5%. The details of these estimates are available upon request.

To assess the robustness of these (local) results around the threshold, we run two placebo tests. We generate two simulated treatments at two different values of the starting value of the auctions: 350,000 and 700,000 euros. We then use these thresholds to statistically test for the presence of discontinuities in the outcomes. Table 10 reports estimates repeating the analysis at the two fake thresholds in two subsamples that do not include the 500,000 euros threshold (i.e., between 200,000 and 499,999 euros; and between 500,001 and 900,000 euros). We reestimate the same baseline specification considering the number of bidders and the winning rebate. We do not find evidence of significant effects at the two simulated thresholds.[49] This evidence reinforces the robustness of our results, as they are not driven by random chance alone.

In Table 11, we parametrically assess the continuity condition discussed in Section 5.2, and reestimate the baseline model considering 7 pre-intervention variables as outcomes of our main equation.[50] We consider the following variables: whether the works are schools, the age of the auction manager, the manager's gender, whether the public administration is the municipality, whether it is the district, whether it is located in the south, and the resident population of the city of the public administration. In even columns we add the same good, public administration, technical, and geographical characteristics included in Table 9. As a matter of fact, the evidence suggests that both publicity and theoretical publicity do not affect the type of works, their location, the public administration that is managing the project, and the identity of the auction manager. We find instead, in column 13, some differences between public administrations with different population size: larger contracts are realized by smaller public administrations. This is in part due to large differences in the frequency of the public works in smaller municipalities. We are somewhat encouraged by the fact that once we add to the regression (column 14) controls for good, public administration, technical, and geographical characteristics there is no evidence of differences in the size of the public administration managing the contract above and

[49]The McCrary (2008) tests around these simulated thresholds show no jumps. We also compute similar estimates for the pre-treatment variables. These results are available upon request.

[50]We explain its rationale in Appendix A.

below the threshold. This compelling evidence together with the graphical evidence (on the pre-intervention variables) reinforces the robustness of our identification strategy and the validity of the continuity assumption.

7.1 The Role of an Information Provider

Are firms becoming aware about upcoming auctions from a for-profit information provider rather than just from government publicity? We empirically test this possibility collecting data from *Telemat*, an information-provider leader in the Italian market for reselling information on public contracts.[51] With this database, we construct a measure of publicity based on the number of days each auction is posted on *Telemat*'s website, and we re-run the RDD analysis illustrated in Section 5.

We focus on the sample of auctions for public works with open participation and with a starting value between 200,000 and 800,000 euros. In the 2000-2005 sample, the average winning rebate is 16.93% and calls for tenders are publicized, on average, for 30 days (standard deviation 15) before the date of bid delivery. Similarly to the main sample, the distribution of the starting value around the threshold is very right skewed and does not show any jump around the discontinuity threshold.[52]

In column 1 of Table 12, we augment our baseline empirical specification including, as a regressor, *Telemat*'s publicity.[53] We find that an increase in one standard deviation in the number of days *Telemat* publishes a tender on its website increases the winning rebate by 1.2%. Similar to our main estimates, an increase in publicity requirements increases the winning rebate by 5%, and both effects are statistically significant. In columns 3-8 of Table 12, we report a set of estimates to assess the robustness of the RDD in this

[51] *Telemat* is a private company operating in Italy since 1987. Every year more than 7,000 new firms join *Telemat*. Its services cover the entire Italian territory. In 2006, *Telemat* was one of the two leaders in a market characterized by 6 large competitors and several small local competitors. *Telemat*'s clients pay a small fee to have access to a website where information on upcoming procurement auctions are posted. The price to join Telemat is about 600-800 euros per year.

[52] This evidence is confirmed by the McCrary (2008) tests available upon request.

[53] Since *Telemat* is not collecting the actual level of publicity by the public administration, we focus the analysis on the OLS-ITT effects of publicity requirements. Section 2 explains how the law determines the publicity requirements while Section 4.1 discusses the properties of the ITTs.

alternative sample. Estimates confirm the robustness of the effects of publicity requirements to different bandwidth selection around the threshold, different model specifications (columns 3-5) and the validity of the RDD assumptions (columns 6-8).

Finally, we inspect whether and how publicity requirements have an effect on the information provider. We estimate how the probability that a contract is quickly posted on *Telemat* is affected by the publicity requirements. Column 2 shows that an increase in theoretical publicity causes a positive and statistically significant increase by 13% in the number of days a contract is published on *Telemat*. This suggests that the information providers has direct benefits from the legally prescribed publicity.

We conclude that the effects of the publicity requirement–government publicity–are robust to the inclusion of the for-profit provided publicity, the latter being systematically affected by the former.

8 Conclusions

We have used a regression discontinuity design to document the extent to which publicizing a public procurement auction influences public procurement through its effects on entry and the costs of procurement, using a large database on public procurement auctions in Italy. We identify the effects of publicity on outcomes by comparing auctions around a discontinuity threshold caused by legally-mandated rules on whether an auction must be publicized on the notice board in the premises of the public administration, or in Regional Official Gazettes and Provincial newspapers. The set of auctions with a starting value close to the discontinuity threshold is likely to be similar to each other in both observable and unobservable characteristics, which can be exploited in a quasi-experimental evaluation framework.

We have reported evidence that publicity "improves" the functioning of the auction mechanism and reduces the amount of public funds spent for public procurement, which is reflected in more entry, higher winning rebates, and a distribution of the bids shifted toward higher bids. Consistently with the theoretical predictions of Conley and Decarolis

(2012), we also provided evidence that the number of bidders is the channel through which publicity affects rebates.

Increasing publicity also selects winners. We show that publicity increases the likelihood that the winner hails from outside the region of the public administration (not statistically significant), increases the probability that the winner is a large company, and increases the number of repeated winners. These results contribute to the literature of selective entry in auctions.

The estimated gains from increasing publicity are not nullified in the *ex-post* phase of works' executions. We find that publicity does not increase subcontracting, while it reduces the probability that the works are *ex-post* executed with delays.

The effects of publicity requirement seems to be more important when it is harder to be informed of an upcoming auction managed by the local municipalities because they number ten thousand, too many to keep track of. Our estimates are robust to a large number of empirical specifications and to the possibility that firms learn about upcoming auctions from a for-profit information provider.

We observe here that, to the extent that publicity ameliorates collusion, publicity is a relatively convenient anti-collusion policy, in the sense that it does not require any information or oversight on the part of the regulator. In this sense, the findings in this paper contribute, albeit indirectly, to our toolkit for fighting collusion and corruption in procurement auctions.

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Appendix A: Parametric Tests for Sorting and Lack of Continuity

Our identification strategy is based on the validity of the continuity conditions, Section 5. The main threat to the validity of these assumptions comes from the fact that the starting value is not exogenously determined and that the publicity threshold is public knowledge. Public administrations, therefore, might have incentives to set the starting value to favor certain bidders (e.g., local bidders that are also voters).

We formally test this possibility considering the statistical tools suggested by McCrary (2008), and Lee (2008). The former proposes a *t-test* for the difference in density function of the running variable (in this case the starting value of the auction) estimated below and above the threshold. The latter suggests to look at the behavior of the pre-treatment variables around the discontinuity threshold.

Following Lee (2008), we estimate the same models as in equation (7) but use as outcomes, the 7 pre-treatment variables. In practice, we extend the graphical analysis of Section 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 and whether located in the South of Italy, and the resident population). In Table 11 we report the OLS-ITT and IV-LATE estimated coefficients of the effects of actual publicity on the pre-treatment variable. Odd columns report the estimates from the baseline mode. In even columns we add: The works characteristics (roads, education, culture, etc.); auctions characteristics (the technical requirement to participate, OG1-OG3), public administration characteristics (whether the contracting authority is the municipality or the province); and the location of the public administration (110 provincial dummies). Most of the estimated coefficients are not statistically different from zero at 1, 5, 10% significance levels. This indicates that there are no systematic effects of publicity (theoretical publicity in Panel A) on the pre-intervention characteristics.

In Table 3 we report the estimated coefficients and standard errors of the McCrary (2008) test for discontinuity of the running variable around the threshold for two different samples, by year and by typology of the public work. McCrary (2008) shows that the test behaves as a *t-test* hence a statistics above 2 would suggest a rejection of the null hypothesis of no jump in the density function. Most of the estimated coefficients reported in the table are below 2, thus do not allow to reject the null hypothesis of no jump in the density function around the threshold.

We, therefore, exclude the existence of perfect sorting around the discontinuity threshold.

Table 1: Publicity: Requirements, Target population, and Costs

Starting Value y (in 100000 euro)	Publicity requirements	Target popluation	Costs of publishing (in euro)	Non-compliance to the law (%)
	EU-Official Journal (GUCE)	738,200,000	Free	
	Italian Official Journal (GURI)		7000-8000	
$y \geq 65.5$	National Newspapers (at least 2)		800	10
	Regional Newspapers (at least 2)		600	
	Italian Official Gazette (GURI)	56,995,744	7000-8000	
$10 \leq y < 65.5$	National Newspapers (at least 2)		800	22.5
	Regional Newspapers (at least 2)		600	
	Regional Official Gazette (BUR)	3,031,322	200-500	
$5 \leq y < 10$	Provincial Newspapers (at least 2)		400	50
$y < 5$	Notice Board	13,000	Free	6.5

Notes. In the table y represent the starting value/reserve price 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 of publishing on regional official journals, and of the regional/provincial newspapers are regional and provincial averages. The target population represents the EU and the Italian population at the 2001 census, while the rest are regional and municipal averages at the 2001 census. Source: Law 109/1994, authors' interviews with national advertisement companies, National Institute of Statistics.

Table 2: Descriptive Statistics

	Mean	St.Dev.	p10	p25	p50	p75	p90	Obs.
Outcomes:								
Minimum Rebate (%)	8.25	6.57	1	3.05	6.98	12	17.7	31,610
Winning Rebate (%)	16.3	8.17	6.03	11	15.3	21.3	28.6	31,610
Anomaly Threshold (T, %)	16.7	8.09	6.67	11.6	15.6	21.7	28.8	31,610
Maximum Rebate (%)	20	8.5	10.1	14.6	18.7	25.9	32.1	31,610
Number of Bidding Firms	36.1	31.2	8	13	27	49	79	31,610
Number of Bidding Firms Excluded with Rebate Above T	9.33	8.97	2	3	6	12	22	31,610
Winner from Outside the Region	.371	.483	0	0	0	1	1	28,025
Max (%) Wins Same Firm	.336	.325	.0455	.0833	.2	.5	1	28,025
Limited Liability Winner	.444	.497	0	0	0	1	1	28,025
Works Interruption	.507	.5	0	0	1	1	1	28,025
Resales	.604	.489	0	0	1	1	1	28,025
Publicity:								
Notice Board	.92	.27	1	1	1	1	1	31,610
Regional Official Gazette	.25	.43	0	0	0	1	1	31,610
Italian Official Gazette	.18	.39	0	0	0	0	1	31,610
European Official Gazette	.02	.13	0	0	0	0	0	31,610
Number of Provincial Newspapers	.24	.72	0	0	0	0	1	31,610
Number of Regional Newspapers	.42	.81	0	0	0	0	2	31,610
Number of National Newspapers	.61	.92	0	0	0	1	2	31,610
Characteristics of the Works:								
Auction Starting Value (in 100000 Euro)	6.8	11	1.7	2.1	3.3	6.5	14	31,610
Roads	.31	.46	0	0	0	1	1	31,610
Education	.11	.31	0	0	0	0	1	31,610
Culture	.071	.26	0	0	0	0	0	31,610
Health and Hydric	.07	.19	0	0	0	0	0	31,610
Trains and Airports	.015	.1	0	0	0	0	0	31,610
Other	.43	.49	0	0	0	1	1	31,610
Requirements: Roads and others, Buildings	.28	.35	0	0	0	0	1	31,610
The public administration is:								
Municipality	.53	.5	0	0	1	1	1	31,610
Province	.12	.33	0	0	0	0	1	31,610
North East	.2	.4	0	0	0	0	1	31,610
North West	.27	.44	0	0	0	1	1	31,610
Center	.2	.4	0	0	0	0	1	31,610
South	.24	.43	0	0	0	0	1	31,610
Islands	.06	.23	0	0	0	0	0	31,610
Population	13	35	.2	.55	2	8.3	32	31,610

Notes. All the auctions for public works with value greater or equal to 150,000 euros auctioned in Italy between the years of 2000-2005 with public participation. *Winning Rebate* is the winning bid and is expressed as a percentage reduction form the starting value. The *Anomaly Threshold, T* is the sum of the average bid (not available in the data) and the average deviation of the bids above the average. The winning rebate is the maximum rebate below *T*. R^{min} and R^{Max} the minimum and the maximum rebate. *Number of Bidding Firms Excluded with Rebate Above T* is the number of bidders automatically excluded with a rebate above the anomaly threshold T. *Winner from outside the region* is a dummy for whether the winning firm is registered outside the region of the public administration. *Max % wins same firm* is the highest percentage of auctions assigned to the same firm for each of the years in the sample and for each public administration. *Limited Liability Winner* is a dummy for whether the winning firm is a small company as defined by Art. 2463 of the Civil Code (10,000 euros of minimum corporate capital). *Works interruption* is a dummy for whether the works have been interrupted because of chance occurrences, unavoidable accidents, places unavailabilities or the judicial police. *Resales* is a dummy for whether the public administration authorized subcontractors to realize the works. Notice Board-European Official Gazette are dummies for whether the contract has been published on one or more of the Official Journals. *Auction Starting Value* is the value/reserve price set by the public administration (in 2000 equivalents). *Requirements* are the technical and financial characteristics required by the contracting authority to the bidders (OG1-OG3). *Municipality* (*Province*) is a dummy for whether the public administration is a municipality (provincial institution) *Population* is the number of resident inhabitants (in 10,000, year 2001) in the city of the public administration with at least one auction between 2000-2005.

Table 3: Density Test for Sorting of the Auctions Starting Value Around the Threshold

Type of Works	Year 2000	2001	2002	2003	2004	2005	All years
	Panel A: Estimation Sample, $y \in [2, 8]$						
Roads	.58	.11	-.026	-.42	-.5	-.2	-.21
(se)	(.42)	(.32)	(.28)	(.23)	(.29)	(.31)	(.19)
Education	-.71	-1.2	2.1	-1.3	-.48	.3	.12
(se)	(.51)	(.57)	(1.4)	(1)	(.64)	(.59)	(.33)
Culture	-.047	.29	-.11	-1	-.16	-.15	-.17
(se)	(.64)	(.59)	(.6)	(.82)	(.59)	(.67)	(.33)
All types	-.11	-.013	-.25	-.098	-.15	.29	-.10
(se)	(.2)	(.16)	(.19)	(.22)	(.22)	(.28)	(.10)
	Panel B: Half-Window, $y \in [3.5, 6.5]$						
Roads	.42	-1.1	-.25	.26	-.29	-1.6	-.14
(se)	(.69)	(1)	(.42)	(.63)	(.5)	(1.1)	(.24)
Education	-.69	1.1	-.25	-.29	.47	.22	.23
(se)	(.79)	(1)	(1.1)	(1.2)	(1.3)	(1.4)	(.37)
Culture	.44	-.51	-.11	1.4	.92	.01	.038
(se)	(.67)	(.94)	(.6)	(1.4)	(2)	(1.8)	(.45)
All types	-.57	.24	-.077	-.45	-.034	.24	-.15
(se)	(.37)	(.25)	(.28)	(.31)	(.32)	(.4)	(.12)

Notes. Coefficient (and standard error in parenthesis) of the McCrary (2008) parametric *t-test* for the presence of sorting in the starting value (the running variable of the RDD estimator) around the discontinuity. *Panel A* reports statistics for the main estimation sample with starting values $y \in [2, 8]$, while *Panel B* for the auctions in the "half-window" subsample with starting values $y \in [3.5, 6.5]$. Source: Statistics for all the public procurements works tendered between 2000 and 2005 with starting value y in 100,000 euros (2000 equivalents).

Table 4: Discontinuity Effect of Publicity on Entry and Winning Rebate: Regression Analysis

Dependent variable	Publicity	Number of bidders	Number of bidders	Winning rebate	Winning rebate
Method	OLS-ITT	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE
	(1)	(2)	(3)	(4)	(5)
Mean outcome		35.13		16.06	
Theo. Publicity	0.204***	4.534***		0.974**	
	(0.019)	(1.544)		(0.378)	
Publicity			22.189***		4.765**
			(7.832)		(1.922)
F-first stage			197.8		197.8
Year effects	yes	yes	yes	yes	yes
4^{th} order poly.	yes	yes	yes	yes	yes
$y \in [2, 8]$	yes	yes	yes	yes	yes
Observations	17,512	17,512	17,512	17,512	17,512

Notes. Coefficient (and SE in parenthesis) of the effect of publicity. In column 1 the *Dep.Var.* is the observed level of publicity (first stage), while the number of bidders in columns 2-3, and the winning rebate in columns 4-5. The first row reports the mean outcome of each dependent variable. *Theo. Publicity* is the theoretical level of publicity determined by the starting value, $y \geq 5$. *Publicity* is the observed level of publicity. *F-first stage* is the first-stage F-statistics for the excluded instrument. All the regressions include the 4^{th} order polynomial in the difference of the starting value from the threshold, and five year indicators. Columns 2 and 4 report OLS-ITT estimates while 3 and 5 report IV-LATE estimates using *Theo. Publicity* as the instrument for *Publicity*. 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 $y \in [2, 8]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 2, because here we restrict the analysis to auctions with starting value $y \in [2, 8]$.

Table 5: Heterogenous effects

	Panel A: Municiality				Panel B: Population			
Dependent variable	Number of bidders	Number of bidders	Winning rebate	Winning rebate	Number of bidders	Number of bidders	Winning rebate	Winning rebate
Method	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean outcome	35.77		16.06		35.77		16.06	
Theo. Publicity · Municipality	2.271		1.179***					
	(1.420)		(0.337)					
Publicity · Municipality		7.695		4.086***				
		(5.408)		(1.271)				
Theo. Publicity ·Population					0.045		0.006	
					(0.037)		(0.010)	
Publicity · Population						0.558		0.096
						(0.456)		(0.114)
Theo. Publicity	3.573*		0.413		4.591**		1.096***	
	(1.972)		(0.452)		(1.850)		(0.408)	
Publicity		18.717**		2.650		20.010**		4.857**
		(9.523)		(2.222)		(9.360)		(2.090)
Municipality	-10.605***	-9.644***	-2.885***	-2.777***				
	(1.155)	(1.211)	(0.284)	(0.324)				
Population					0.087***	0.078***	0.040***	0.038***
					(0.013)	(0.017)	(0.008)	(0.008)
F-first stage		97.47		97.47	88.78		88.78	
Year effects	yes	yes	yes	yes	yes	yes	yes	yes
4^{th} order poly.	yes	yes	yes	yes	yes	yes	yes	yes
$y \in [2, 8]$	yes	yes	yes	yes	yes	yes	yes	yes
Observations	17,512	17,512	17,512	17,512	17,152	17,152	17,152	17,152

Notes. Coefficient (and SE in parenthesis) of the effect of publicity. In columns 1-2, 5-6 the *Dep. Var.* is the the number of bidders; in columns 3-4 and 7-8 the winning rebate. The first row reports the mean outcome of each dependent variable. *Theo. Publicity* is the theoretical level of publicity determined by the starting value, $y \geq 5$. *Publicity* is the observed level of publicity. Odd columns report OLS-ITT estimates; even columns the IV-LATE using *Theo. Publicity* as instrument for *Publicity*. *F-first stage* is the first-stage F-statistics for the excluded instrument. All the regressions include the 4^{th}-order polynomial in the difference of the starting value from the threshold, and five-year indicators. In *Panel A* the model includes an indicator of whether the public administration is a municipality an interaction term with the level of *Publicity* (or *Theo. Publicity*). In *Panel B* the model includes the resident population in the municipality of the public administration and an interaction term with the level of *Publicity* (or *Theo. Publicity*). SEs are clustered for the presence of within-cities correlation. 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 $y \in [2, 8]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 2 because here we restrict the analysis to auctions with starting value $y \in [2, 8]$.

Table 6: Distribution of the Rebates and Number of Excluded Bidders

Dependent variable	Min rebate	Min rebate	Anomaly threshold (T)	Anomaly threshold (T)	N. bidders excluded with bid above T	N. bidders excluded with bid above T	Max rebate rebate	Max rebate rebate
Method	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean outcome	8.190		16.49		9.102		19.70	
Theo. Publicity	0.529*		1.049***		1.085**		1.280***	
	(0.298)		(0.374)		(0.437)		(0.389)	
Publicity		2.589*		5.133***		5.327**		6.264***
		(1.491)		(1.911)		(2.209)		(2.010)
F-first stage		197.8		197.8		197.8		197.8
Year effects	yes	yes	yes	yes	yes	yes	yes	yes
4^{th} order poly.	yes	yes	yes	yes	yes	yes	yes	yes
$y \in [2, 8]$	yes	yes	yes	yes	yes	yes	yes	yes
Observations	17,512	17,512	17,512	17,512	17,512	17,512	17,512	17,512

Notes. Coefficient (and SE in parenthesis) of the effect of publicity. In columns 1-2 the *Dep.Var.* is the minimum rebate; in 3-4 the anomaly threshold T (the average rebate plus the average of the bids above the average and below the top 10 % of the distribution of the rebates); in 5-6 the number of bidders with a rebate above the anomaly threshold T and therefore excluded; in 7-8 the maximum rebate. The first row reports the mean outcome of each dependent variable. *Theo. Publicity* is the theoretical level of publicity determined by the starting value, $y \geq 5$. *Publicity* is the observed level of publicity. *F-first stage* is the first-stage F-statistics for the excluded instrument. All the regressions include the 4^{th}-order polynomial in the difference of the starting value from the threshold, and five year indicators. Odd columns report OLS-ITT estimates; even columns the IV-LATE using *Theo. Publicity* as instrument for *Publicity*. 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 $y \in [2, 8]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 2 because here we restrict the analysis to auctions with starting value $y \in [2, 8]$.

Table 7: Type of Winners, Incumbency, and *ex-post* execution of the works

Dependent variable	Winner non-local	Winner non-local	Winner small company	Winner small company	Max (%) wins	Max(%) wins	Works delivered with delay	Works delivered with delay	Resales	Resales
Method	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Mean outcome	.34		.44		.35		.54		.64	
Theo. Publicity	0.020		-0.041*		0.044***		-0.042*		-0.011	
	(0.023)		(0.023)		(0.015)		(0.025)		(0.023)	
Publicity		0.089		-0.181*		0.194***		-0.224*		-0.059
		(0.100)		(0.104)		(0.068)		(0.136)		(0.121)
F-first stage		264.7		264.7		264.7		142.3		142.3
Year effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
4^{th} order poly.	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
$y \in [2, 8]$	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	16,606	16,606	16,606	16,606	16,606	16,606	14,046	14,046	14,046	14,046

Notes. Coefficient (and SE in parenthesis) of the effect of publicity. In column 1-2 the *Dep. Var* is an indicator of whether the winner is non-local (coming from outside the region); in 3-4 the winner is a small company (a limited liability company); in 5-6 is the highest percentage of works assigned to the same firm within a year (the market share); in 7-8 an indicator of whether works were interrupted; in 9-10 whether to contract was resold to a subcontractor. The first row reports the mean outcome of each dependent variable. *Theo. Publicity* is the theoretical level of publicity determined by the starting value, $y \geq 5$. *Publicity* is the observed level of publicity. *F-first stage* is the first-stage F-statistics for the excluded instrument. All the regressions include the 4^{th}-order polynomial in the difference of the starting value from the threshold, and five year indicators. Odd columns report OLS-ITT estimates; even columns the IV-LATE using *Theo. Publicity* as instrument for *Publicity*. 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 $y \in [2, 8]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 2 because here we restrict the analysis to auctions with starting value $y \in [2, 8]$.

Table 8: Publicity in Official Journals

Dependent variable	Publicity on Gazette	Number of bidders	Winning rebate	Min rebate	Anomaly threshold (T)	N. bidders excluded with bid above T	Max rebate	Winner non-local	Winner small company	Max(%) wins	Works delivered with delay	Resales
Method	OLS-ITT	IV-LATE	IV-LATE	IV-LATE	IV-LATE	IV-LATE	IV-LATE	IV-LATE	IV-LATE	IV-LATE	IV-LATE	IV-LATE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Mean outcome		35.77	16.06	8.188	16.49	9.102	19.68	0.342	0.440	0.346	0.541	0.636
Theo. Publicity	0.472***											
	(0.025)											
Publicity on Gazette		9.608***	2.063**	1.121*	2.223***	2.368**	2.712***	0.040	-0.082*	0.088***	-0.085*	-0.022
		(3.269)	(0.808)	(0.636)	(0.801)	(0.953)	(0.837)	(0.046)	(0.047)	(0.031)	(0.051)	(0.046)
F-first stage		427.5	427.5					470.1	470.1	470.1	353.0	353.0
Year effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
4^{th} order poly.	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
$y \in [2, 8]$	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	17,512	17,512	17,512	17,512	17,512	17,512	17,512	16,606	16,606	16,606	14,046	14,046

Notes. Coefficient (and SE in parenthesis) of the effect of publicity. In column 1 the *Dep.Var.* is the number of bidders, in 2 the winning rebate, in 3 whether the winner is non-local (coming from outside the region); in 4 the winner is a small company (a limited liability company); in 5 is the highest percentage of works assigned to the same firm within a year (the market share); in 7 an indicator of whether works were interrupted; in 9 whether to contract was resold to a subcontractor. The first row reports the mean outcome of each dependent variable. *Theo. Publicity* is the theoretical level of publicity determined by the starting value, $y \geq 5$. *Publicity on Gazette* is an indicator of whether the auction as been published on the Italian Official Gazzette. *F-first stage* is the first-stage F-statistics for the excluded instrument. All the regressions include the 4^{th}-order polynomial in the difference of the starting value from the threshold, and five year indicators. Odd columns report OLS-ITT estimates; even columns the IV-LATE using *Theo. Publicity* as instrument for *Publicity on Gazette*. 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 $y \in [2, 8]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 2 because here we restrict the analysis to auctions with starting value in $y \in [2, 8]$.

Table 9: Model Specifications and Discontinuity Samples

Model	4^{th}-Order poly. Full-info	4^{th}-Order poly. Full-info	3^{th}-Order poly.	3^{th} Order poly.	Local linear	Local linear	4^{th}-Order poly.	4^{th}-Order poly.	Local linear	Local linear	4^{th}-Order poly.	4^{th}-Order poly.	Local linear	Local linear	Linear	Linear
($y \in$)	[2, 8]	[2, 8]	[2, 8]	[2, 8]	[2, 8]	[2, 8]	Opt.-Band.	Opt.-Band.	Opt.-Band.	Opt.-Band.	[3.5, 6.5]	[3.5, 6.5]	[3.5, 6.5]	[3.5, 6.5]	[4.63, 6.38]	[4.63, 5.38]
Method	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	IV-LATE	OLS-ITT	Wald
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	Panel A: N. of bidders															
Mean out.	35.77						34.07				34.52				35.28	
Theo. Pub.	3.706***		3.807***		2.394**		4.288***		2.914**		3.725**		1.344		3.201**	
	(1.534)		(1.460)		(1.144)		(1.572)		(1.201)		(1.808)		(1.511)		(1.551)	
Pub.		17.926**		17.597**		9.908**		22.505***		12.838**		20.306**		6.519		16.259**
		(7.470)		(6.858)		(4.765)		(8.455)		(5.315)		(10.031)		(7.320)		(7.953)
	Panel B: Winning rebate															
Mean out.	16.06						15.88				15.98				16.31	
Theo. Pub.	0.486*		0.780**		0.542*		0.785**		0.665**		0.845*		0.410		0.768*	
	(0.273)		(0.367)		(0.282)		(0.388)		(0.300)		(0.456)		(0.384)		(0.400)	
Pub.		2.358*		3.605**		2.244*		4.122**		2.931**		4.606*		1.990		3.898*
		(1.354)		(1.724)		(1.179)		(2.085)		(1.335)		(2.558)		(1.872)		(2.068)
F-first stage		206.2		236.8		498.7		189.1		445.2		112.5		196.0		147.6
Year effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Obs.	17,512	17,512	17,512	17,512	17,512	17,512	16,103	16,103	16,103	16,103	9,365	9,365	9,365	9,365	2,207	2,207

Notes. Coefficient (and standard error in parenthesis) of the effect of publicity on the number of bidders *(Panel A)* and the winning rebate *(Panel B)*. The rows denoted with *Mean out.* report the mean outcome of each dependent variable. *Theo. Pub.* is the theoretical level of publicity determined by the starting value, $y \geq 5$. *Pub.* is the observed level of publicity. Odd columns report OLS-ITT estimates; even columns the IV-LATE using *Theo. Pub.* as instrument for *Pub.*. *F-first stage* is the first-stage F-statistics for the excluded instrument. Columns 1,2; 7,8; 11,12 include the 4^{th}-order polynomial in the difference of the starting value from the threshold; columns 3,4 the 3^{th}-order polynomial; columns 5.6; 9,10; 13,14 include the interaction term between *Theo. Pub.* and the starting value (Local Linear regressions). All the regression include five year indicators. Columns 1-6 consider all the works tendered between 2000 and 2005, with starting value $y \in [2, 8]$; columns 7,8 all the works with starting value in the interval $y \in [2.66, 7.34]$ determined using the Imbens Kalyanaraman (2009) optimal bandwidth criterion. In columns 11-14 the estimation window is divided by two and $y \in [3.5, 6.5]$. In columns 15,16 are considered works with starting value 37,500 euro (7.5 %) below and above the threshold as in Angrist and Lavy (1999). Columns 1,2 include indicators on the nature of the good (*Goods:* roads, culture, education, hospitals, rails, bridges, basins and damns, and airports.) the administrative nature of the contracting authority (*P.A.:* Municipality or province), technical and financial characteristics required by the contracting authority to the bidders (*Tech.:* OGs), and 110 provincial dummies and the resident population of the municipality of the public administration (in 10,000 inhabitants in 2001) *Geo.*. For this reason, in columns 1,2 SEs are clustered for the presence of within cities correlation while in columns 3-16, SEs are 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 in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 2 because here we restrict the analysis to auctions with starting value $y \in [2, 8]$, $y \in [2.66, 7.34]$, $y \in [3.5, 6.5]$, or $y \in [4.63, 5.38]$ depending on the specification.

Table 10: Falsification Exercise at Simulated Thresholds

Dependent variable	Threshold at $y \geq 3.5$		Threshold at $y \geq 7$	
	Number of bidders	Winning rebate	Number of bidders	Winning rebate
	(1)	(2)	(3)	(4)
Mean outcome	34.52	15.97	42.51	16.25
		Panel A: OLS-ITT		
Theo. Publicity	0.041	0.032	0.526	0.642
	(1.438)	(0.386)	(3.002)	(0.594)
		Panel B: IV-LATE		
Publicity	2.264	1.759	21.389	26.101
	(79.536)	(21.362)	(129.671)	(51.404)
F-first stage	2.372	2.372	0.366	0.366
Year effects	yes	yes	yes	yes
4^{th} order poly.	yes	yes	yes	yes
$y \in [2, 5)$	yes	yes	no	no
$y \in (5, 9]$	no	no	yes	yes
Observations	13,075	13,075	4,330	4,330

Notes. Coefficient (and standard error in parenthesis) of the effect of publicity on the number of bidders (columns 1 and 3); the winning rebate (columns 2 and 4). The first row reports the mean outcome of each dependent variable in the sub-sample. *Panel A* reports the OLS-ITT estimates; *Panel B* the IV-LATE estimates the using *Theo. Publicity* as instrument for *Publicity*. *Theo. Publicity* is the theoretical level of publicity determined by the starting value ($y \geq 3.5$ in columns 1 and 2; $y \geq 7$ in columns 3 and 4), *Publicity* is the observed level of publicity. *F-first stage* is the first-stage F-statistics for the excluded instrument. All the regressions include the 4^{th} order polynomial in the difference of the starting value from the thresholds ($y \geq 3.5$ in columns 1 and 2; $y \geq 7$ in columns 3 and 4), and five-year indicators. 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) in columns 1 and 2; all the public procurements works tendered between 2000 and 2005, with starting value $y \in (5, 9]$, in 100,000 euros (2000 equivalents) in columns 3 and 4. The number of observations is smaller than the one of the full sample described in Table 2 because here we restrict the analysis to auctions with starting value in $y \in [2, 5)$ for columns 1 and 2; and in $y \in (5, 9]$ for columns 3 and 4.

Table 11: Sorting and Continuity Conditions: Parametric Tests on Pre-Treatment Variables

Dependent Variable	Education	Education	Age manager	Age manager	Male manager	Male manager	Prov.	Prov.	Munic.	Munic.	South	South	Pop.	Pop.
Model		full-info		full-info		full-info		full-info		full-info		full-info		full-info
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Mean outcome	0.10		51.92		0.90		0.13		0.56		0.27		10.53	
Panel A: OLS-ITT														
Theo. Publicity	-0.002	0.007	-0.552	-0.350	-0.008	-0.015	0.017	0.004	0.024	0.028	0.026	0.030	-3.914***	-1.515
	(0.013)	(0.012)	(0.380)	(0.368)	(0.014)	(0.014)	(0.014)	(0.014)	(0.023)	(0.022)	(0.020)	(0.020)	(1.307)	(1.044)
Panel B: IV-LATE														
Publicity	-0.009	0.035	-2.678	-1.686	-0.040	-0.071	0.081	0.021	0.116	0.139	0.129	0.145	-19.086***	-7.319
	(0.066)	(0.059)	(1.865)	(1.775)	(0.069)	(0.068)	(0.069)	(0.066)	(0.112)	(0.108)	(0.098)	(0.098)	(6.555)	(5.066)
F-first stage	197.8	205.6	197.5	206.4	197.8	206.2	197.8	202.1	197.8	202.1	197.8	197.9	194.8	204.7
Year effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
4^{th}-order poly.	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
$y \in [2, 8]$	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Goods charact.	no	no	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
P.A. charact.	no	yes	no	yes	no	no	no	no	no	no	yes	yes	no	yes
Tech. charact.	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
Geo. charact.	no	yes	no	yes	no	yes	no	yes	no	yes	no	no	no	yes
Observations	17,512	17,512	17,512	17,512	17,512	17,512	17,512	17,512	17,512	17,512	17,512	17,512	17,512	17,512

Notes. Coefficient (and standard error in parenthesis) of the effect of publicity on the pre-treatment outcomes: Whether the good is a public school or a library (columns 1-2); the age of the manager (columns 3-4); his gender (columns 5-6); whether the administration is a provincial administration (columns 7-8), a municipality (columns 9-10), whether is located in the south (columns 11-12), and (columns 13-14) its resident population (in 10,000 inhabitants in 2001). *Panel A* reports the OLS-ITT estimates; *Panel B* the IV-LATE estimates. The first row reports the mean outcome of each dependent variable. *Theo. Publicity* is the theoretical level of publicity determined by the starting value, $y \geq 5$. *Publicity* is the observed level of publicity. *F-first stage* is the first-stage F-statistics for the excluded instrument. All the regressions include the 4^{th}-order polynomial in the difference of the starting value from the threshold, and five year indicators. Even columns include indicators on the nature of the good (*Goods:* roads, culture, education, hospitals, rails, bridges, basins and damns, airports.) the administrative nature of the contracting authority (*P.A.:* Municipality or province), technical and financial characteristics required by the contracting authority to the bidders (*Tech.:* OGs), and 110 provincial dummies *Geo.*. 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 $y \in [2, 8]$, in 100,000 euros (2000 equivalents). The number of observations is smaller than the one of the full sample described in Table 2 because here we restrict the analysis to auctions with starting value $y \in [2, 8]$.

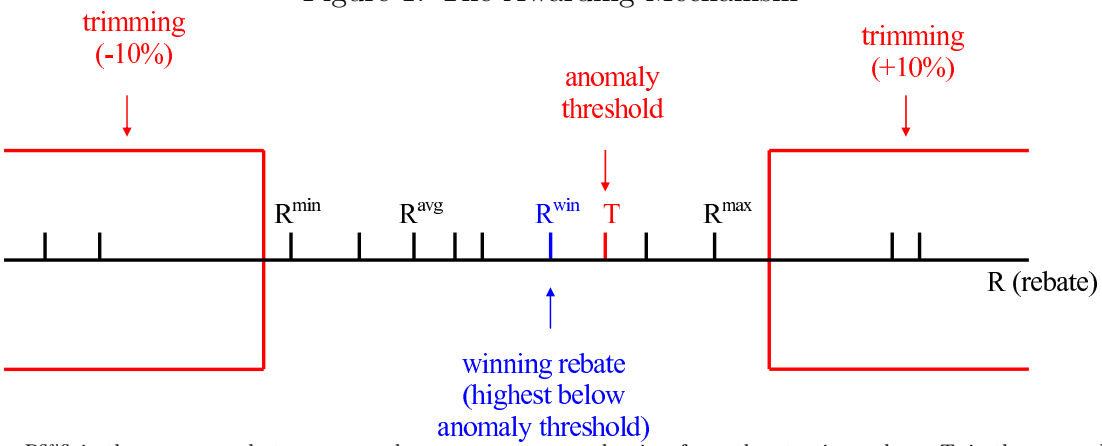
Table 12: Information Entrepreneur

	Outcomes		Sensitivity Analysis and Pre-treatment Variables					
Dependent variable	Winning rebate	Days on Telemat	Winning rebate	Winning rebate	Winning rebate	Province	Population	South
Method	OLS-ITT	OLS-ITT	OLS-ITT	OLS-ITT	LLR	OLS-ITT	OLS-ITT	OLS-ITT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean outcome	16.93	30.53	16.93	17.16		0.152	0.202	30.13
SD outcome		14.69						
Theo. Publicity	0.843**	3.760***	0.891**	1.511***	1.261***	0.005	0.008	-2.515
	(0.358)	(0.542)	(0.358)	(0.462)	(0.410)	(0.013)	(0.015)	(2.322)
Days on Telemat	0.013**							
	(0.006)							
Year effects	yes	yes	yes	yes	yes	yes	yes	yes
4^{th} order poly.	yes	yes	yes	yes	no	yes	yes	yes
Window ($y \in$)	$[2, 8]$	$[2, 8]$	$[2, 8]$	$[3.5, 6.5]$	$[3.5, 6.5]$	$[2, 8]$	$[2, 8]$	$[2, 8]$
Observations	22,049	22,049	22,049	9,498	9,498	22,049	22,049	22,049

Notes. Coefficient (and SE in parenthesis) of the effect of publicity. In columns 1, 3-5, 6 the *Dep.Var.* is the minimum rebate; in column 2, *Days on Telemat* reports the number of days the contract appeared on the Telemat website before the official date of bid delivery; in column 6-8 whether the administration is a provincial administration, its resident population (in 10,000 inhabitants in 2001) and whether located in the south, respectively. *Theo. Publicity* is the theoretical level of publicity determined by the starting value, $y \geq 5$. Column 1 includes as a regressor *Days on Telemat*. All the columns include the 4^{th}-order polynomial in the difference of the starting value from the threshold, and year indicators. Column 5, reports the estimated coefficient of the effect of publicity when the interaction term between *Theo. Publicity* and the starting value is included (Local Linear regressions). Columns 4, 5 consider the subsample of auctions window with $y \in [3.5, 6.5]$. SEs adjusted for heteroskedasticity. Significance at the 10% (*), at the 5% (**), and at the 1% (***).

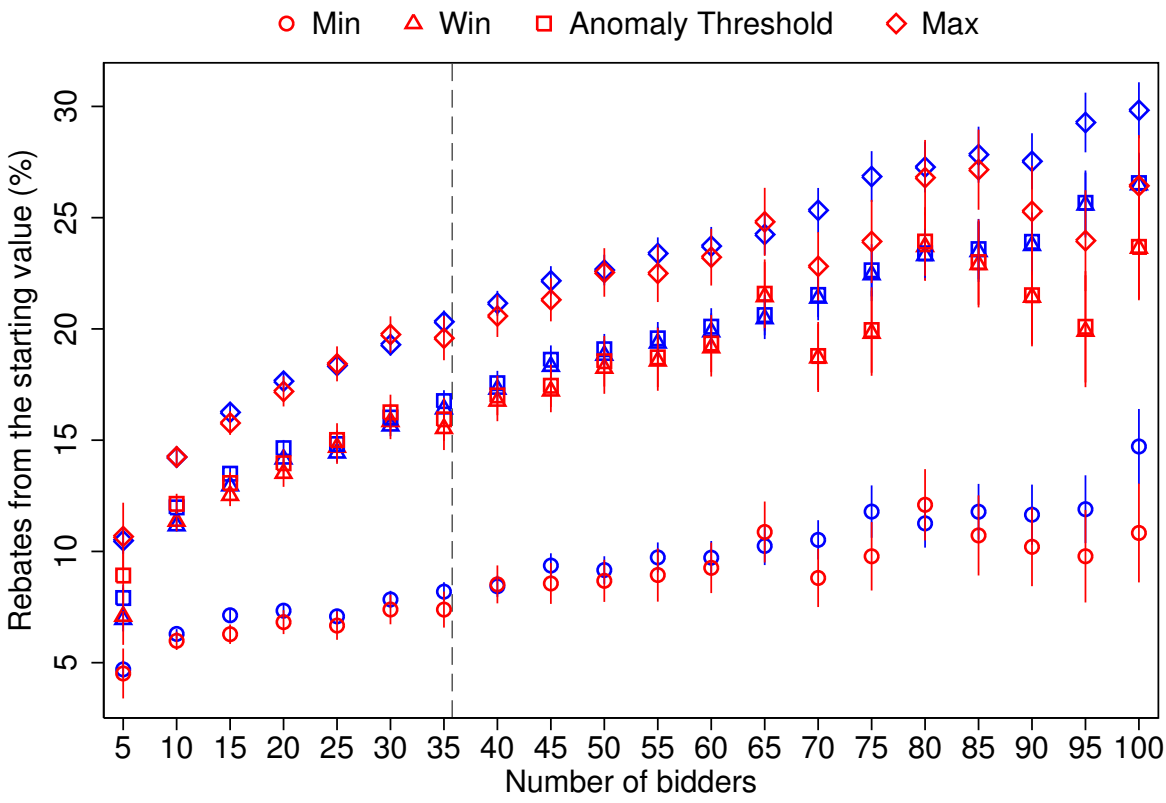
Source: Statistics for Telemat all the public procurements works tendered between 2000 and 2005, with starting value in 100,000 euros (2000 equivalents).

Figure 1: The Awarding Mechanism



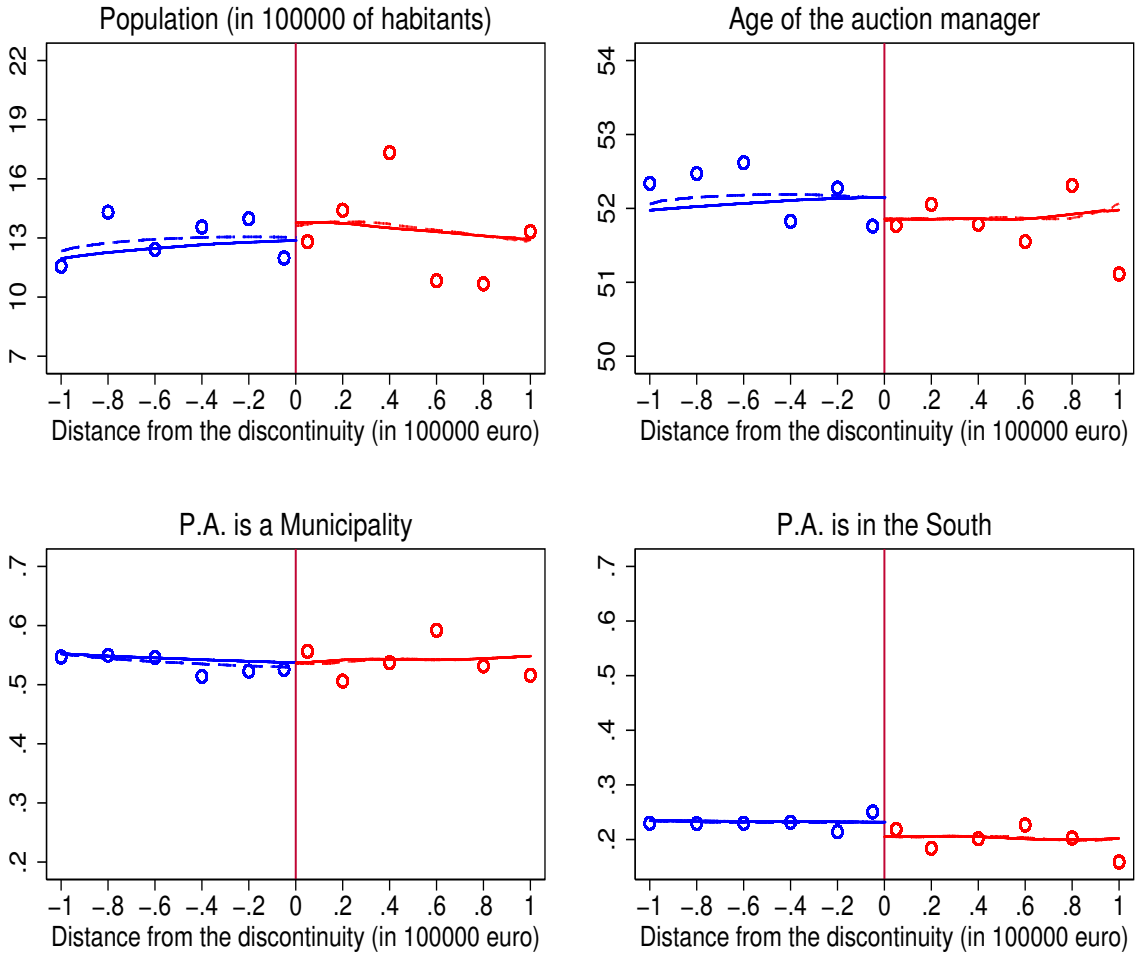
Notes. R^{avg} is the average rebate, expressed as a percentage reduction form the starting value. T, is the anomaly threshold obtained as the sum of R^{avg} and the average deviation of the bids above R^{avg}. R^{win} is the winning rebate and is the max rebate below T. R^{min} and R^{Max} the minimum and the maximum rebate, respectively.

Figure 2: Rebates Distribution, Number of Bidders and Publicity Requirements



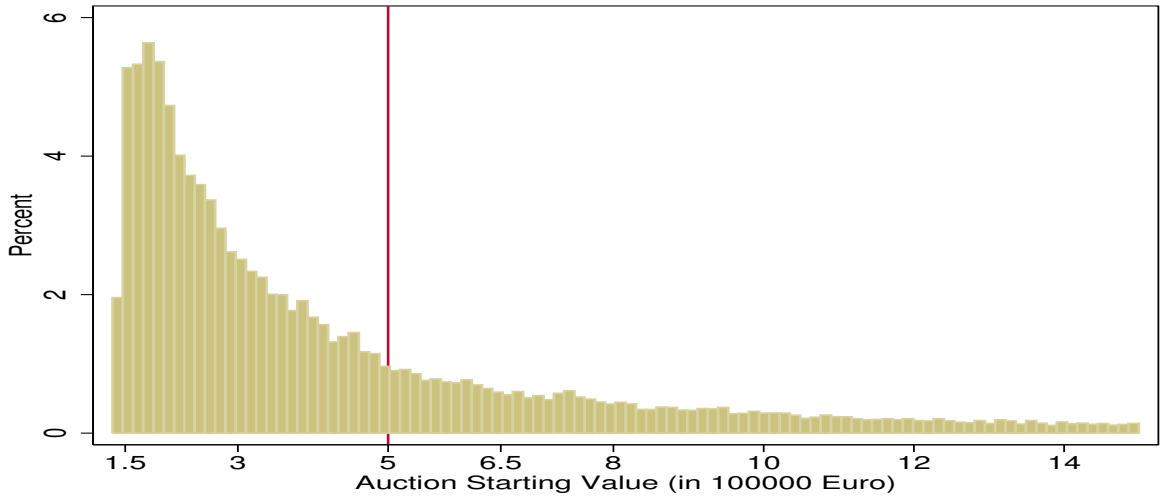
Notes. Distribution of the rebates conditional on the number of bidders participating to the auction at different levels of publicity: local (in red) or regional (in blue). Circles denote the minimum rebate; triangles the winning rebate; squares the anomaly threshold; diamonds the maximum rebate. Vertical lines denote the 95 % confidence intervals.
Source: Statistics for all the public procurements works tendered between 2000 and 2005, with starting value $y \in [2, 8]$, in 100,000 euros (2000 equivalents).

Figure 3: Discontinuity Effect of Publicity on Pre-Treatment Variables: Graphical Analysis (Continuity Conditions)



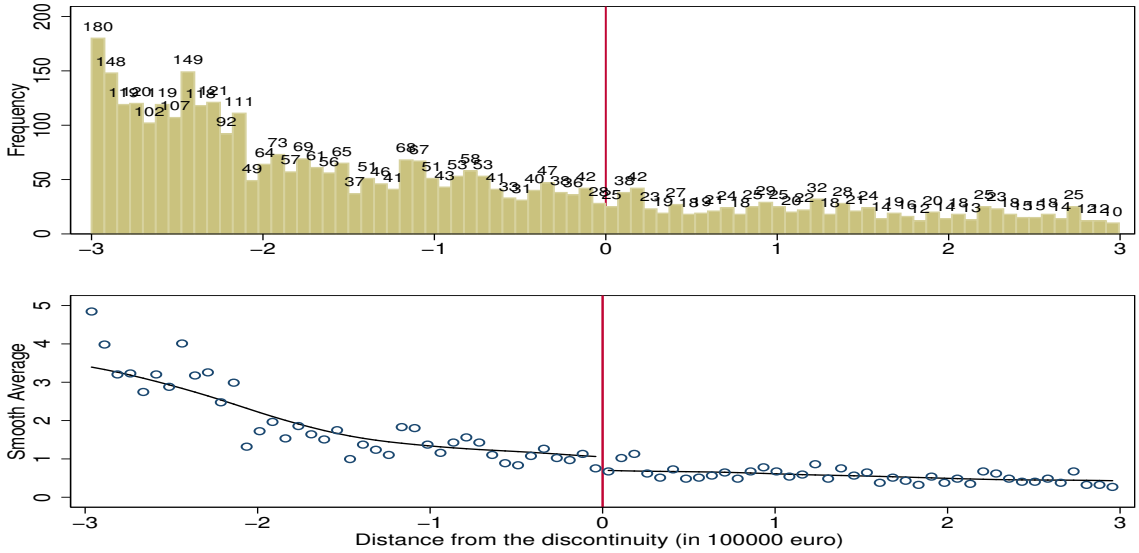
Notes. Circles represent sample averages of the dependent variable computed on 20,000 euros brackets of the running variable. The solid line (dashed line) is a least squares running-mean smoothing, separate on either side of the threshold computed on the sample of all auctions with starting value $y \in [2, 8]$ ($y \in [2.66, 7.34]$, determined using the Imbens and Kalyanaraman, 2011 optimal bandwidth criterion), in 100,000 euros (2000 equivalents). For presentational reasons, the figure plots averages of the dependent variable with running variable $y \in [4, 6]$. The red vertical line denotes the discontinuity, normalized to zero.

Figure 4: Distribution of the Auctions Starting Value



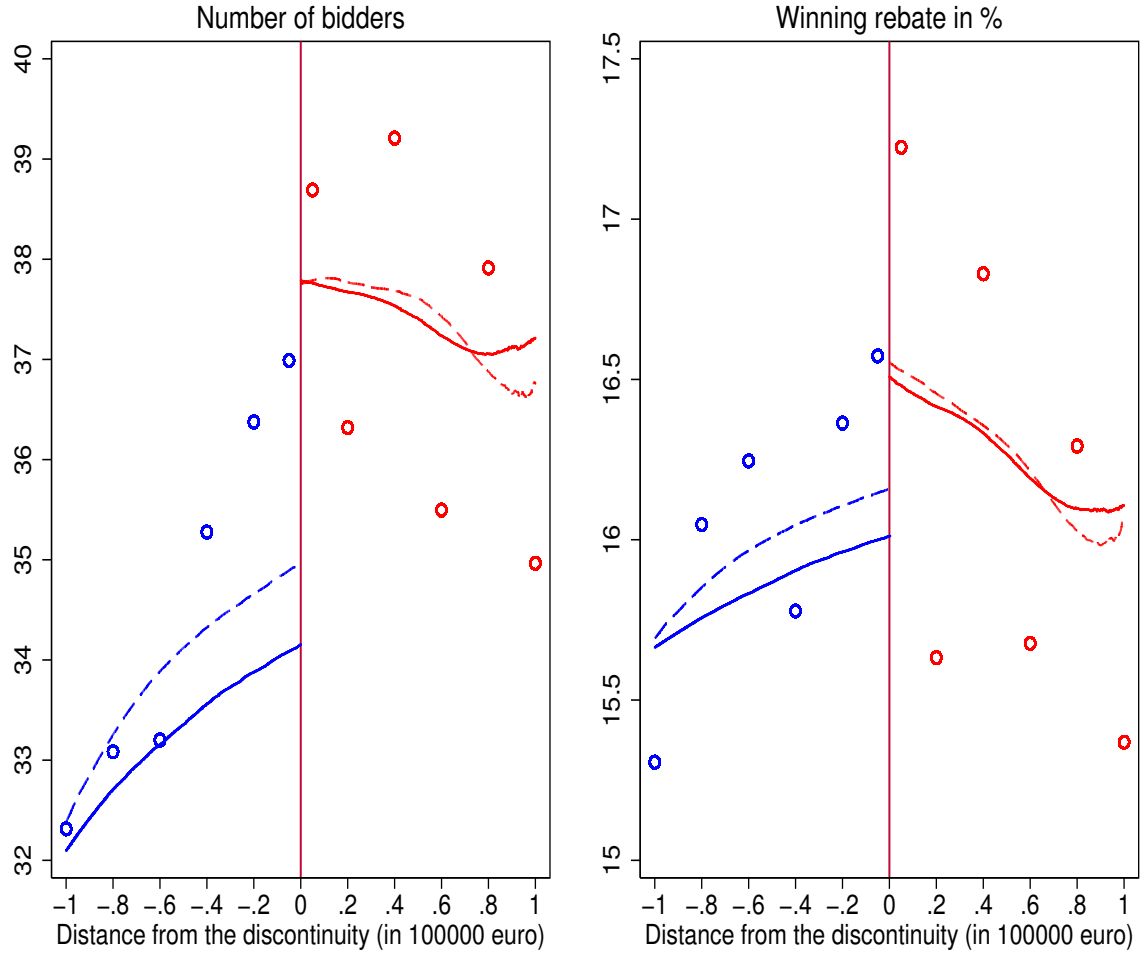
Notes. The red vertical line denotes the 500,000 euros discontinuity. Source: All the procurement auctions, with starting value $y \in [1.5, 20]$, in 100,000 euros (2000 equivalents).

Figure 5: Density of the Auctions Starting Value Around the Threshold



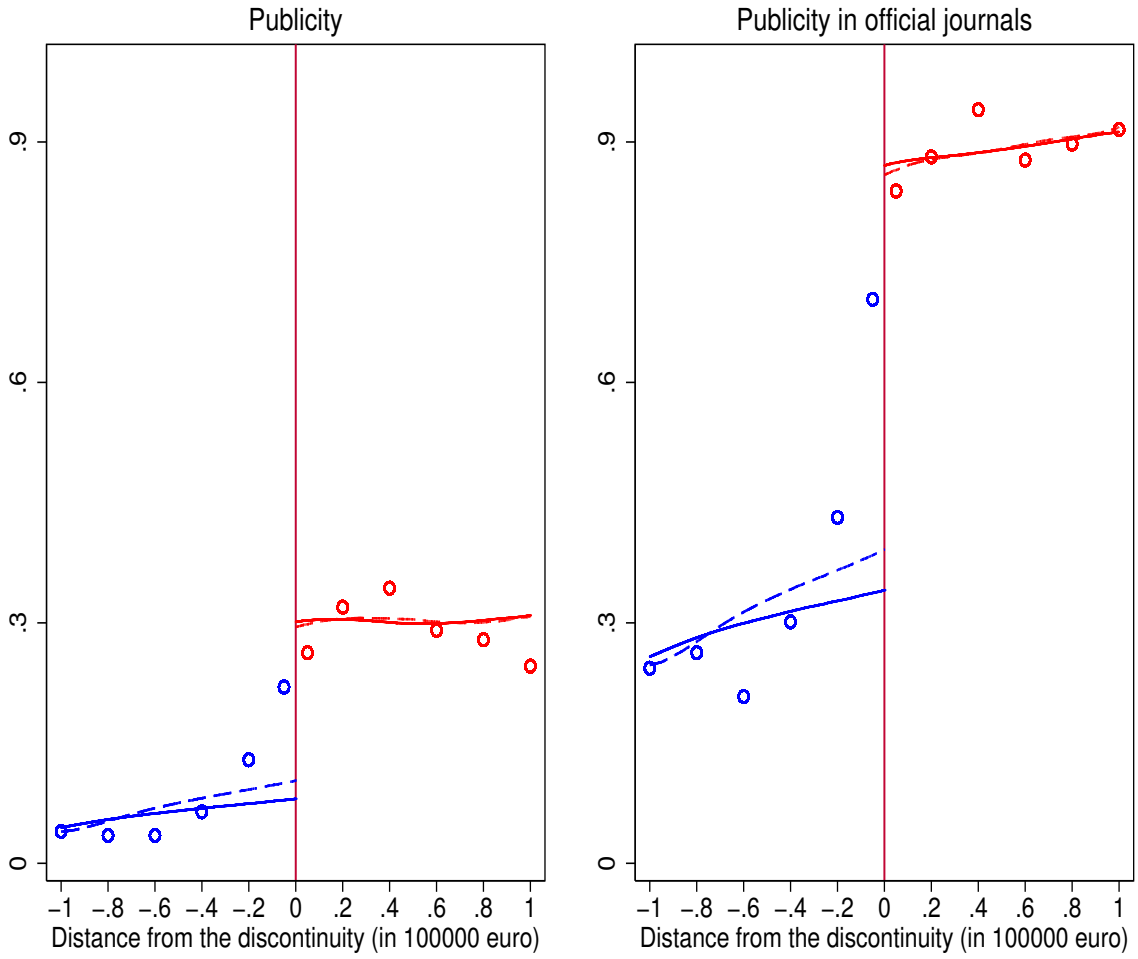
Notes. Circles represent sample averages of the dependent variable computed on 10,000 euros brackets of the running variable. The solid line is a least squares running-mean smoothing, separate on either side of the threshold computed on the sample of all auctions tendered in Year 2000 with starting value $y \in [2, 8]$, in 100,000 euros (2000 equivalents). The red vertical line denotes the discontinuity, normalized to zero.

Figure 6: Discontinuity Effect of Publicity on Entry and Winning Rebate: Graphical Analysis (Intention-to-Treatment)



Notes. On the left the number of bidders, while on the right the winning rebates expressed as a percent reduction from the starting value of the auction. Circles represent sample averages of the dependent variable computed on 20,000 euros brackets of the running variable. The solid line (dashed line) is a least squares running-mean smoothing, separate on either side of the threshold computed on the sample of all auctions with starting value $y \in [2, 8]$ ($y \in [2.66, 7.34]$, determined using the Imbens and Kalyanaraman, 2011 optimal bandwidth criterion), in 100,000 euros (2000 equivalents). For presentational reasons, the figure plots averages of the dependent variable with running variable $y \in [4, 6]$. The red vertical line denotes the discontinuity, normalized to zero.

Figure 7: Discontinuity Effect on Publicity: Graphical Analysis (Intention-to-Treatment)



Notes. Circles represent sample averages of the dependent variable computed on 20,000 euros brackets of the running variable. The solid line (dashed line) is a least squares running-mean smoothing, separate on either side of the threshold computed on the sample of all auctions with starting value $y \in [2, 8]$ ($y \in [2.66, 7.34]$, determined using the Imbens and Kalyanaraman, 2011 optimal bandwidth criterion), in 100,000 euros (2000 equivalents). For presentational reasons, the figure plots averages of the dependent variable with running variable $y \in [4, 6]$. The red vertical line denotes the discontinuity, normalized to zero.