Effects of Transparency in Procurement Practices on Government Expenditure: A Case Study of Municipal Public Works *

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Abstract

This paper examines the effect of improved transparency in the bidder qualification process, using the experience based on a case study of municipal public work auctions. It reveals that improved transparency reduces procurement cost by a maximum of three percent. This finding is robust to the concerns of endogeneity, sample selectivity, and distributional assumptions. The bidding-function estimates, combined with features of Japanese procurement system, imply that the improved transparency limits abuse of auctioneer's discretion, and thus weakens the stability of collusion among bidders.

Keywords: Public Procurement; Transparency; Discretion; Propensity Matching; Quantile Regression; Collusion; Corruption

JEL: F14; H57; L13

1 Introduction

Public procurement is notorious for the levels of corruption attained by dishonest public officials. A mounting body of evidence reported across the world indicates that opaque and discretionary procurement procedures often engender the relationship between government officials and contractors and result in enforcing collusion among contractors (Stapenhurst and Kpubdeh, 1999). It is often recommended that the introduction of transparency in procurement procedure be an effective method to curb corruption and restore efficiency in state purchasing. Nevertheless, the penetration of transparent practices in public procurement has been quite limited throughout the world. Indeed,

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while the WTO has been successful in reaching a transparency agreement on the transaction of goods and services, it has encountered difficulties in extending the agreement to state purchasing.[1] The question that arises is whether the implementation of transparency in public procurement is actually beneficial to countries. Empirical research that measures the effect of improved transparency in procurement practices, however, remains scarce. The dearth of the empirical research is mainly due to that many procurement auctions tend to operate under a given set of rules and fail to experiment with alternative designs. This paper aims to conduct such empirical research by using the unique experience of municipal small-scale public-works auctions in Japan.

The central government and a majority of the local governments in Japan have been using opaque and discretionary practices while qualifying suppliers for bidding for small-scaled public-works projects. The practice is discretionary in that, for each bid letting, procuring officials use their discretion to decide which suppliers are qualified to submit bids. It is opaque in that the officials are not accountable for the reasons why particular suppliers are qualified for the bidding.[2] While the direct effect of this conventional practice is to alleviate competition by limiting the number of qualified bidders, it also breeds corruption; this is a real possibility when the officials qualify a supplier only when the supplier offers pecuniary incentives or well-paid private sector employment after retirement. In turn, the corruption could engender collusion in an attempt to avoid bribe competition among suppliers. The discretionary practice could also help in disciplining the collusion, when the officials, on behalf of the ring, punish deviators by not qualifying them.

This paper uses public-works bidding data from the local government of Mie Prefecture in Japan. During our study period, the Mie government replaced the opaque and discretionary procedure with a transparent and rule-based one in order to qualify bidders. In the new procedure, suppliers are allowed to bid as long as they satisfy the minimum financial and technical requirements specified by the government. Thus, there is no scope for procuring officials to exercise their discretion. [3] The new practice substantially reduces the incentive for suppliers to bribe officials and thus weakens the collusion mechanism.

Through an analysis of supplier's bidding patterns, this paper examines the extent to which the improved transparency reduces government expenditure. It reveals that suppliers bid more aggressively under a transparent practice than under a discretionary one. The impact of the improved transparency on winning bids is greater at the upper quantiles of the distribution of bids than at the lower quantiles. The paper concludes that the improved transparency saved the

[1] The 2003 meeting of the WTO Ministers in Cancun failed to deliver a consensus, and the WTO Council decided in July 2004 at Geneva that these issues were not prepared for negotiation.

[2] We use the terms "discretionary" and "opaque" interchangeably to describe the conventional procurement procedure.

[3] We use the terms "transparent" and "rule-based" interchangeably to describe the new procedure.

Mie government a maximum of three percent of their annual procurement expenditure. This is equivalent to annual cost savings of only 50 million JPY, or below half a million USD.

Why does the introduction of transparency in procurement practices result in a marginal amount of saving in government expenditure? Based on our analysis of residuals obtained from the estimated bidding function, we conjecture that this is because collusion continues to exist even under the new procurement regime. The presence of collusion is not surprising; the Mie government institutes a system similar to that of exclusive territories and protects local suppliers against the entry of suppliers from outside the jurisdiction. This system facilitates repeated interaction among local suppliers without the fear of new entrants and breeds conspiratory practices. Indeed, it has been known that bid rigging — *Dango* for Japanese word — is widespread in awarding public-works projects in Japan (McMillan, 1991; Woodall, 1996). The analysis of the residuals also indicates that the improved transparency weakens the stability of the collusion. This finding is consistent with and suggestive of the existence of corruption: The procuring officials, who are being bribed by the ring members, use their discretionary power to punish deviators on behalf of the ring. Since suppliers cannot participate in the bidding without being qualified by the officials, the latter use their discretionary powers to effectively facilitate the ring's activities.

To our knowledge, this paper is the first work that empirically confirms theoretical implication as to the effect of corruption on competition in auctions. Compte et al (2005) and Lambert-Mogiliansky and Sonin (2006) show independently that collusion may emerge in equilibrium in auctions conducted by a corrupt auctioneer. In their model, the auctioneer has discretion to secretly allow firms to readjust their bids prior to the official opening. Self-interested abuse of this discretion to extract rents (i.e., corruption) provides a mechanism to enforce collusion. The theoretical implication remains the same in our application where auctioneer's discretion is to allow firms to submit bids. We extend their intuition to a collusive environment under Mie's "exclusive territory" system and claim that the effect of improved transparency (and thus less abuse of self-interested discretion) is to force the ring to lower its price; otherwise, the collusion would collapse because of deviators who lower their price to seek short-term profit. Our empirical analysis identifies a reduction of approximately three percent of winning bids.

Empirical studies on the detection of collusion, including Porter and Zona (1993; 1999) and Pesendorfer (2000), use evidence revealed at court cases regarding bid-rigging operations. The market that we are studying had neither been accused of nor is under investigation for criminal activities. However, this should not be taken as evidence against collusion and corruption. In the past, the Fair Trade Commission in Japan (hereafter, JFTC) was characterized by lax enforcement and weak penalties for antitrust violation against corruption and conspiratory practices, and the effectiveness of the implementation of the Japanese competition law has been doubtful.[4] We follow the method proposed by Porter and Zona (1993; 1999) and elaborated by Bajari and Ye (2003), and base our inference of market competitiveness on bidding data. The evidence in this paper suggests that collusion existed in the market, and it weakened on the introduction of transparent practices. Although our finding is a poor substitute for the evidence obtained using wiretap or the confession by a dissident ring member, the paper provides useful insights on the manner in which a procurement institution influences the market structure.

At this point, it is useful to clarify the meaning of the terms "discretion" and "transparency" in comparison with the notion of "discrimination" in the qualification procedure. In the context of this paper, the notion of discrimination implies that the government employs one or more commercially irrelevant characteristics of a bidder in the qualification procedure. The difference between discretion and transparency in the qualification process depends on the extent to which the qualifying criteria are codified and made publicly observable. Thus, discretion and discrimination refer to different aspects of the procurement process. In this paper, we focus on the difference between the practices in which the qualification procedure is based on codified criteria (i.e., a transparent procedure) and in which it is based on the official's discretion such that it is not codified (i.e., discretionary procedure). [5]

The remainder of this paper is organized as follows. Section 2 documents the features of the local government public-works procurement that have an important bearing on our estimation framework. This section describes the main focus of this paper — the change in the procurement procedure — along with other critical features of the procurement rule. Section 3 delineates the estimation framework employed in measuring the impact of the implementation of transparency in public purchasing. The section also reports estimation results. Section 4 presents the conclusion.

[4] Miwa and Ramseyer (2005) discuss the enforcement and monitoring problems of the JFTC. Under the new leadership of Commissioner Chairman, Kazuhiko Takeshima, the JFTC began enforcing the law. In the year of 2006, three governors and more city mayors were arrested by independent bid-rigging scandals. Detailed evidence uncovered during investigations shows that corrupt politicians and procurement officials arbitrated collusion in the allocation of contracts.

[5] Let us clarify the difference by citing an example from another procurement practice used by the Mie government. As discussed in the next section, the Mie government employs a system that is similar to that of exclusive territories to protect suppliers from new entrants. Under this system, the government compels each supplier to bid and procure only from the same district in which its headquarter is located. The exclusive territories are discriminatory such that they introduce asymmetric treatment across bidders in terms of their locations. However, the exclusive territories are transparent in that the rule is explicitly codified and publicly known.

2 Public Procurement Procedure in Japan

This section provides an overview of the public-works procurement system in Japan. It begins with a description of the discretionary procurement procedure that prevails in Japanese public-works auctions. It illustrates another element of procurement practice — exclusive territories — adopted by Japanese governments involved in procurement. The discretionary practice, combined with exclusive territories, provides an ideal breeding ground for collusion and corruption. The procurement practice described in this section will help us to formulate an empirical strategy to analyze bidding behavior. This section also presents the summary statistics of our data set, which has an important bearing on the estimation in the subsequent sections.

2.1 Overview of the Government Purchasing System

A government purchases a variety of goods and services. This paper focuses on the procurement of public works, a major component of public procurement around the world. [6] In Japan, the central and local governments are required to solicit bids and award public-works contracts to the lowest responsible bidders under the first-price sealed-bid auction. According to statutes and case laws, "responsible" implies being financially and technically capable of executing the terms of the contract. Many industrial countries, including Japan, specify qualifications of suppliers in order to screen responsible bidders. The qualifications usually include criteria regarding production performance, the number of employees in its work force, and the amount of its capitalization.

National procurement policies cover a number of objectives. While the main concern is usually the acquisition of the required goods and services on the best possible terms, other objectives involve promoting certain industries, protecting national securities, and favoring local suppliers through redistribution. Japanese procurement regulations place a substantial emphasis on allocation of resources to local suppliers. This concern creates two additional qualifications unique to Japan that relax the competition among local suppliers.

The first qualification resembles the practice of exclusive territories. A procuring entity in Japan divides its jurisdiction into several districts, and compels each supplier to bid and procure only from the same district in which the supplier's headquarter is located. The Mie government in our study divides the prefecture into eleven districts, as indicated in Figure 1. By implementing this rule, the government successfully prevents the entry of suppliers from outside the district and procures only from local suppliers within the district. This qualification results in a loss of efficiency because the opportunity of procuring from more efficient suppliers outside the prefecture's jurisdiction is lost and the intensity of competition is reduced. Furthermore, the repeated interaction among local

[6] As of 2002, public works accounted for 2.5 percent of the GDP in the United States, 3.3 percent in France, and 4.7 percent in Japan (OECD, 2004).

suppliers, without the fear of new entrants, would be an ideal ground for breeding conspiratory practices. Bid rigging, known as *Dango* — a negotiation conducted among bidders to decide which firm should be awarded the job (McMillan, 1991) — is considered to be widespread in the awarding of public works contracts. It is presumed that the exclusive territories system plays a major role in preserving the *Dango* practice.

The second qualification intends to provide extra protection to local suppliers, particularly to small-scale ones. Since the actual implementation of the second qualification varies among procuring governments, we use the Mie government as an example to explain this qualification. The Mie government regulates that, for a project worth 70 million JPY (approximately half a million USD) or less, the government should choose qualified bidders at its own discretion, and that the project should be procured by small-scale suppliers. The practice of the government exercising its discretion is beneficial to the suppliers because the government is able to limit the number of qualified bidders and thus suppress bidding competition. It is presumed that the practice also provides incentives for suppliers to bribe officials in return for their bidding qualification, and it is possible that the officials exercise their power of discretion to encourage suppliers to do so. Furthermore, this practice can encourage suppliers to form a cartel in an attempt to relax the bribe competition. The discretionary procedure of small-scale public works projects was abolished in mid 2002 and replaced with the existing rule-based transparent procedures that are applied to projects worth more than 70 million JPY.

This paper studies the second qualification and examines how the introduction of transparency in procurement practices affects the bidding behavior of a project that is worth a maximum of 70 million JPY. Note that the exclusive territories system is imposed on the projects in this range. Therefore, our empirical results regarding the effect of improved transparency depend on the existence of exclusive territories. [7] We will describe our data set in the following section.

2.2 The Data

The data used in our analysis is obtained from the Mie government. The Mie Prefecture is located in the center of the Japanese main island (see Figure 1) with a population of less than two million. The data contain information on all public-works projects offered for bid letting by the government from May 2001 to March 2004. These projects include construction on rivers (14.9), ports (10.2), roads (41.8), bridges (2.2), sewage (1.9), and erosion and torrent control works (23.8). The numbers in the parentheses indicate the percentage of the number of public-works projects in our data. Projects are auctioned off on an average of 16 lettings per month on an irregular basis. To account for differences

[7] We need a structural estimation approach to analyze the effect of exclusive territories. Due to the reasons discussed in the next section, the analysis of exclusive territories is beyond the scope of this paper.

in project types, we include project-specific dummy variables in the empirical implementation described in Section 3. The Mie government, like other Japanese procuring entities, uses a sealed-bid auction where a low bid is generally awarded a contract: The government rejects unreasonably low bids, [8] and those that exceed the ceiling price, or government's estimated contract price for the project.[9] The ceiling price is made public only when a winner is awarded a project. No considerations are placed on the quality nor features of the proposed work.

This paper focuses on public-works contracts worth a maximum of 70 million JPY. A large portion of public-works letting falls into this category, accounting for 73 percent in terms of the number of lettings and 50 percent in terms of the value of all the lettings announced by the Mie government during the study period. The Mie government employed the discretionary procedure for these projects until May 2002 and later replaced it with the transparent procedure.

With regard to each public-works contract, we are aware of the identity and bid of each participating bidder, the winner, and the characteristics of each project that was put out to in the tender. Table 1 presents important statistics in the data classified by procurement procedure. [10] The average auction conducted under transparent practices receives 15.8 bidders, approximately twice as many as those conducted under discretionary practices (8.9 bidders). As mentioned in the previous subsection, in contrast to the discretionary practices under which the number of bidders is limited to less than or equal to fifteen, the government did not restrict the number of bidders under transparent practices. There were a total of 328 actual bidders (i.e., suppliers who actually participate in the bidding) — an eighth of the number of potential bidders (2680) identified by the Mie government, which updates the list of potential bidders annually. Of the potential bidders, 12 percent entered and 20.3 percent exited the market during our study period. We use the information on potential bidders when controlling for sample selectivity in the estimation section.

Table 1 divides the information into three categories: characteristics of bidders, characteristics of auctions, and auction outcomes. The characteristics of bidders do not differ significantly between the practices. The Mie government provided the locations of the bidders' headquarters and each public-works project. Figure 1 presents the spatial distribution of the locations. As noted in the previous section, the Mie government divides the prefecture into eleven districts and enforces each

[8] The government excludes from participation in a procurement all suppliers that submitted tenders with prices below the secret minimum price. This system prevents suppliers from being awarded a contact at a price that is excessively low and may result in inferior construction work. The value of the minimum price is disclosed when the contract is awarded. We control the existence of the minimum price on the basis of the bidder's participation decision in our empirical analysis.

[9] The government runs a second auction when all bids are above the engineering estimate.

[10] This paper focuses on solo bids and excludes bids made by joint ventures. Joint ventures are often observed for large-scaled projects, which are not the focus of the paper. When constructing the variables of backlog and utilization rate, we consider the bidder's committed work not only from solo contracts but also from joint-venture contracts.

bidder to bid and procure only from the same district where its headquarters are located. For each bid, we calculate the great circle distance between the locations of the bidder's headquarter and the project site.[11] The calculated distance serves as a proxy for construction cost because a small supplier usually brings its own heavy machines to the project site from its storage located on the premise of the headquarter.[12] This variable is also used in other empirical studies on bidding patterns, such as the studies conducted by Bajari and Ye (2003) and De Silva et al (2003).

The utilization rate is defined as the supplier's current job backlog divided by its capacity. The job backlog is calculated as the total value of the projects undertaken by the firm at the time of the bidding. For each contract awarded, our data include the contract value in yen and the length of the contract in days. We assume that each project is completed at a uniform speed over the period of the contract. [13] We aggregate the values of the backlog of projects, including joint-venture projects.[14] Firm's capacity is defined as the maximum backlog carried by the firm in our study period. The calculated utilization rate of a firm thus differs with time. In fact, the regression of the utilization rate on supplier-specific dummies shows that the variation between suppliers explains merely 24 percent of the total variation of the utilization rate. Therefore, the manner in which the utilization rate affects bids is not evident. With regard to low utilization rates, an increase in the rate would decrease the production cost and consequently the submitted bid level. However, since capital is fixed at any given time, at high utilization rates, diminishing returns to scale must begin to occur.

In the Japanese public-works sector a system of government ratings has been established. This system is important because the rating determines the project size for which a firm is allowed to bid. The government rating system involves a sophisticated process that takes into account the contractor's financial condition, credit line, paid-in capital, management structure, past history of similar projects completed, and the number of engineers employed. In general, the Mie government revised the individual rating annually during the study period. A majority of the bidders included in our study received ratings lower than 1000, indicating that they are not large suppliers and are

[11] The great circle distance between the two points with coordinates ($a1$, $b1$) and ($a2$, $b2$) is calculated as (See for example http://williams.best.vwh.net/avform.htm#Dist)

$$2 \cdot a \sin\left(\sqrt{\frac{\sin(a1-a2)}{2}}\right)^2 + \cos(a1) \cdot \cos(a2) \cdot \sin\left(\left(\frac{b1-b2}{2}\right)^2\right)$$

[12] Although official statistics are unavailable, interviews with officials in the Mie government revealed that the use of leased machines was not popular during the study period.

[13] The utilization rate estimates reported in the next section are similar under the alternative assumption of no depreciation until the end of the contract.

[14] While calculating the backlog of a joint-venture project, we divide the value of the joint-venture contact by the number of firms participating in the project.

permitted to bid for public works whose worth is equal to or less than 70 million JPY. Suppliers with ratings higher than 1000 would not usually be allowed to procure projects in this size range.

The variable of past wins is constructed as the ratio of the past number of wins to the past number of bids at the timing of bidding. This variable captures two aspects of the bidder's characteristics: difference in efficiency and difference in skill across bidders. The first aspect indicates that bidders with more past wins submit lower bids, while in contrast, the second aspect indicates that bidders with more wins submit higher bids because they are capable of undertaking more difficult tasks that other bidders cannot perform. The sign of the estimated coefficient would indicate which aspect of the variable is more relevant to our data.

Sales characteristics do not differ between the procedures. On an average, the construction size is less than 50 million JPY, and the average length of the contract is more than five months. The major type of public works is road construction, followed by river works and port construction works. One interesting question from the econometrics viewpoint is the possible endogeneity of the project size. This concern arises when procuring officials are indeed corrupt. Note that the discretionary practice applies only to small-scale projects. Hence, to maximize the opportunities of receiving bribes, the officials would have an incentive to split a large project into pieces, so that each piece is classified as a small-scale project. Indeed, Mauro (1998) finds evidence that corruption distorts government spending toward the items prone to bribery. We discuss this issue of endogeneity in the next section.

While the average value of bidders and sales characteristics are similar between the two practices, clear differences emerge in the auction outcomes. The average bid and the winning bid, both normalized by the ceiling price, are respectively three and four percent higher under the discretionary procedures than under the rule-based procedures. The Herfindahl index is measured by each bidder's fraction of the sum of public works won (in values) during the study period. The index indicates that the auctions under the discretionary procedure are twice as concentrated as those under the rule-based one, suggesting that the former procedure substantially restricts the number of bidders.

In order to examine whether contractors under the transparent procedure bid more aggressively than those under the opaque procedure, we compare the distributions of bids between the two procedures. Figure 2 presents the cumulative distribution of the winning bids. The figure indicates that low bids are likely to be submitted under the transparent procedure than under the opaque one. The relation of the first-order stochastic dominance essentially persists for the entire range of values. The Kolmogorov-Smirnov test rejects the hypothesis that the two distributions are equal with a D statistic of 0.587.

Although the direct comparison of the winning bid distributions is informative, it may not be very meaningful. We have not yet controlled for the differences in the type of works and bidders, and the number of competitors. The concerns for the heterogeneity across projects and bidders, along with endogeneity in the competition effect could explain the observed difference in the distribution of the cumulative bids. The next section considers such econometric issues and measures the extent to which improved transparency affects bidding outcomes. [15]

3 Analysis of the Bidding Behavior

3.1 Estimation Model and Identification

This section examines the effect of improved transparency in procurement auctions on the bidding behavior. Based on the analysis of the bidding behavior, the section also estimates the extent to which the government decreases its procurement expenditure by the introduction of transparent practices.

There are two ways through which bidding behavior can be analyzed. First, we could develop a structural representation of an equilibrium bidding function by making specific assumptions that allow for the possibility of collusion and corruption. Alternatively, we could forego identification of structural parameters and approximate a bidding function as a reduced-form expression of exogenous auction and bidder characteristics that are observed among bidders and procuring officials. In principle, the first approach allows identification of the parameters of the bidding function and provides a complete description of the bidding behavior. Its main disadvantage is that restrictive parameterization is required in order to describe the supplier's bidding patterns. This problem is particularly grave in our application because we lack detailed knowledge regarding the structure of the market in which more than 300 bidders participated. Based on the description of the procurement market in the previous section, we suspect that the market can be collusive. As Porter and Zona (1993) argue, it is difficult to build a structural model of conspiratory behavior without a detailed account of the operation and bidding practice of collusion. Thus, we pursue the reduced-form approach in this paper to assess the role of improved procurement practice in bidding patterns.

We employ the technique used by Porter and Zona (1993) and Bajari and Ye (2003) that proposes methods to detect collusion from an independent private values model. The basic structure of the estimation model for bidder i, project c, and year t, is as follows:

$$y_{i,c,t} = \alpha \cdot Transparency_{c,t} + N_{c,t}\beta + X_{i,c,t}\gamma + \varepsilon_{i,c,t}. \tag{1}$$

[15] An easy solution is to regress bids on contract-, year-, and bidder-specific dummy variables. The obtained residuals can be regarded as idiosyncratic variations in bids. We split the residuals into two subsets corresponding to each of the two procurement procedure regimes. The cumulative distributions of the residuals, not shown in the paper, possess qualitatively similar features to those presented in Figure 2.

The dependent variable, $y_{i,c,t}$, is the logarithm of either a bid or a winning bid, normalized by the corresponding government's estimated contract price of the project.[16] As discussed in the previous section, the government rejects bids that exceed the estimate. Thus, the valid normalized bid must lie between zero and one. We use this dependent variable, because our preliminary analysis found that the coefficient of the contract-price estimate is economically and statistically equal to one when the logarithm of the bid is used as the dependent variable, and the logarithm of the corresponding government's estimated contract price is used as an explanatory variable, using the same set of other explanatory variables in (1). Since the dependent variable is normalized, the use of either the nominal or deflated bids does not affect our resulting estimates. The dummy variable, $Transparency_{c,t}$, is equal to one when project c is procured under the transparent procedure at time t, and zero when the project is under discretionary procedure. The number of actual bidders in the logarithm is denoted by $N_{c,t}$. This variable is designed to capture the effect of competition on the bids level. In the presence of collusion, we certainly do not expect this variable to affect the logarithm of bids. The other bidders and the auction characteristics described in Table 1 are included in $X_{i,c,t}$. The variables included in $X_{i,c,t}$ are considered to be cost variables and are often used in the estimation of the independent private values model, such as in the case of Porter and Zona (1993; 1999), Pesendorfer (2000), and Lee (1999). All continuous variables are expressed in logarithms. In order to account for the possible nonlinearity in the bidder's cost determinants, we include squared terms of the distance and utilization-rate variables. We include a set of dummy variables to control for the types of constructions along with a set of year- and district-specific dummies. We also include supplier-specific dummies in some specifications mentioned below. [17]

The $Transparency$ variable is included in (1) only in the intercept. The effect of the improved transparency on bids has to be measured by both this direct effect (i.e., the $Transparency$ dummy) and indirect effects (i.e., through the number of bidders and attributes of participating bidders). Therefore, in the preliminary analysis, we also interacted the $Transparency$ variable with the bidder's covariates and the number of bidders. We, however, found that most interacted covariates are found not significantly different from zero.[18] Thus, we drop the interaction terms in our base specification, and only focus on the direct effect of the improved transparency policy.

Apart from the sets of variables described in (1), important determinants of bids include the bidder's unobserved efficiency and the project's unobserved attributes. Such unmeasured determinants

[16] Alternatively, one can use the simple ratio of a bid (or winning bid) to the estimated contract price. Since no theory guides us on which specification should be used, we use the logarithmic form on the basis of better fit to the data, in the same way as Lee (1999) and Pesendorfer (2000) do.

[17] Unless mentioned otherwise, we do not include project-specific dummy variables because they perfectly explain the $Transparency$ variable.

[18] The variables that are statistically significant are the bidder's rating and past wins. However, this estimation result does not qualitatively influence our results in any significant way.

are represented by $\varepsilon_{i,c,t}$. The presence of this term creates two problems related to endogeneity — endogeneity in project size and in the bidder's participation.

Endogeneity in project size arises when procuring officials are indeed corrupt. Note that the discretionary practice applies to a small-scale project that is worth a maximum of 70 million JPY. Hence, in maximizing the opportunity of receiving bribes, the officials have an incentive to divide a large project into small pieces in order to ensure that each piece is classified as a small project. Indeed, the study by Mauro (1998), involving a cross section of countries, finds evidence that corruption distorts government expenditure toward the items prone to bribery. The distortion in the size composition of projects would create inefficiency because it is usually optimal to order a large-scale project rather than to divide it into small pieces. Thus, other conditions being equal, the bids are likely to be higher under the discretionary practice. The concern for this distortion creates a downward bias in the estimate of α.

In order to check whether this concern is acute in our application, we examine the distribution of project sizes for all the contracts auctioned by the Mie government during the study period, as shown in Figure 3. The project size is measured in terms of the government's estimated contract price. We anticipate that, in the presence of corruption, the number of small projects would be greater under the discretionary practice. However, the distribution of project sizes is the same before and after June 2002 when transparent practices were introduced. In fact, the proportion of the number of small projects to the total number of contracts increased from 72 to 76 percent. This observation contradicts the inference drawn from the findings of Mauro (1998). We conclude that the endogeneity in the transparency variable is not severe, and thus treat this variable as exogenous in the estimation of (1). However, note that the exogeneity assumption of the transparency dummy does not necessarily indicate the absence of corruption. This is because the officials in charge of qualifying bidders often differ from those in charge of allocating project sizes. It is plausible that the first group of officials finds it prudent not to work with the second group due to the increasing risk of being caught. However, the first group can have a smooth relationship with suppliers over a given set of small projects.

The concern of endogenous bidders' participation arises in the absence of collusion. Endogeneity emerges under both discretionary and transparent practices. Under the former practice, the government restricts the participation of bidders at its own command. The number of bidders is generally restricted to less than sixteen bidders. The endogeneity in participation arises if the government selects bidders based on the bidder's valuations and signals, instead of random assignment. Endogeneity is also a concern under transparent practices. Since the government uses a binding ceiling price, only bidders with favorable signals are likely to submit bids. While it is often claimed that the government's estimated contract price (i.e., the ceiling price) is set adequately high to ensure that suppliers receive generous profit margins, it is theoretically possible that the actual bidders in the data are drawn from the truncated distribution of potential bidders.

In empirical implementation, the concern regarding endogenous participation is made apparent by considering the expectation of (1) over the selected sample:

$$E\left(y_{i,c,t}|d_{i,c,t}\right) = \alpha \cdot Transparency_{c,t} + \left(\sum_{j \in I_{c,t}} d_{j,c,t}\right)\beta + X_{i,c,t}\gamma + E\left(\varepsilon_{i,c,t}|d_{i,c,t}\right),$$

where the selection indicator, $d_{i,c,t}$ equals one when supplier i bids for project c at time t. The set of potential bidders that bids for letting c at time t is denoted by $I_{c,t}$. Thus, $\sum_{j \in I_{c,t}} d_{j,c,t}$ is equivalent to the number of active bidders, $N_{c,t}$. If the selection indicator correlates with the bidder's unmeasured attributes, the last term of the above mentioned equation is not equal to the unconditional expectation, $E\left(\varepsilon_{i,c,t}\right)$, and thus correlates with the number-of-bidders variable. We assume that the latent variable that determines the participation decision is normally distributed with the bidding function error. We use the Heckit procedure to control for the self-selection bias in the estimation [19].

The validity of the selection-control model relies on the assumption of the normal distribution. A misspecified selection rule generates biased estimates. We expect that the misspecification most significantly influences the estimate of the coefficient in $N_{c,t}$ because this variable and the conditional expectation of $\varepsilon_{i,c,t}$ both contain a vector of selection indicators, $d_{i,c,t}$. In order to protect against the possibility of the selection model being misspecified, we supplement the Heckit model with the instrumental variable (IV) method to control the number-of-bidders variable. The IV method helps us assess the robustness of our estimates to the Heckit selection model.

The above discussion is based on the specification in (1). It is possible that a misspecified functional form of (1) leads to a biased estimate of α. In order to check the robustness of our results with regard to this functional form, we employ a method of matching the estimator to assess the effect of the improved transparency. In its traditional form, a matching estimator pairs each treated unit with an observationally similar control, thereby adjusting for the difference in the distribution of covariates. The calculated difference is interpreted as the effect of the policy (i.e., the improved transparency). In our application, however, due to a large number of explanatory and fixed-effect dummy variables, it is difficult to implement this straightforward matching method. Provided that the conditional treatment probability can be estimated using a parametric method, such as a probit model, the dimensionality of the matching problem is reduced to matching on the uni-variate propensity score. Let $P_i = \Pr\left(Transparency = 1|X_i, N_i\right)$ for simplicity (here we omit the subscripts c and t). A propensity matching is expressed as:

[19] In our empirical implementation discussed below, we consider the possibility that the selection rule differs depending on the procuring practices.

$$\widehat{\alpha}_{Matching} = \frac{1}{n} \sum_{i \in I^1 \cap S} \left[y_i^1 - \widehat{E}\left(y_i^0 | Transparency = 1, P_i \right) \right],$$

where

$$\widehat{E}\left(y_i^0 | Transparency = 1, P_i \right) = \sum_{j \in I^0} W(i,j)\, y_j^0.$$

Note that y_i^1 and y_i^0 are supplier i's bids under the respective treatment (i.e., transparency) and control (i.e., discretionary) practices, where the sets of suppliers corresponding to the respective practices are I^1 and I^0. The region of common support is denoted by S, and the number of suppliers in the set $I^1 \cap S$ by n. This method allows us to match solely on the basis of the predicted probability of selection into the treatment, instead of conditioning on a large number of variables included in (1). Thus, the propensity-score matching provides a practical method to break the curse of dimensionality for matching. In general, the match for each treated suppliers $i \in I^1 \cap S$ is constructed as a weighted average over the outcomes of control suppliers, where the weights $W(i,j)$ depend on the distance between P_i and P_j. Define a neighborhood $C(P_i)$ for each supplier i in the treated sample. The controls matched to i are those in the set $A_i = \left\{ j \in I^0 | P_j \in C(P_i) \right\}$. Matching estimators differ in the way in which the neighborhood is defined and the weights $W(i,j)$ are constructed. In this paper, we employ the simple nearest-neighbor matching:

$$C(P_i) = \min_j \|P_i - P_j\|$$

where $j \in I^0$. The control supplier with the value of P_j closest to P_i is selected as the match. We use several nearest neighbors and use their average as counterfactual outcomes in the next section.

We have thus far described the estimation methods to measure the average effect of improved transparency on the bids and the winning bids. The estimated average effects would not necessarily inform us of the changes in the distribution of bids caused by the introduction of transparent procurement practices. In order to analyze the effects on the distribution in bids, we estimate the quantile regression model of (1). We restrict the estimation to five quantiles of 0.1, 0.25, 0.5, 0.75, and 0.9. This estimation model would allow us to assess the magnitude of the effect according to the quantiles of the distribution of bids while controlling for other factors that contribute to the variability of bids.

3.2 Estimation Results

This section reports the estimation results of the effect of improved transparency on the bidding behavior. We present the estimation results indicating that improved transparency in procurement auctions lowers the levels of both the bids and the winning bids. This result is robust to concerns related to endogeneity and sample-selection and distributional assumptions. A strong effect is observed at the upper quantiles of the distribution of bids and winning bids. In this section, we find that the estimated impact of the improved transparency is approximately three percent on the winning bids or equivalent to an annual cost saving of only 50 million JPY. An analysis of residuals obtained from the bids regression implies that collusion existed but weakened when the qualification procedure became transparent.

Tables 2 and 3 show the regression estimates of the bids and the winning bids respectively. Heteroskedasticity-robust standard errors are used in the tables. With regard to all the specifications in Table 2, the Wald tests reject the hypothesis that all the estimates are zero. The data fit well for the models with supplier-specific components in the bids regressions. Although most coefficients are not precisely estimated, result (A) indicates that the bidders under transparent practices bid more aggressively than those under discretionary practices. This result could be influenced by unmeasured bidder characteristics. Thus, we estimate the model with supplier-specific dummy variables and report the results under (B). The effect of improved transparency remains significant at -0.03. The distance between the construction site and the bidder's location appears to increase the supplier's bids level. This finding is also consistent with that of other studies on procurement auction, such as the studies by Porter and Zona (1999) and Bajari and Ye (2003). The past-wins variable also positively correlates with the bids. This result may imply the importance of the supplier's skill in bidding patterns; more experienced suppliers tend to procure more difficult tasks than do inexperienced suppliers, and thus they are capable of charging skill premiums on bids. This finding is in contrast with that of De Silva, Dunne, and Kosmopoulou (2003), which suggests that the bids decrease with the past wins and associates this result with efficiency differences across bidders. Our finding regarding the estimates of past wins indicates that the effect of skill differences dominates that of efficiency differences in our bidding data.

Results (A) and (B) are based on the assumption that variation in the bidder's participation is exogenous, and both suggest that the number of active bidders has no statistical influence on the normalized bids. However, it is possible that active bidders are selected on the basis of their unmeasured attributes. The participation decision of bidders could be endogenous in case there exists a persistent relationship between the bidder's unmeasured attributes and the participation decision. This concern would invalidate the assumption of the OLS method used in our previous analyses. We use the Heckit correction procedure for the sample selection in specifications (C) and (D). As we discussed in Section 2.2, we are aware of the identity and characteristics of potential bidders. We estimate the probit and describe the entry decision of potential bidders. The set of covariates include the estimated contract price of the project, the minimum price, the distance between the project site and the bidder's location, and the contract period, along with dummy variables specific to project types and geographical districts.[20] Since it is plausible that the selection procedure differs between the discretionary and transparent practices, we also estimated the probit and construct the Heckit term for the respective practices. Since the estimated coefficients of the Heckit terms were not statistically different, we restrict the coefficients to be the same, and report the estimation results under (C) and (D). With the inclusion of these variables and under the assumption of normality, the bidding function estimates will be consistent even if the bidder's participation is endogenous. We find that the coefficients of $N_{c,t}$ remain insignificant in both the specifications, and the estimated coefficients of other variables are close to those under (A) and (B).

In order to check the robustness of the aforementioned results to the Heckit-selection-model assumption, we apply the instrumental variable on the specifications of (C) and (D) to directly control the number of bidders. In the first-stage regression, we regress the number of bidders in an auction on various covariates with a Poisson specification. Our regression specification includes the estimated contract price, minimum price, contract period, and dummy variables specific to project types, districts, and suppliers. The estimated number of bidders from this first-stage regression is used as an instrument for the number-of-bidders variable in (E) and (F). The results under (E) and (F) indicate that self selection on the error term is not very severe. The magnitude of differences in the estimated elasticities between the pair of (C) and (E), and that of (D) and (F), are not significantly different from zero.

Table 3 shows the winning-bids estimates. The supplier-fixed effect cannot be included in this regression because according to our data, merely 30 percent of the suppliers won the auctions more than once. The effect of improved transparency on the winning bids ceased to be significant for all specifications, in contrast to those in Table 2. The result of this insignificant average effect leads us to conduct quantile regressions later in this section and examine the policy effect on the distribution of winning bids. While the distance variable is now insignificant, the utilization-rate variable becomes significantly different from zero. At the average utilization rate of 10 percent, the winning bids increase at a decreasing rate as the job backlog increases. The winning bids are highest at a utilization rate of approximately 25 percent. At this rate, the bids are approximately 5 percent higher than those at the utilization rate of zero. The coefficient of the number of bidders becomes statistically significant but economically insignificant. For example, result (E) indicates that adding one bidder to the average bid letting would decrease the proportion of winning bids by merely a tenth of one percent.

Tables 4 and 5 present the quantile regression estimates for the bids and the winning bids,

[20] The minimum price is explained in footnote 8.

respectively. Five quantile regression results are reported in each table. The quantile regression helps us to analyze the changes in the distributions of the bids caused by the introduction of transparent procurement practices. Thus, the estimated policy effects reported in this paper are more detailed as compared to the results regarding the average effects. We use the same specification as (A) in the quantile regression. Due to the complex computation, the standard errors reported in the tables are unadjusted by heteroskedasticity.

At all the levels of quantiles reported in Table 4, the improved transparency reduces the bids by three percent. The firm's bids increase at a decreasing rate with an increase in the distance to the construction site. The bidder ratings decrease the logarithm of bids at the 25th percentile and beyond. The variable may serve as a proxy for the bidder's production efficiency. The number of bidders also decreases the bids level but at an economically insignificant level. The utilization rate is estimated to be negative on the 0.9 quantile but at a marginal significance level.

It is interesting to note that the model fit improves toward the upper quantiles of the distribution. The number of coefficients at the 95 percent significance level increases beyond the 50th percentile. A similar observation applies to the winning-bids regressions reported in Table 5. The effect of improved transparency significantly lowers the logarithm of the winning bids by two percent at the 0.5 quantiles and above. These quantile regressions show that the introduction of transparency lowers the winning bids by two percent at the upper quantiles of the bids distribution. Note that the policy effect averaged over the winning-bids distribution is not significantly estimated in Table 3. As the utilization rate increases, the winning bids initially increase and then decrease from the 0.25 quantile regression results. The winning bids are highest at the utilization rate of 17 percent. The number of bidders negatively correlates with the bids at the 0.25 quantiles and above. Other bidders' own characteristics are no longer statistically significant in these quantile regressions.

Table 6 summarizes the estimates of the transparency dummy mentioned above. The upper block of the table presents the average effect obtained from the results of the OLS, IV, and matching estimators. The bottom block presents the effect on the distributions of the bids obtained from the quantile regression results. For each block, the estimated effect on bids is presented in the first row, followed by the effect on the winning bids.

We have already discussed the OLS and IV estimates. In order to construct matching estimators (columns G and H), we first estimate, using probit, the probability of selection into the transparency regime with the same set of explanatory variables used in (A) and (B). We then compare the outcome (either the bids or the winning bids) of each auction c with the average outcome of the matched auction. Finally, we estimate the average effect of the improved transparency as the average of these comparisons. We employ four matches to construct the estimators. [21] The robust standard errors proposed in Abadie, Drucker, Herr, and Imbens (2001) are used for (G) and (H).

All the estimates of the average effect of the improved transparency on the bids are at the similar level of approximately -2.9 percent. The effects on the winning bids present mixed results: the effects obtained from the mean regressions are insignificant, whereas those based on the matching estimators are significant at the -2.3 percent level. A concern in the application of the mean regressions to the winning bids is that the bidder covariates associated with discretionary and transparent practices are considerably different, especially for the following three variables: distance to the construction sites (0.02 and 0.04), past wins (0.08 and 0.15), and the number of bidders (8.9 and 15.8). The first (second) number in the parentheses indicates the mean value of each variable under the discretionary (transparent) practice. In order to assess the impact of improved transparency from the mean regression, we have to rely on the functional form (1) to extrapolate the explanatory covariates. The matching estimator alleviates our reliance on the functional form by selecting subsamples using intermediate propensity scores. Thus, we prefer the results from the matching estimators for the measurement of the average policy effect on the winning bids. The concern of extrapolation is not very severe in the bid regressions because the covariates at the mean are similar between the two practices.

The estimated policy effects are observed more significantly on the upper quantiles of the bid distributions. The magnitudes of the effects on the bids differ by 20 percent when we compare the estimates at the 0.5 quantiles with those at the 0.9 quantile. The effect on the winning bids is significant only at the upper quantiles of the distribution. If the number of bidders is sufficient to control for the competition effect, the quantile regression results indicate the existence of a non-competitive market structure under discretionary practices. The negative coefficient on the policy variable suggests two competing hypotheses with regard to the policy effects: first, the introduction of transparent practices resolved the collusion, and second, it did not resolve but instead weakened the collusion. The latter hypothesis is not implausible because the exclusive territories system is in place, and the enforcement of the Fair Trade Commission has been weak in Japan. Either of the hypotheses predicts that the improved transparency has a larger impact on the upper quantiles of the distribution of the bids.

In an attempt to draw inferences on the market competitiveness in our study, we test for statistical independence in residuals obtained from the bids regression. Porter and Zona (1993; 1999) develop and Bajari and Ye (2003) elaborate an approach to test for collusion in procurement auctions based on the reduced-form bids function. We calculate the correlation coefficient for a pair of large suppliers and test for statistical independence of the pair of residuals by using

[21] We use the Stata program (match.ado) documented by Abadie, Drucker, Herr, and Imbens (2001).

the Fisher statistics. Under the null hypothesis on independent action, the information on the bids of a particular supplier should not help in predicting the bids of the other supplier. Under the alternative hypothesis of collusive action, knowledge that one cartel member bids above the predicted level helps predict whether other members will bid above that level. If one cartel member offers a high bid, then the other cartel members also tend to offer high bids. We focus on 30 large suppliers in terms of the number of submitted bids, and calculate the correlation coefficients of all the pairs of the thirty suppliers. We obtain residuals from the model (1) with year-, district-, supplier-, and project-specific components. We add project-specific dummy variables in this case because unmeasured project heterogeneity might generate a correlation between the residuals. While this specification is unsuitable when the transparent dummy estimate is emphasized, the inclusion of the project-fixed effects will help us control for the project characteristics unobservable to the econometrician. Note that we are able to calculate a correlation coefficient for the pair of suppliers who submit simultaneous bids on more than two occasions. The average pairwise correlation coefficients substantially differ depending on the procurement practice: it takes 0.75 under the discretionary practice, but 0.35 under the transparent practice. The Fisher statistics of the discretionary and transparent practices are 15.41 (20.36) and 21.54 (23.44), respectively, with the average number of observations within parentheses. This result indicates that the average pairwise correlation coefficients are significantly different from zero as well as from each other. We also expand the number of suppliers to 50, but the results are qualitatively similar to those with the smaller sample.

The test results of statistical independence in the residuals from the bid function are suggestive, albeit not conclusive, evidence for the presence of collusion and against the presence of competition. The ring would have bribed the procuring officials with pecuniary incentives or revolving doors, and used the discretionary qualification process as a device to punish deviators. Since suppliers cannot participate in the bidding process without being qualified by the government, this device could effectively facilitate collusion. Thus, the ring would have been able to maintain high winning bids without inviting deviation. When the government ceased the discretionary practice and replaced it with transparent and rule-based practices, the collusive mechanism became weaker in the absence of the officials' discretion. However, the absence of the official's discretion would not have eliminated the Dango practice under the protection offered by exclusive territories preserved by the Mie government.

4 Conclusion

Efficiency in government procurement is an important issue in cases where public procurement accounts for a large portion of economic activity. Government procurement ranges from eight to ten percent of the gross domestic product of major OECD countries, and this share is even larger in developing countries. [22] Ensuring transparency in the procurement procedure is an essential determinant of efficiency, as it enhances the competitiveness of public procurement. Opaque and discretionary procurement practices typically reduce incentives for firms to enter the market, and often engender the relationship between government officials and contractors. This can result in a substantial loss in the government's budget as the government has to pay an excessive amount and award contracts to undeserving suppliers.

This paper conducted an analysis based on a unique experience from the Mie government in Japan where discretionary practices were replaced by transparent practices in the qualification procedure. Under the discretionary practice, the Mie government used their discretion to decide on which the suppliers were qualified for the bid letting. This discretionary practice was often viewed as an opportunity for breeding corruption, supported by Japan's considerable history of bid rigging in the award of public-works contracts (see McMillan, 1991; Woodall, 1996, for details). Indeed, Japan exhibited a poor performance in terms of the control-of-corruption indicator, as estimated by Kaufman, Kraay, and Mastruzzi (2005). Among the twenty-four OECD countries, Japan is steadily descending in the anticorruption ranking; it slipped from 18th in 1996 to 20th in 2004. The introduction of rule-based and transparent practices in the qualification of bidders is expected to substantially weaken the smooth relationship between the officials and the suppliers. However, the estimated effect of improved transparency on the government expenditure is small. The reduction of the government's expenditure on procurement is estimated as merely two percent or an annual amount of 50 million JPY. This result is robust to concerns of endogeneity and sample selection, and distributional assumptions. The test of statistical independence on the residuals from the bids regression indicates the occurrence of collusion in our sample period. The collusion weakened but remained after the introduction of transparent practices. The findings of a marginal cost saving on the government procurement help us understand a reason for slow proliferation of transparency in public procurement practices. The paper's results indicate that the introduction of transparent practice is insufficient to warrant competitive public procurement. In order to enjoy maximum benefits from the reform toward transparency, countries simultaneously combat suppliers' conspiratory practices in the public procurement tendering system.

[22] The average government expenditure of OECD countries is approximately 20 percent of their GDP. This figure is calculated such that the government procurement meets the standard of the WTO Government Procurement Agreement. For further details, see Trionfetti, 2000.

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TABLE 1

Summary Statistics by Procurement Practice
Small-Scale Public Works
April 2001 - March 2004

	Discretionary	Rule-based	Differences
Year of Sale	Until May 31, 2002	Since June 1, 2002	
Number of Bids	945	1622	
Number of Auctions	220	177	
Number of Bidders	235	279	
Bidder Characteristics			
Distance	0.05	0.08	-0.03
	(0.047)	(0.065)	(0.005)
Utilization Rate	0.12	0.10	0.02
	(0.229)	(0.206)	(0.019)
Bidders Rating	887.20	898.52	-11.32
	(99.852)	(112.00)	(9.348)
Past Wins	0.14	0.11	0.03
	(0.238)	(0.107)	(0.017)
Auction Characteristics			
Avg Constr Size (in million yen)	49.60	46.90	2.70
	(16.40)	(17.40)	(2.349)
Contract Length (in days)	153.89	159.53	-5.64
	(72.12)	(111.48)	(12.99)
Type of Construction works			
% River works	0.18	0.11	0.07
% Port constr. Works	0.14	0.22	-0.08
% Road constr.	0.46	0.37	0.09
% Bridge constr. Works	0.04	0.06	-0.02
% Sewage works	0.02	0.05	-0.03
% Anti-erosion works	0.15	0.16	-0.01
Auction outcomes			
Number of Participating bidders	8.91	15.77	-6.86
	(0.511)	(6.62)	(0.645)
Normalized winning bids	0.91	0.87	0.04
	(0.078)	(0.104)	(0.012)
Normalized bids	0.95	0.91	0.03
	(0.051)	(0.068)	(0.002)
Herfindahl Index	0.06	0.03	0.04
	(0.107)	(0.056)	(0.012)

The table presents mean value of each variable, with the standard error inside parenthesis.
The public-works projects described in this table are worth 70 million JY or less per project.
Distance is calculated using the formulae discussed in footnote 11.
Herfindahl Index is is measured by each bidder's fraction of the sum of public works won (in values).

TABLE 2
Regression Results on Bids

	(A) OLS	(B) OLS	(C) Selection	(D) Selection	(E) IV + Selection	(F) IV + Selection
Supplier-fixed Effects	N	Y	N	Y	N	Y
Tranparency Dummy	-0.04 [a]	-0.03 [a]	-0.04 [a]	-0.03 [a]	-0.02 [a]	-0.02 [b]
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Distance	-0.08	0.22 [a]	-0.08	0.23 [a]	-0.06	0.22 [a]
	(0.09)	(0.09)	(0.09)	(0.09)	(0.08)	(0.08)
Squared Distance	0.12	-0.75 [a]	0.12	-0.78 [a]	0.02	-0.74 [a]
	(0.17)	(0.28)	(0.17)	(0.28)	(0.14)	(0.28)
Utilization Rate	0.02	-0.01	0.02	-0.01	0.02	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Squared Utilization Rate	-0.01	0.00	-0.01	0.00	-0.01	0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Bidders Rating	-0.01	0.21 [c]	-0.01	0.21 [c]	-0.01	0.21 [c]
	(0.01)	(0.12)	(0.01)	(0.12)	(0.01)	(0.12)
Past Wins	-0.02	0.04 [b]	-0.02	0.04 [b]	-0.02	0.04 [b]
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Number of Bidders	0.01	-0.01	0.01	-0.01	-0.02 [c]	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Contract Length	1.11 [a]	0.59 [a]	1.11 [a]	0.58 [a]	1.17 [a]	0.59 [a]
	(0.31)	(0.20)	(0.31)	(0.20)	(0.34)	(0.22)
Selection Control	-	-	0.18	-1.66	0.29	-1.29
			(1.12)	(1.27)	(1.09)	(1.21)
Constant	-0.05	0.03	-0.05	-1.64 [c]	0.03	-1.60 [c]
	(0.07)	(0.06)	(0.07)	(0.89)	(0.06)	(0.88)
F Statistics						
All Explanatory Variables	13.12 [a]	6.61 [a]	12.73 [a]	6.61 [a]	12.75 [a]	6.59 [a]
Districts Fixed Effects	8.62 [a]	2.54 [a]	6.89 [a]	2.34 [a]	8.70 [a]	2.51 [a]
Work-Types Fixed Effects	6.90 [a]	7.38 [a]	8.12 [a]	6.96 [a]	7.11 [a]	7.58 [a]
Suppliers Fixed Effects	-	6.12 [a]	-	6.13 [a]	-	6.13 [a]
R-squared	0.07	0.52	0.07	0.52	0.07	0.52
Number of obs	2542	2542	2542	2542	2542	2542

A heteroskedasticity-robust standard error is in parenthesis.
For expositional purpose, the coefficient of Contract Length is multiplied by 10000, and that of Selection Control is multiplied by 100.
Subscripts a, b, c indicate the 99-, 95-, and 90-percent significance levels.

TABLE 3

Regression Results on Winning Bids

	(A) OLS	(C) Selection	(E) IV + Selection
Tranparency Dummy	-0.02	-0.02	0.09
	(0.02)	(0.02)	(0.06)
Distance	-0.77	-0.69	-0.53
	(0.69)	(-0.73)	(0.64)
Squared Distance	-0.23	-0.51	-1.92
	(2.74)	(2.83)	(2.89)
Utilization Rate	0.43 [c]	0.41 [c]	0.47 [c]
	(0.24)	(0.25)	(0.26)
Squared Utilization Rate	-0.84 [b]	-0.82 [c]	-0.97 [b]
	(0.43)	(0.44)	(0.47)
Bidders Rating	0.01	0.00	-0.02
	(0.10)	(0.10)	(0.10)
Past Wins	-0.01	-0.01	-0.02
	(0.06)	(0.06)	(0.06)
Number of Bidders	-0.06 [c]	-0.06 [c]	-0.23 [b]
	(0.03)	(0.03)	(0.10)
Contract Lengh	3.89 [c]	4.01 [c]	4.13 [c]
	(2.15)	(2.12)	(2.39)
Selection Control	-	-0.07	-0.05
		(0.08)	(0.08)
Constant	-0.07	0.06	0.53
	(0.67)	(0.69)	(0.74)
F Statistics			
All Explanatory Variables	1.76 [a]	1.84 [a]	1.57 [a]
Districts Fixed Effects	1.81	1.16	1.15
Work-Types Fixed Effects	1.25	1.64	1.18
R-squared	0.14	0.17	0.18
Number of obs	242	242	242

A heteroskedasticity-robust standard error is in parenthesis.
For expositional purpose, the coefficient of Contract Lengths is multiplied by 10000, and that of Selection Control is multiplied by 100
Subscripts a, b, c indicate the 99-, 95-, and 90-percent significance levels.

TABLE 4

Quantile Regressions for Bids

Quantiles	0.1	0.25	Median	0.75	0.9
Tranparency Dummy	-0.03 [a]	-0.03 [a]	-0.03 [a]	-0.03 [a]	-0.03 [a]
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
Distance	0.21 [a]	0.16 [a]	0.12 [a]	0.06 [a]	0.03 [b]
	(0.042)	(0.024)	(0.015)	(0.012)	(0.014)
Squared Distance	-0.37 [a]	-0.39 [a]	-0.26 [a]	-0.09 [a]	-0.08 [b]
	(0.137)	(0.078)	(0.056)	(0.028)	(0.033)
Utilization Rate	1.15	0.37	0.15	-0.49	-1.34 [b]
	(1.600)	(0.935)	(0.554)	(0.493)	(0.603)
Squared Utilization Rate	-0.48	-0.30	-0.34	0.31	0.96
	(1.986)	(1.196)	(0.709)	(0.628)	(0.732)
Bidder's Rating	-1.05 [b]	-0.34	-0.74 [a]	-0.89 [a]	-0.87 [a]
	(0.527)	(0.521)	(0.267)	(0.182)	(0.206)
Past Wins	-0.79	-0.36	-0.28	-0.01	0.95 [a]
	(0.889)	(0.540)	(0.310)	(0.269)	(0.324)
Number of Bidders	-0.93 [b]	-0.53 [b]	-0.53 [a]	-0.73 [a]	-0.76 [a]
	(0.395)	(0.252)	(0.150)	(0.137)	(0.181)
Contract Length	0.16	0.12	0.04	0.05	0.12 [a]
	(0.197)	(0.086)	(0.046)	(0.035)	(0.033)
Constant	-2.99	-3.08	2.07	4.86 [a]	6.09 [a]
	(3.633)	(3.560)	(1.866)	(1.323)	(1.571)
F Statistics					
All Explanatory Variables	34.38 [a]	21.41 [a]	63.08 [a]	101.42 [a]	96.09 [a]
Districts Fixed Effects	37.36 [a]	1.24	1.07	0.79	1.55
Work-Types Fixed Effects	18.01 [a]	7.95 [a]	17.96 [a]	21.25 [a]	9.32 [a]
R-squared	0.04	0.08	0.13	0.21	0.27
Number of obs	2567	2567	2567	2567	2567

A heteroskedasticity-robust standard error is in parenthesis.
For expositional purpose, the coefficients of Utilization Rate, Squared Utilization Rate, Bidders Rating, Past Wins, Number of Bidders are multiplied by 100, and the coefficient of Contract Length is multiplied by 10000.
Subscripts a, b indicate the 99- and 95-percent confidence levels.

TABLE 5

Quantile Regressions for Winning Bids

Quantiles	0.1	0.25	Median	0.75	0.9
Tranparency Dummy	0.01	-0.02	-0.02 [a]	-0.02 [a]	-0.02 [a]
	(0.181)	(0.013)	(0.004)	(0.006)	(0.006)
Distance	-0.59	0.02	-0.05	-0.09	0.05
	(4.074)	(0.316)	(0.081)	(0.136)	(0.161)
Squared Distance	-4.10	-2.02 [c]	-0.03	0.09	-0.27
	(13.614)	(1.191)	(0.279)	(0.497)	(0.558)
Utilization Rate	0.57	0.24 [c]	0.02	0.01	0.02
	(1.598)	(0.140)	(0.036)	(0.047)	(0.059)
Squared Utilization Rate	-1.01	-0.69 [b]	-0.07	-0.04	-0.08
	(2.997)	(0.280)	(0.069)	(0.079)	(0.101)
Bidders Rating	-0.38	-0.01	0.01	0.01	-0.01
	(1.044)	(0.074)	(0.018)	(0.026)	(0.028)
Past Wins	0.01	0.01	0.01	0.01	0.01
	(0.405)	(0.048)	(0.011)	(0.015)	(0.017)
Number of Bidders	-0.15	-0.06 [a]	-0.03 [a]	-0.02 [b]	-0.02 [c]
	(0.256)	(0.020)	(0.006)	(0.008)	(0.010)
Contract Length	5.22	2.01 [c]	0.49 [c]	-0.02	0.14
	(19.656)	(1.173)	(0.264)	(0.412)	(0.467)
Constant	2.70	0.08	-0.09	-0.08	0.05
	(7.106)	(0.509)	(0.125)	(0.178)	(0.195)
F Statistics (degree of Freedom)					
All Explanatory Variables	0.25	1.86 [b]	8.38 [a]	4.40 [a]	7.14 [a]
Districts Fixed Effects	0.02	0.22	0.44	0.03	0.45
Work-Types Fixed Effects	0.07	1.19	3.71 [a]	0.75	0.80
R-squared	0.21	0.10	0.14	0.14	0.14
Number of obs	242	242	242	242	242

A heteroskedasticity-robust standard error is in parenthesis.
For expositional purpose, the coefficient is multiplied by 100 on Contract Length.
Subscripts a, b, c indicate the 99-, 95-, and 90-percent significance levels.

TABLE 6

Estimated Effects of Improved Transparency on Bids and Winning Bids

OLS / IV / Matching Estimates

Estimation Method	A OLS	B OLS	C Selection	D Selection	E IV + Selection	F IV + Selection	G Matching	H Matching
Supplier-Fixed Effects	N	Y	N	Y	N	Y	N	Y
Effect on Bids	-0.045 [a]	-0.031 [a]	-0.042 [a]	-0.026 [a]	-0.024 [a]	-0.023 [b]	-0.033 [a]	-0.029 [a]
	(0.007)	(0.006)	(0.008)	(0.008)	('0.008)	(0.011)	(0.008)	(0.007)
Effect on Winning Bids	-0.018	-	-0.022	-	0.086	-	-0.023 [b]	-
	(0.024)	-	(0.020)	-	(0.061)	-	(0.011)	-

Quantile Regression Estimates

Quantiles	0.1	0.25	Median	0.75	0.9
Effect on Bids	-0.028 [a]	-0.026 [a]	-0.028 [a]	-0.029 [a]	-0.034 [a]
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
Effect on Winning Bids	0.010	-0.018	-0.022 [a]	-0.019 [a]	-0.018 [a]
	(0.181)	(0.013)	(0.004)	(0.006)	(0.006)

Specifications used in Quantile regression are based on (A).
Subscripts a, b indicate the 99- and 95-percent confidence levels.

FIGURE 1
Geographical Supply Concentration and Project Sites

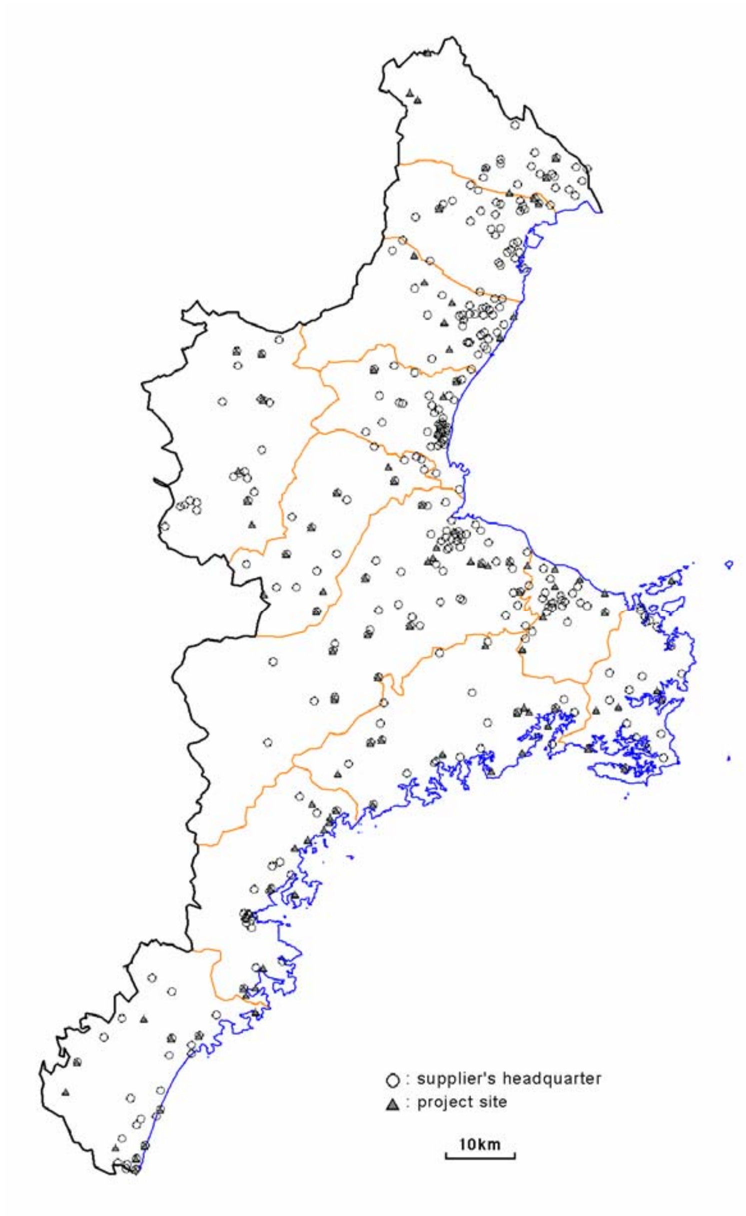
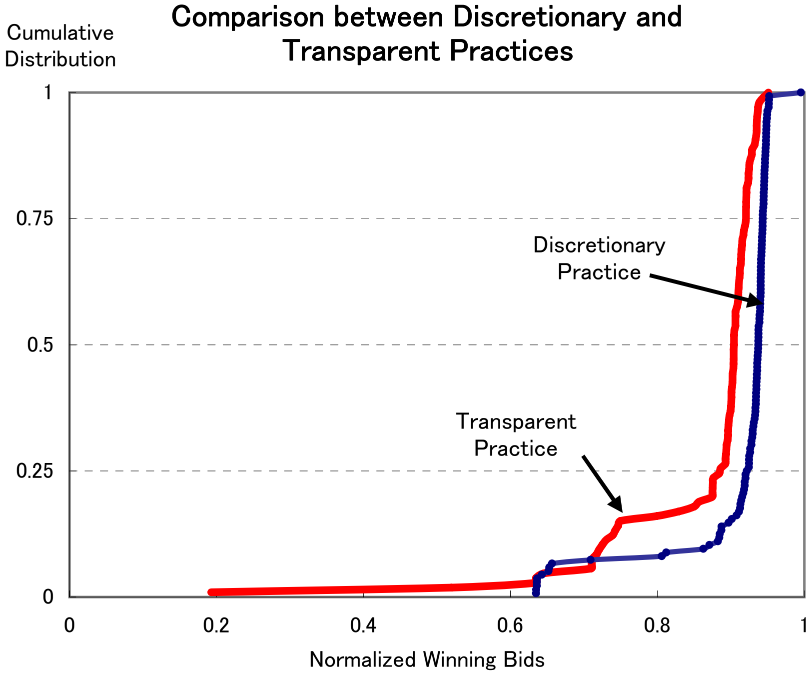
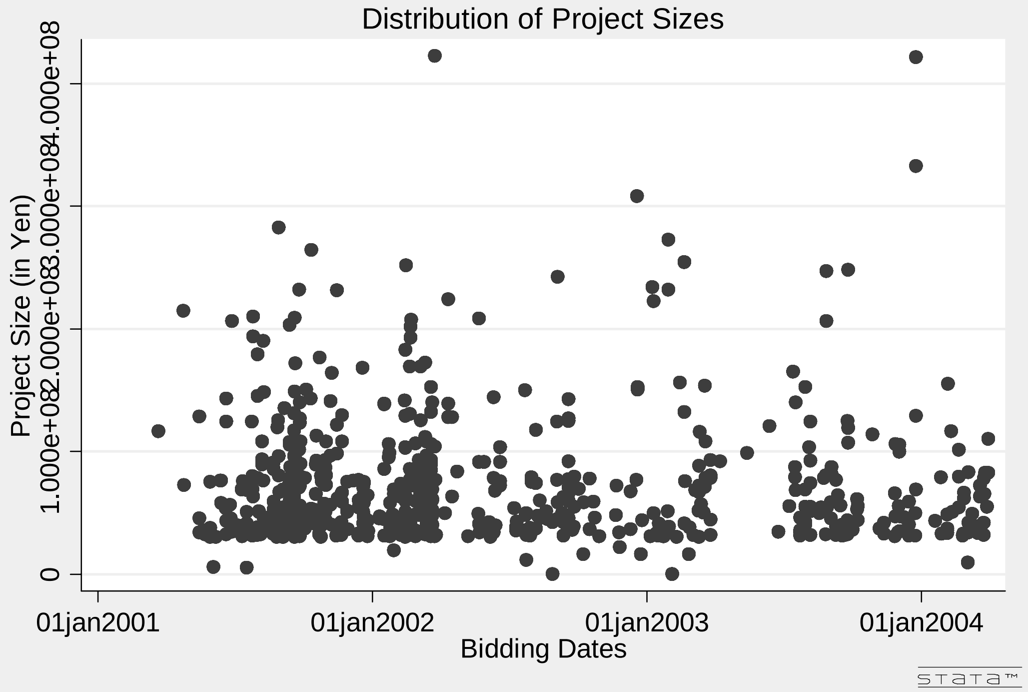


FIGURE 2
Cumulative Distribution:
Comparison between Discretionary and
Transparent Practices



Note:
The horizontal axis is defined by winning bid, divided by the corresponding government's estimated contract price.

FIGURE 3



Distribution of Project Sizes
Project Size (in Yen)
0
1.000e+08
2.000e+08
3.000e+08
4.000e+08
01jan2001
01jan2002
01jan2003
01jan2004
Bidding Dates
stata™