An empirical analysis about Japanese 'Dango'*

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1. Introduction

In Japan, it is well known that bid riggings, so-called "Dango", are pervasive in procurement auctions. The Japanese Fair Trade Commission (JFTC) took 37 legal actions in 2002 fiscal year, and 30 of them were related to the bid rigging and 7 related to others[1]. Thus, the most cases are associated to the Dango problem. Bid rigging is the firms' behavior to intend to raise the bidding price in concert through the firms' communication and to take collusive rents at the cost of the local government, and ultimately taxpayers.

Usually, bid rigging is illegal, it is taken as a case by the JFTC and ordered the firms associated with the rigging to pay the surcharge. To detect bid rigging, the JFTC uses as a clue the report from interested parties or articles from published magazines and newspapers. But recently, it tends to be difficult for the Commission to obtain such plausible evidence, since the related parties are taking more effort to hide their actions. In such circumstances, it is important for the JFTC to utilize data analysis to detect bid rigging.

In this paper, using the actual bidding data in procurement auctions organized by the Japanese local government, we attempt to identify the existence of bid rigging. To do this, we compare the collusive case and the competitive case by the econometric analysis for the data on bidding price, the target price, which is actually set as the price ceiling by the local government, and the data reflected by the characteristics of individual firms. If the behavior between the collusive case and the competitive case is

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[1] Japanese Fair Trade Commission (2004)

different, we could expect to identify which case fits the given data. Here, we implement this comparison by defining the data which is taken before the JFTC inspection date as the collusive data and the data after the JFTC inspection date as the competitive data.

Three cases from the construction procurement auction conducted by the Japanese local government are analyzed. The result is that it was observed that in the competitive case the bidding behavior tends to depend on the cost parameter of each firm, which is the proxy variable of the utilization rate of the each firm capacity, while in the collusive case there was no such tendency. This result could be interpreted that the competitive behavior would follow the rational behavior derived by the auction theory, that is the bidding reflects each firm's cost parameter, while in collusive case it is unnecessary for the dango members except winning bidder to take such rational behavior.

In section 2, we illustrate the outline of the empirical study. From section 3 to 5, we explain the outline of the case and show the result of empirical studies of three cases.

2. Method of Empirical Studies

In this paper, we analyze the collusive behavior and competitive behavior of local construction firms in procurement auctions by using econometric method to compare statistically the collusive data and competitive data.

The cases treated here were taken as the legal cases by JFTC, and they are all construction procurement work demanded by the Japanese local government through auction procedures. Data is divided into the collusive data set and competitive data set on the standard that before the inspection to take evidence for bid rigging by JFTC as the collusive and after the inspection as the competitive. Regression is conducted by taking the parameter thought to be firm's characteristics as the explanatory variables, and the index showing bidding behavior as the explained variable for the collusive case and competitive case. Actual explained variable is the ratio of bidding price to the target price, which we named bidding ratio. The target price is considered as the measure of each job scale, since it is usually computed as the estimation of the job by the local government, so we can normalize the scale of each construction job by dividing bids by the target price.

3. Case 1
3.1. Outline and Data

In this section, we examine the bidding for a construction work, which was

ordered by a local government A. Here, the procurement auction procedure were mixed with two systems. First, just the designated firms could submit the bids and second all qualified firm can submit the bids. But most jobs are conducted by the former method. Target price set by the local government is disclosed ex post before November 2000 and ex ante after November 2000.

Data we used here are related to the bidding for a construction work and about the characteristics of each construction firm. JFTC has conducted an on-the-spot inspection about 14 months before the last bidding of the sample period. According to the document of trial decision officially announced by JFTC, by the time the inspection was conducted, building constructors had been engaged in bid-rigging for 4 years. The number of sample firms is 24 and the total number of the sample of construction job is 58, 51 of them are bids by cartel firms, and 7 of them are bids by competitive firms. The variables used for the estimation are as follows; BID_{ij} as a bid price of the firm for the bid, EST_j as a target price by the local government, DIS_{ij} as distance between the work zone and the office of the firm for the bid, $UTIL_{ij}$ as the capacity utilization rate of the firm for the bid, CAP_i as the capital and $DUMBIDDER_{ij}$ as the dummy variable where it is 0 if the firm is a winner in the bid and 1 otherwise. $UTIL_{ij}$ is the proxy variable for utilization which is computed as the percentage index whose numerator is the three month sum of winning bid of construction job just before each construction job auction date in the prefecture B and whose denominator is the maximum number of the denominator size in the whole sample period.
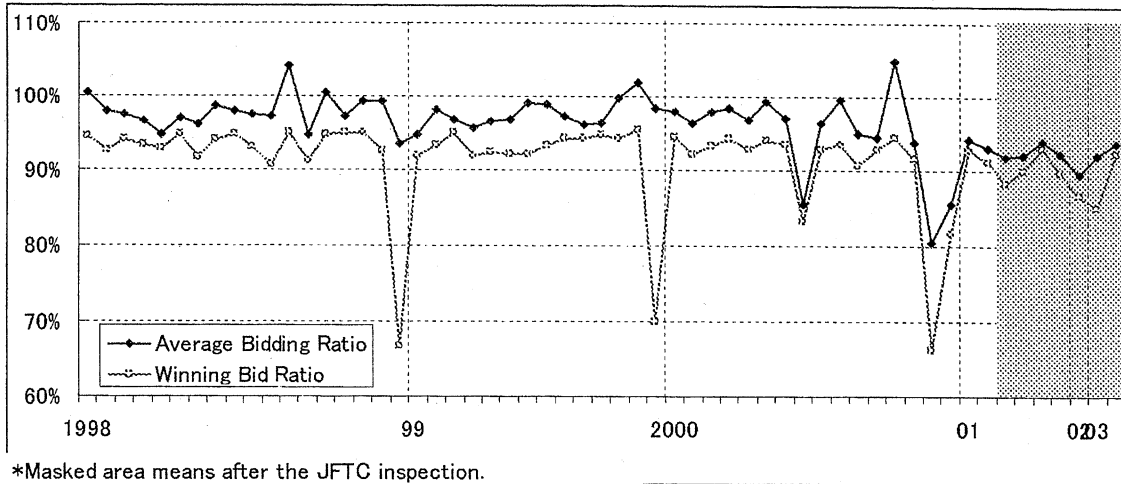
Characteristics of the construction firms are shown in figure 1 and figure 2 through descriptive statistics. Here, average bidding ratio means the average number of the ratio of each bid to target price for each construction job and winning bid ratio means the ratio of winning bid to target price, that is the minimum bidding ratio. Bidding variance means the variance of bidding ratio for each job.

Comparing the bids between those by cartel firms and those by competitive firms, both average bidding ratio and winning bid ratio tends to decline after the inspection of JFTC. The reason for the downslide of these variables seems to have been brought by the drop of the bid price caused by the drop off of the markups. The variance of the rate of bid price also tends to become lower after the inspection. However, the difference of the number of jobs between the inspection and the change to ex ante disclosing of target price is just 2, so it is difficult to identify of rationale of this decline of average bidding ratio, since if the target price is revealed ex ante, the firms do not intend to submit bids below this price, as the bid above the target price is excluded
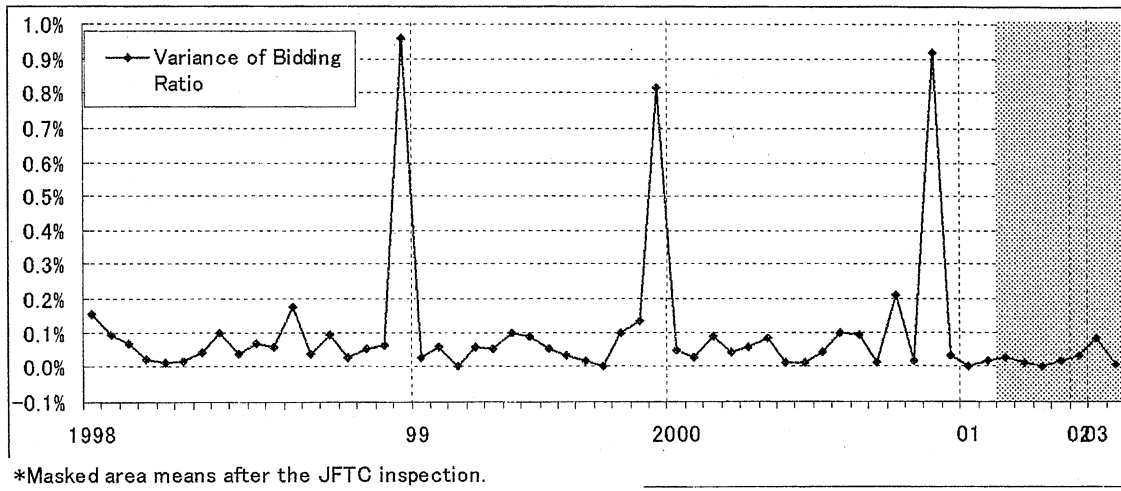
from the job. From this reason, actually, average bidding ratio is less than 100% after the date of this change of the target price revelation system.

As other observation from this statistics, closing to the end of fiscal year, the tendency of regular fall of the average bidding ratio and rise of bidding variance. Since this observation comes from the collusive data sample, the possibility of the tendency would be the occurrence of excess competition among the firms. But actual reason of this is unclear.

<Figure 1 >

*Masked area means after the JFTC inspection.

<Figure 2 >

*Masked area means after the JFTC inspection.

5

3.2 Model

We have estimated a regression model based on the following equation:

$$BID_{ij}/EST_j = \beta_0 + \beta_1 DIS_{ij} + \beta_2 UTIL_{ij} + \beta_3 CAP_j + \beta_4 DUMBIDDER_{ij} \quad \text{for bids by}$$

competitive firms and bids by cartel firms.

3.3 Results

The results of estimation are given in table 2. It is shown that the coefficient on UTIL is significantly positive in competitive bids, while they have no significant effects in bids by cartel firms. The result of estimation for competitive bids is consistent with auction theory[2], for it is interpreted that firms' pricing behavior is dependent on the change of their cost conditions. In comparison, the result that the collusive bid is not statistically significant with the utilization would be interpreted as the bids are not dependent on the cost condition of firms. The possible reason for this result is that since the collusive bidders predetermined the winning bidder, so it is unnecessary for their bid to depend on their cost conditions as rational behavior.

DIS also could be a variable to indicate firms' cost conditions, however, the variable was not statistically significant for both bids by competitive firms and bids by cartel firms. This would be because in Japan the distance between the firm and the job place is not so far that the cost is not so different.

The coefficient on DUMBIDDER was positive and statistically significant in both collusive and competitive data. The coefficient for bids by cartel firms is 6.72 (6.70 in panel estimation) and the coefficient for bids by competitive firms is 5.25 (5.14 in panel estimation). This means that winner's pricing is about 7% lower than those of other bidders in collusive data and about 5% in competitive data. Therefore, the bidders tend to submit higher bid compared with the winning bidder in collusive situation than in the competitive situation. One possibility of this difference is that in collusive situation bidders except winning bidder would submit the phony bid, so bid are likely to be higher than bids determined rationally. However, as we said earlier, the date of inspection and the date of change of target price disclosing ex post to ex ante are close, so the latter effect might derive this result.

From estimation results shown above, we can see the difference in pricing behavior between bids by cartel firms and bids by competitive firms. That is, competitive firms' pricing behavior tends to depend on their cost conditions (UTIL),

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2 About auction theory, refer to Krishna (2002).

while we cannot see such tendency for cartel firms.

<Table 1 >

case1						
	total		collusive		competitive	
	Plain OLS	PANEL	Plain OLS	PANEL	Plain OLS	PANEL
Dis	-0.01	-0.01	-0.12	-0.11	0.24	0.23
	-0.12	-0.09	-0.97	-0.94	1.07	1.05
Util	0.00	0.00	0.00	0.00	3.61	3.57
	-0.88	-0.87	-0.98	-1.00	2.41 (*)	2.35 (*)
Capital	0.00	0.00	0.00	0.00	0.00	0.00
	0.18	0.18	1.48	1.48	-0.76	-0.71
dumbidder	6.23	6.20	6.72	6.70	5.25	5.14
	7.11 (**)	7.09(**)	7.34(**)	7.41(**)	2.17 (*)	2.13 (*)
Constant	90.79	90.79	90.96	90.91	88.44	88.51
	99.34	98.50	93.65	92.76	35.21	35.12
observations	569		442		127	
r-squeared	0.08	0.08	0.11	0.11	0.06	0.06
number of id	31		16		21	

The lower number of each variable is t-value.

*significant at 5%; **sifnificant at 1%

4. Case 2

4.1. Outline and Data

In this section, we examine the bidding for a construction work, which was ordered by a local government C. In this case, the procurement auction procedure said just the designated firms can submit the bids. Target price have not been disclosed in all sample period.
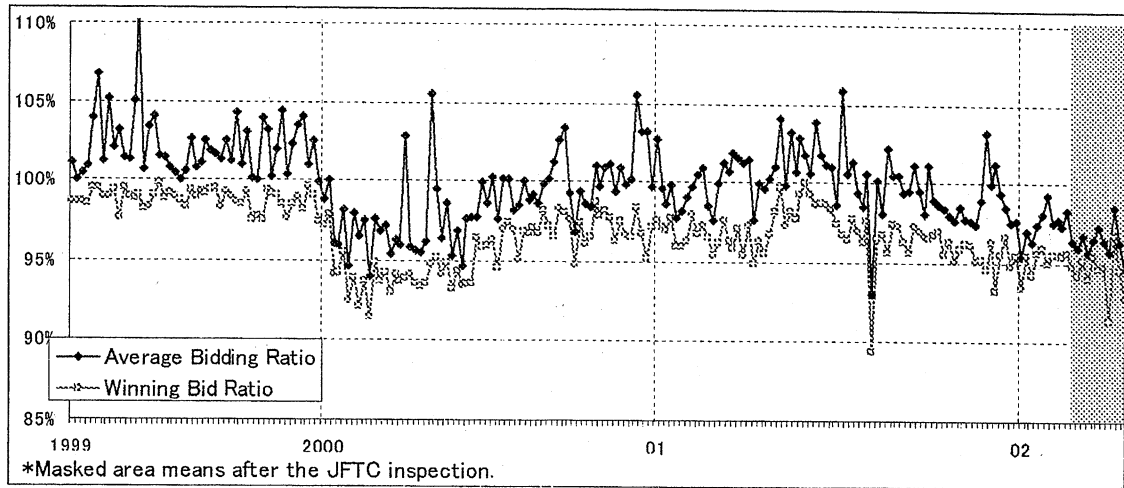
Data we used here are related to the bidding for a construction work and about the characteristics of each construction firm. JFTC has conducted an inspection about 1 month before the last bidding of the sample period. According to the document of trial decision officially announced by JFTC, by the time the inspection was conducted, building constructors had been engaged in bid-rigging for 3 years. The number of sample firms is 24 and the total number of the sample of the bidding are 206, 195 of them are bids by cartel firms, and 11 of them are bids by competitive firms. The variables used for the estimation are as follows; BID_{ij} as a bid price of the firm for the bid, EST_j as a target price by the local government, DIS_{ij} as distance between the work zone and the office of the firm for the bid, $UTIL_{ij}$ as the capacity utilization rate of the firm for the bid, and $DUMBIDDER_{ij}$ as the dummy variable where it is 0 if the firm is a winner in the bid and 1 otherwise. As for $UTIL_{ij}$, the variable is calculated according to the definition showed in case 1, by using order volume of the whole construction work in a local government D, which has broader definition than specific used for taking bidding data in this case.

Characteristics of the construction firms are shown in figure 3 and figure 4 through descriptive statistics. Comparing the bids between those by cartel firms and those by competitive firms, both average bidding ratio and winning bid ratio tends to decline after the inspection of JFTC. The variance of the rate of bid price also tends to become lower after the inspection. In this case, since there was no change in method of revelation of a target price, the reason for the downslide of these variables seems to have been brought only by the drop of the bid price caused by the drop off of the markups.
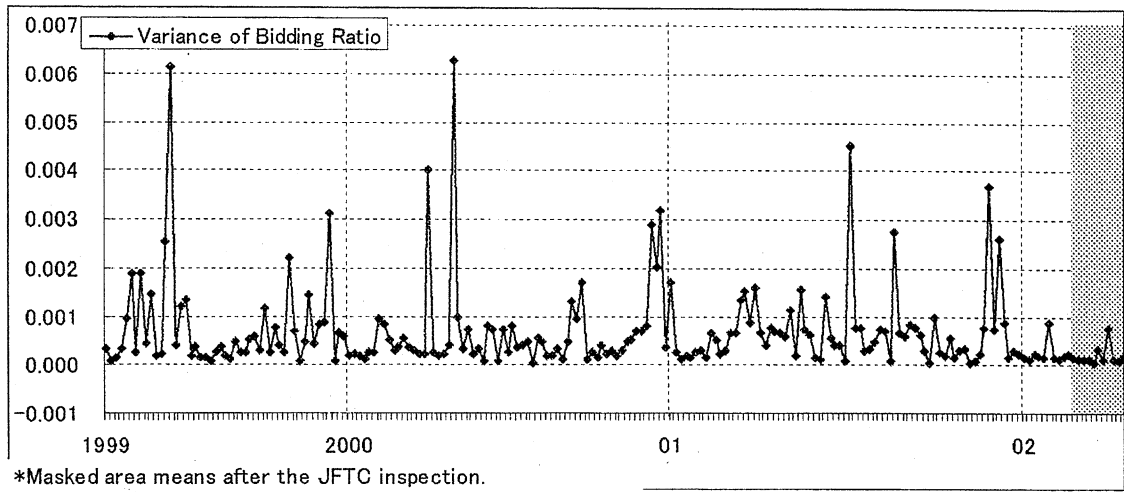
As other observation from these statistics in this case, there are characteristics of trends of bidding ration for each fiscal year. In 1999 fiscal year, significantly higher bidding ratio are observed than other fiscal years, in 2000 fiscal year the average bidding ratio and winning bid ratio progressively tend to increase, and in 2001 fiscal year both indexes seems to increase in the first half and to decrease in the last half. One possible reason for this trend may be that the composition of bidders is changed by the

9

local government. But actual reason of this is also unclear.

<Figure 3>

*Masked area means after the JFTC inspection.

<Figure 4>

*Masked area means after the JFTC inspection.

.11

4.2 Model

We have estimated a regression model based on the following equation:

$$BID_{ij}/EST_j = \beta_0 + \beta_1 DIS_{ij} + \beta_2 UTIL_2 + \beta_3 UTIL_{ij}^2 + \beta_4 DUMBIDDER_{ij} \quad \text{for bids by}$$

competitive firms and bids by cartel firms.

4.3 Results

The results of estimation are given in table 2. It is shown that the coefficient on UTIL is significantly negative and the coefficient on UTIL square is significantly positive in competitive bids, while they have no significant effects in bids by cartel firms. The result of estimation for competitive bids is consistent with auction theory, for it is interpreted that firms' pricing behavior is dependent on the change of their cost conditions. Furthermore, the direction of the coefficients of UTIL and UTIL square shows that the figure of the cost function is not linear but U-shaped. In comparison, the result that the collusive bid is not statistically significant with the utilization would be interpreted as the bids are not dependent on the cost condition of firms. The possible reason for this result is also that since the collusive bidders predetermined the winning bidder, so it is unnecessary for their bid to depend on their cost conditions as rational behavior.

DIS also could be a variable to indicate firms' cost conditions, however, the variable was not statistically significant for both bids by competitive firms and bids by cartel firms.

The coefficient on DUMBIDDER was positive and statistically significant in both collusive and competitive data. The coefficient for bids by cartel firms is 4.02 (4.00 in panel estimation) and the coefficient for bids by competitive firms is 2.75 (2.65 in panel estimation). This means that winner's pricing is about 4% lower than those of other bidders in collusive data and about 3% in competitive data. Therefore, the bidders tend to submit higher bid the winning bidder in collusive situation than in the competitive situation. Since in this case there was no change of disclosure of target price, this difference would be caused by that in collusive situation bidders except winning bidder would submit the phony bid, so bid are likely to be higher than bids determined rationally.

From estimation results shown above, we can see the difference in pricing behavior between bids by cartel firms and bids by competitive firms. That is, competitive firms' pricing behavior tends to depend on their cost conditions (UTIL), while we cannot see such tendency in cartel firms. In this case, we can also say that

the difference of price submitted between the winner and the others is larger in cartel firms than competitive firms.

<Table 2>

case: 2						
	total		collusive		competitive	
	Plain OLS	PANEL	Plain OLS	PANEL	Plain OLS	PANEL
dis	-0.01	-0.02	-0.01	-0.02	-0.02	0.05
	-1.03	-1.51	-1.46	-1.57	-0.97	0.41
Util	-0.56	-1.11	0.32	-0.10	-14.96	-9.43
	-0.57	-0.98	0.33	-0.09	-4.28(**)	-2.16(*)
Util²	1.19	1.77	-0.03	0.42	17.57	8.28
	1.09	1.42	-0.03	0.35	4.59(**)	1.76
dumbidder	3.87	3.85	4.02	4.00	2.75	2.65
	15.63(**)	15.34(**)	16.06(**)	15.67(**)	3.17(**)	6.09(**)
constant	96.68	97.05	96.75	96.95	96.72	
	337.37	246.44	333.71	271.60	100.76	
observations	1079		1006		73	
r-squeared	0.19	0.19	0.20	0.20	0.28	0.84
number of id	24		16		16	

The lower number of each variable is t-value.

*significant at 5%; **sifnificant at 1%
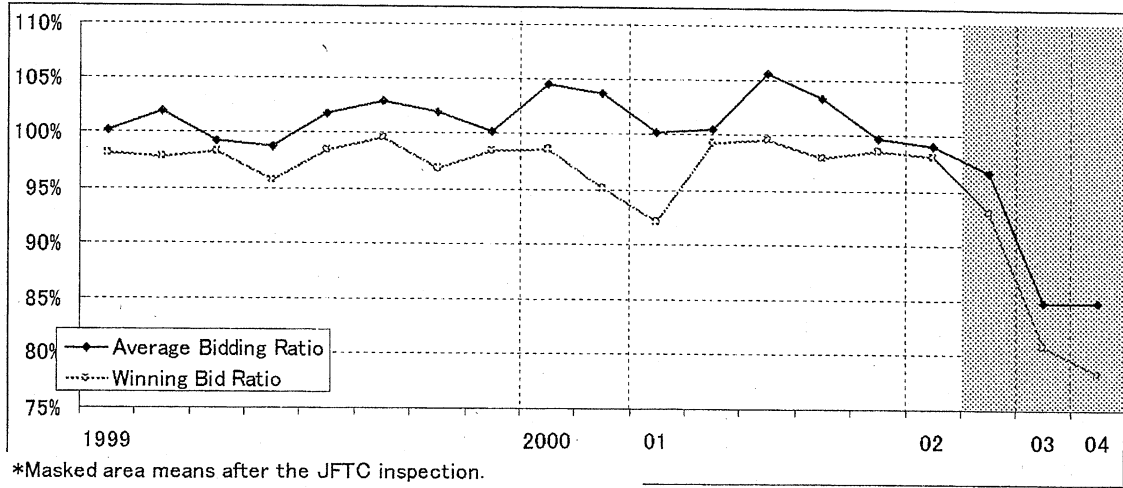
5. Case 3

5.1 Outline and Data

In this section, we examine the bidding for construction work, which was ordered by a local government D. In this case, auction procedure said that firms which announce the desire to get the job are more likely to become designated bidder who can submit the bid for the job, and there was no pre-disclosing of the target price during the examined period[3].

Data we used here are related to the bidding for construction work and about the characteristics of each construction firm. JFTC has conducted an inspection about 20 months before the last bidding of the sample period. According to the document of trial decision officially announced by JFTC, by the time the inspection was conducted, building constructors had been engaged in bid-rigging for 3 years and a half. The number of sample firms is 33 and the total number of the sample of the bidding job are 19, 16 of them are bids by cartel firms, and 3 of them are bids by competitive firms. The variables used for the estimation are as follows; BID_{ij} as a bid price of the firm for the bid, EST_j as a target price by the local government, DIS_{ij} as distance between the work zone and the office of the firm for the bid, and $UTIL_{ij}$ as the capacity utilization rate of the firm for the bid and $DUMBIDDER_{ij}$ as the dummy variable where it is 0 if the firm is a winner in the bid and 1 otherwise. As for $UTIL_{ij}$, the variable is calculated according to the definition showed in case 1, by using order volume of the construction work in a local government D.
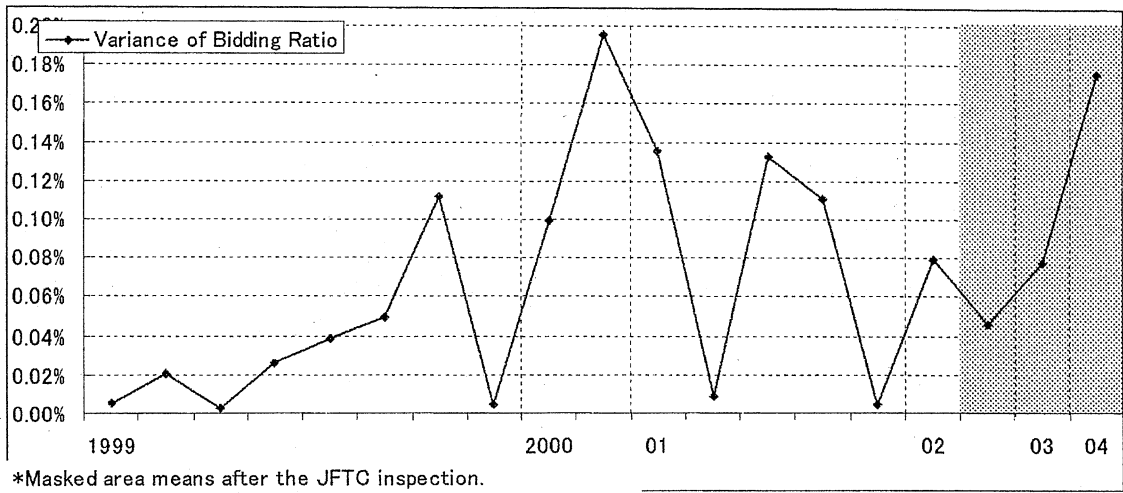
Characteristics of the construction firms are shown in figure 5 and figure 6 through descriptive statistics. Comparing the bids between those by cartel firms and those by competitive firms, both average bidding ratio and winning bid ratio are substantially declining after the inspection of JFTC. In this case, since there was no change in method of declaration of a target price, the reason for the downslide of these variables seems to have been brought only by the drop of the bid price caused by the drop off of the markups. As for the variance of the rate of bid price, its change is different from case1 and case2—it stays or rather goes up after the inspection for the bids by competitive firms. Given the fact that the specifics of construction work of case 3 is different from case 1 and case 2, there is a probability that this difference had a certain effect to the change in those descriptive statistics.

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[3] After the sample period, the disclosure of target price is changed from ex post to ex ante.

<Figure 5>

*Masked area means after the JFTC inspection.

<Figure 6>

*Masked area means after the JFTC inspection.

16

5.2 Model

We have estimated a regression model based on the following equation:

$$BID_{ij}/EST_j = \beta_0 + \beta_1 DIS_{ij} + \beta_2 UTIL_2 + \beta_3 UTIL_{ij}^2 + \beta_4 DUMBIDDER_{ij}$$ for bids by competitive firms and bids by cartel firms.

5.3 Results

The results of estimation are given in table 3. It is shown that the coefficient on UTIL is significantly negative and the coefficient on UTIL square is significantly positive in competitive bids, while they have no significant effects in bids by cartel firms. The result of estimation for competitive bids is consistent with auction theory, for it is interpreted that firms' pricing behavior is dependent on the change of their cost conditions. Furthermore, the direction of the coefficients of UTIL and UTIL square shows that the figure of the cost function is U-shaped. On the other hand, in bids by cartel firms, we can see no significance for both the coefficients of UTIL and UTIL square, same as in case 2. It suggests that firms did not take account of cost condition, such as UTIL, when deciding the bid price.

DIS also could be a variable to indicate firms' cost conditions, however, the variable was not statistically significant for both bids by competitive firms and bids by cartel firms.

The coefficient on DUMBIDDER was positive and statistically significant when estimated by panel estimation, while it was significant for cartel firms and not significant for competitive firms when estimated through pooled OLS estimation. The coefficient for bids by cartel firms is 3.96 and the coefficient for bids by competitive firms is 5.75. This means that winning bid ratio is about 6% lower than those of other bidders when focusing on bids by competitive firms. On the other hand, the winner's bidding ratio is about 4% lower when we look into the bids by cartel firms. Therefore, in this case, different from case 1 and case 2, the difference between the winning bid ratio and the other bidders' ratio are larger when competitive rather than when cartel is formed.

From estimation results shown above, we can see the difference in pricing behavior between bids by cartel firms and bids by competitive firms. That is, competitive firms' pricing behavior tends to depend on their cost conditions (UTIL), while we cannot see such tendency for cartel firms. In this case, we can also say that the difference of price set between the winner and the others is much larger in competitive firms than cartel firms, which is different from other cases.

<Table 3>

case: 5						
	total		collusive		competitive	
	Plain OLS	PANEL	Plain OLS	PANEL	Plain OLS	PANEL
Dis	0.00	0.00	0.00	0.00	0.01	0.01
	0.19	0.23	0.24	-0.13	1.46	1.11
Util	-2.03	-2.21	2.67	2.17	-25.76	-37.83
	-0.41	-0.44	1.02	0.86	-1.94	-3.66(**)
Util^2	3.68	4.03	-3.11	-2.72	29.16	41.20
	0.75	0.83	-1.22	-1.10	2.15(*)	3.90(**)
dumbidder	4.29	4.51	4.03	3.96	4.66	5.75
	2.95(**)	3.31(**)	5.27(**)	5.67(**)	1.32	2.14(*)
constant	95.30	95.15	97.92	98.07	86.91	87.06
	65.77	67.66	127.95	134.41	24.42	30.66
observations	177		144		33	
r-squeared	0.04	0.04	0.15	0.15	0.20	0.19
Number of id	38		33		21	

The lower number of each variable is t-value.

*significant at 5%; **sifnificant at 1%

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