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An Empirical Study on Korean Public-Works Contract Market: Public Policy Recommendation

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Preface

This research is the first rigorous empirical study to find some solid statistical evidence of collusion in auction and to gauge the possible effects of bid-rigging on auction prices in Korea. With limited information contained in the sketch bid data, we show that local construction firms enjoy statistically significant incumbency premiums in their incumbent sites. Competitors submit relatively high bids in incumbent sites so that an incumbent contractor can win a contract at a higher price in incumbent sites than in non-incumbent site. Thus, it is inferred that contractors engage in complementary bidding, in which all bidders, except one, submit high bids to lose. Utilizing the transition from cooperative regime to non-cooperative regime, we also estimate potential damage ratio of structural bid rigging in public-works contract by year and construction type.

To recover fully the antirust damage, Korean competition agency needs to develop a variety of statistical programs involving advanced damage estimation techniques. Because more accurately estimated damage and appropriate extra charge are imposed on firms accused of collusion in a market, then antitrust agency can more effectively deter firms from engaging in a bid rigging. In the long run Korean government

should revise the KFTA so that a private individual can easily raise antitrust damage suit.

Recently, the government announced that in principle it would gradually go back to the lowest price auction system. As earlier noted, starting from 2001, the lowest bid will win a contract for construction works more than 100 billion won in contract size. Gradually the coverage of lowest bid system will be extended to other projects. The extension of lowest price auction to other projects will depend on the successful establishment of supervision and guarantee system for the completion of construction. Government policy direction set on the lowest price auction system is in principle right. However, the lowest price auction system is highly likely to lead to dumping price and shoddy construction. The lowest bid system can be working well if and only if the surety certificate and supervision system is well equipped and strictly enforced. The issuer of surety certificate for the completion of construction should set up a fair and transparent standard to curb the dumping price. The letter of guarantee should not be issued if the contract price ratio is fall short of a bid price at least covering construction cost and normal profit. Construction supervision is strictly enforced toward shoddy construction, for which the concerning constructor is penalized in such a manner that it is barred from the bidding competition for a fixed period of time. Even in the case of inevitable cost overrun due to the change in construction draft, the government need to share the cost overrun with the

concerning contractor, just like risk-sharing contract. The fixed price contract with bidding competition should be generally applied to most projects, where-as the cost-plus contract with bidding competition should be exceptionally permitted.

The authors thank Youngsan Kim, Sung Wook Joh, and fellowes of KERI for their helpful comments and suggestions. It should be noted that the views contained in this study are not purported to reflect those of Korea Economic Research Institute.

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1) Kim (2000) and http://www.sarok.go.ku

1. Overview

By the application of the WTO/AGP (Agreement on Government Procurement), the construction market for the public sector in Korea was opened to overseas contractors since January 1, 1997, and tendering and contracting system is also being completely reformed and many deregulation and liberalization measures have been taken.[2] Tendering methods regulated by region and by the size of the contractors are being replaced by more competitive mode, and the use of lowest bidder contract system has increased.

The standard method of obtaining tender is to advertise an invitation to potential contractors to tender for the government work. Advertisements are made through massmedia, including newspapers and government gazette. This is known as open tendering. This method brings in any contractors who care to bid, and the lowest biddder will be chosen regardless of quality and performance. Therefore, the public agency which places an order may feel less trustworthy, and open tendering tends

2) Korea became a member of the Government Procurement Agreement (GPA) in 1996 and thus, for the government projects covered by the GPA, special act has been enacted to observe the international agreement. For projects larger than 5 million SDR (around 7.5 billion won) for the central government and 15 million SDR (around 22.5 billion won) for local governments and state owned enterprises, tendering process and winner selection method strictly follow the GPA code. Also construction related services in excess of 130 thousand SDR (around 0.2 billion won) for the central government and 200 thousand SDR (around 0.3 billion won) for regional governments must also follow the tendering process and winner selection method of the GPA code. Procurement of construction related services of the state owned enterprises is exempted from the application of the GPA code.

to lead to a wasteful multiplication of tendering, the cost of which, in the long run, is borne by the clients.

Common practice is to modify the procedure and to invite tenders only from a selection of firms that meet the minimum qualification standards and also who are acceptable to the client (e.g., pre-qualification system, pre-determined eligible list).[3] While this method reduces the cost of tendering to the industry and ensures acceptable tenders, it is subject to certain disadvantages. Above of all, the number of bids may be reduced and this could raise the overall price. Also where the contractors are limited in this way it will be more difficult for new firms to enter the market. Moreover, when the approved list of contractors is very limited, the contractors will tend to behave as oligopolists and collude or form "bid-rigging cartels" by allocating businesses among members in rotation. A designated bidder gets the business with an artificially inflated price while the rest submit even higher bids.

A lot of debates went on to rectify these problems at the governmental level, but a proper method of tendering, acceptable to all the parties involved, has not yet been worked out. Historically, the tendering system fluctuated from competitive bidding process to various forms of restricted bidding. Table 1 describes the changes in auction for Korean public-works contract over time.

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3) See appendix 1 for the detailed process of pre-qualification system.

Table 1. The Public-works Contract Systems in Korea

Period	Contents	
1951. 3.~1960. 7.	lowest bidder contract	
1960. 7.~1961.12.	bounded lowest bidder contract (above 80% of an estimated price) bounded average bidder contract (above 60% of an estimated price) average bidder contract (under an estimated price)	
1962. 1.~1971.12.	lowest bidder contract	
1972. 1.~1975.12.	bounded average bidder contract (under and above 80% of an estimated price)	
1976. 1.~1981. 2.	lowest bidder with a limited contract	
1981. 3.~1982. 3.	bounded average bidder contract (under and above 80% of an estimated price)	
1982. 4.~1983. 6.	lowest bidder contract	
1983. 7.~1984. 3.	lowest bidder contract with an evaluation of low prices (under 75% of an estimated price) • above 3 billion won of an estimated price	bounded average bidder contract
1984. 4.~1985. 3.	• above 2 billion won of an estimated price	
1985. 4.~1986. 3.	• above 1 billion won of an estimated price	
1986. 4.~1990. 4.	lowest bidder contract with an evaluation of low prices (under 80% of an estimated price)	
1990. 4.~1993. 1.	lowest bidder contract with an evaluation of low prices	
1993. 2.~1993. 9.	above 2 billion won: lowest bidder contract under 2 billion won: bounded lowest bidder contract (above 85% of an estimated price)	
1993. 9.~1995. 7.	above 10 billion won: lowest bidder contract under 10 billion won: bounded lowest bidder contract (above 85% of an estimated price)	
1995. 7.~1996.12.	above 10 billion won: limited lowest bidder contract with a qualification test under 10 billion won: bounded lowest bidder contract (above 88% of an estimated price)	
1997. 1.~1999. 2.	above 10 billion won: limited lowest bidder contract with a qualification test above 5.83 billion under 10 billion won: limited lowest bidder contract with a simple qualification test under 5.83 billion won: bounded lowest bidder contract (above 90% of an estimated price)	
1999. 2.~1999. 9.	above 10 billion won: limited lowest bidder contract with a qualification test above 3 billion under 10 billion won: limited lowest bidder contract with a simple qualification test under 3 billion won: bounded lowest bidder contract (above 90% of an estimated price)	
1999. 9.~	limited lowest bidder contract with a qualification test	

There are four types of tendering format: open, limited, selective, and negotiation. First three are competitive in nature. Public sector follows strict rules according to contract related laws in choosing tendering method and following processes. It provides a standard guideline for the private sector.

Open tendering, as the term suggests, allows all contractors with relevant registrations and minimum qualification to compete for the order. It is used for small projects. Limited tendering is a modified form of open tendering. It is open to all with pre-notified qualifications. Qualification differs from projects, but generally the criteria of past experience, possession of special technical ability or equipments, and certain level of company evaluation are used. Limited tendering is usually used for large projects.

Selective tendering is used when because of the nature of the projects there are less than 10 eligible contractors, the project is so small such that the cost of open competition is not rationalized, or giving preferential treatment to outstanding small and medium sized firms is appropriate, etc. The selection process must be fair and transparent based on construction and technical ability or equipments. Pre-qualified or registered list of contractors can be used. At least five must be selected and minimum of two must participate in the bidding.

Negotiation is used only under exceptional circumstances. Natural disaster, national security, contracts between public

sectors, ongoing projects where contracting with current contractor is overwhelmingly favorable, or projects of less than 100 million won are some of the cases where negotiation is adopted. To win a contract in the case of negotiation, the bidding price must be above the undisclosed budget amount predetermined by the ordering party.

In typical tenders, the lowest bid price is selected as the winner. However, to avoid the vicious cycle of dumping and shoddy construction work, a bounded lowest bid system has been used at times. A bounded lowest bid system takes the form of a winning bid being the lowest bid among bids above 80% (or 85% etc.) of the government pre-calculated cost of a project or the nearest bid to the average of all bidding figures.

In 1995 a new system of qualification test has been introduced to complement the lowest bidding. Using a qualification formula that combines construction capacity and bidding price, bids are evaluated from the lowest to choose a winning bid that passes a certain level of qualification score. If the weight of bidding price is large in the formula, it in fact increases the lower boundary of the winning bid price. Construction works above 10 billion won used qualification test while rest of the projects adopted bounded lowest bidding system. Recently, the usage of qualification test increased over the years and now covers almost all government construction works. For smaller projects the lower bound of the bidding price is maintained at a higher

level so that small and medium contractors can enjoy relatively high bid price.

Recently, the government announced that in principle it would gradually go back to the lowest bidding system. Starting from 2001, lowest bidding will win contract for construction works above 100 billion won. Gradually the coverage will be extended to other projects, the speed of which will depend on the successful establishment of supervision and guarantee system for the completion of construction. We have yet to develop a lowest price auction system where price competition leads to innovation and progress.

For certain types of projects greater than 10 billion won, pre-qualification method is used. Among the qualified competitors the lowest bid contractor may be selected as the winner.

2. General Contract Procedures

As a central procurement agency, PPS (Public Procurement Service) handles the procurement for large-scale construction works for the use of government agencies and semi-government institutes, and also, with its in-house officials, provides supervision services for major construction projects at the request of the end-user.

A. Contract Request (CR)

Upon receipt of a CR for a project from a requesting body, PPS reviews the contents of the CR to ensure that the specifications and drawings state the Government's actual minimum requirements and are designed to promote full and open competition, with due regard to the nature of the construction works to be acquired.

B. Decision of Type and Method of Contract

On reviewing the CR and taking into account the complexity of the work to be procured, the estimated cost or price, and the type of specifications used, PPS determines the type and method of contract.

C. Pre-qualification of Bidders

For very large projects or projects of a complex or special nature, a pre-qualification process is applied to the qualified bidders. Pre-qualification is based upon the capability of the prospective bidders to perform the particular contract satisfactorily, taking into account, among other things, their ① experience and past performance on similar contracts, ② capabilities with respect to technical expertise, equipment and plant, ③ financial position, and ④ trustworthiness. The applicants are evaluated by a committee of in-house senior officials from the Construction Bureau. As soon as the pre-qualification is completed, bidding documents are issued to the qualified bidders.

D. Cost Estimation

Based on the specifications and drawings, PPS estimates the cost for procuring the proposed project.

E. Public Announcement

The invitation for bids is announced in a government gazette. Generally, bidders are allowed 40 days from the date of the announcement for preparation of the bids.

F. Pre-bid Meeting

Bidders are requested to participate in a site orientation which is provided by the end-user in the presence of PPS's officials. Failure to participate in the pre-bid meeting may cause the rejection of the bid.

G. Bid Bond

Bidders must establish a bid bond with PPS for an amount not less than five percent (5%) of the bid price at least one business day prior to the date of bid opening. Bid bonds of unsuccessful bidders will be released on PPS's instructions or automatically on its expiry date.

H. Bid Opening

Bids are received and opened in the presence of bidders at the place and time and date specified in the invitation for bids.

I. Performance Bond

The successful bidder must establish a performance bond with PPS for an amount not less than ten percent (10%) of the contract amount. The performance bond will be released after satisfactory completion of the contract or automatically on its expiry date.

J. Award of Contract

Contract awards will be made to the lowest, qualified and responsible bidder taking into account price, construction plan, compliance with specifications and terms most advantageous to the Government. Written notification of the award to the successful bidder will cause the contract to become effective.

K. Payment

When the construction work has been satisfactorily completed and the inspection certificate issued by the appropriate authority has been submitted, the end-user may issue a certificate of acceptance to the contractor. Payment is made by the end-user when the contractor submits a request for payment with the certificate of acceptance and the accompanying inspection certificate.

L. Closing of Contract

The contract is closed when all deliverables have been accepted, the contractor has been paid, and the contract's other terms and conditions have been satisfied.

II. Bidding Behavior in Public-Work Contract Market

An episode characterizing the ongoing collusion in electric equipment procurement auction...the most revealing incident involved Elmer L. Lindseth, president of Cleveland Electric Illuminating Company and several other utility executives when they were visiting the home of Henry Van Erben, a vice president of General Electric. Erben's wife interrupted their lunch to inform the gathering that Mr. Hodnette (vice president of Westinghouse) wanted to talk with him, an incident that aroused great mirth among the gathered utility executives, but nothing more...disposition of Elmer L. Lindseth.

In many countries, bid-rigging cases in the construction industry have traditionally involved many criminal cases filed by antitrust agencies. The representative bid rigging case in Korean public-works contracts auction is the collusion in auction for the Baekjae Bridge construction contract in 1994. An officer in charge of bidding, working for Firm S, directly called officers of twelve competing construction firms to ask for a concession. He distributed to competing firms bid prices which were all set higher than the bid price Firm S would submit. Firm S eventually won the auction for the Baekjae Bridge construction contract. All related directors and officials of the twelve firms were charged with collusion in the bidding.

In the 1980s price fixing conspiracies in bidding for US

public-works contracts have been observed in auctions for Long Island state highway construction and the North Carolina highway construction.[4] A few of the firms implicated were convicted in federal court of rigging bids on Long Island and North Carolina highway construction projects. Cartel members engaged in bid rigging, both explicitly and implicitly. In Japan, the practice of *dango* (bid rigging) was found in Chiba Prefecture and Saitama Prefecture public-works contracts in 1991. The *dango* system consists primary of obtaining the scheduled price in advance and then holding talks to determine the contractor and the bidding price for the job. The method is used to mutually distribute public works projects.[5]

Bid-riggings are naked restraints of trade and perse illegal in violation of antitrust laws. Bid-riggings take a variety of forms and methods. The antitrust agency needs to distinguish between collusive behavior and non-cooperative behavior, both of

4) Both federal and state authorities have been intensely pursuing federal-aid highway contractors for illegal bidding practices. Initial investigations began in 1979 with rumors that collusive bidding was widespread in Tennessee. Since 1979, many states have discovered not only the existence of bid rigging by highway contractors, but also that collusion was often an accepted practice in this industry. The number of federal persecutions has increased steadily since such concentrated prosecutorial efforts have been directed against a single industry since the electrical equipment conspiracy cases of the 1960s.

5) This is different from the US, where public works projects are open to general competitive bidding, with any contractor free to take part as long as contractors put up bonds to prove their financial capacity. Former US Trade Representative Carla Hills has demanded that measures be taken to ban *dango* and to improve the designated bidding system. See McMillan (1991) for details on how the *dango* works.

which lead to supra-competitive profits since some statistical indicators generally associated with collusion may arise in an equilibrium of non-cooperative game. Rotating bidding and complementary bidding patterns may not be necessarily natural outcomes of collusive behaviors. As Zona (1986) demonstrates, rotating bids are consistent with competitive equilibria when there are decreasing returns to scale, such as when there are capacity constraints. Lang and Rosenthal (1991) analyze a multiple units bidding game in which there is a sunk cost to making each bid, and all bids are made simultaneously. They show that a mixed strategy Nash equilibrium in which the winning strategy can involve paired complementary bids (a serious bid and a high bid) is fully non-cooperative even in this one-shot game. The traditional wisdom that cartel bids are unrelated to cost measures does not hold in the case of non-cooperative tacit collusion. Thus, an appropriate method for the detection of explicit bid rigging and non-cooperative tacit collusion require detailed statistical analyses of strategic behavior and the market environment in addition to simple regression-based analysis.[6)]

Bid-riggers generally utilize two types of bid schemes to allocate contracts in an auction. Namely, rotating and complementary bid schemes. Cartel members can employ a rotating bid scheme, with one firm submitting a low bid and the others submitting high bids. The position of a low bidder is rotated among cartel members so as to achieve pre-

6) See Lee (1998) for further detailes.

determined market shares. The complementary bidding pattern is observed when over time each firm bids low to it's own incumbencies, with other firms bidding high. Thus, over time incumbent contracts tend to be won by the same firms.

It is well known that complementary bidding behavior is pervasive in auctions for Korean public-works contracts to the extent that cartel members enjoy fully their incumbency right. For the case of Seohae highway construction contracts in 1999, three winners including firm H handed out to potential competitors a so-called 'Call Letter' which stated that they had the lowest cost for a particular project and should be the designated winner because they were working on other projects or had construction experience near the site on auction.[7] They hosted meetings for 'self-coordination', asserting a kind of preemptive or incumbent right. Nine companies and a few executive officers were charged with bid rigging and the monetary penalty of about 5 billion won was levied on the concerned contractors.

In this study we presents circumstantial evidence of complementary bidding, in which all bidders but one submit high bids to lose. Empirical result shows that after controlling for cost factors and construction types, incumbent firms appropriate (statistically significant) higher returns in incumbent

7) Under *Dango*, which is a negotiation among bidders for Japanese public-work contracts, this bidding ring has incentive to ensure that the firm that has the lowest cost for a particular project to be the designated winner, because this ensure that the profits to be divided among the conspirators are maximized. Public-work jobs have been distributed to members according to this rule.

sites than in non-incumbent sites. The existence of incumbency premium strongly suggests that complementary bidding behavior in auctions was common for Korean public-works construction contracts. Since the financial crisis of 1997, the public-works construction market has experienced a significant change in the degree of competition. A sharp decrease in the size of the private-works construction market in the wake of the financial crisis disturbs structural bid-rigging regime particularly deeply rooted in public-works construction markets, and push down the ratio of contract price to estimated price, or the relative winning bid price deflated by estimated price. Given the structural transition from collusive regime to non-cooperative regime, we also estimate the potential damage of pervasive bid rigging in public-works contract, inflicted on government and eventually taxpayers. Based on this empirical research, we also try to suggest some public policy recommendations on the changes in competition law and government procurement auction system.

III. Literature Survey on Empirical Studies

1. Circumstantial Evidence of Collusion in Bidding

Signals traditionally regarded as reliable in bid-rigging prosecutions include the presence of fixed market shares, bid not correlated with project costs, levels and patterns of profits, and the sudden rise or fall in prices that are not correlated with changes in cost. Since these signals are not necessarily the natural outcome of collusive behavior, the suggested approaches have limits in their practicality.[8] Because of the difficulty of obtaining solid evidence of collusion, it is alleged that the detection of bid rigging should considerably rely on the search of price patterns that are inconsistent with competitive behavior. In general, finding a single test procedure to detect bid rigging is an impossible goal. As Hendricks and Porter (1989) suggest, it is proper way to tailor empirical work to special cases and to identify differences between the

8) For example, fixed market shares would be a natural outcome in a perfectly competitive equilibrium. It is common sense to argue that it appears very suspicious if a firm were to submit very different bids on two projects that cost the same. However, recent work in game theoretic models of competition provides instances in which firms do not coordinate on price, nonetheless exhibit patterns of behavior which are traditionally taken to indicate bid-rigging or some other kind of price fixing. The level of profits is also an unreliable guide to the existence of bid rigging. Asch and Seneca (1970) suggest that price-fixing may be a response to low profits, engaged in by firms facing stagnant or declining demand. Furthermore, it is possible that a bid rig is necessary to enable a high cost firm to break even, so that excess profits ought not to be expected. Sudden rise and fall in prices which are unrelated to cost do tend to be characteristic of the onset or breakdown of a price-fixing conspiracy and are not characteristic of a competitive market.

observable implications of collusive and competitive behavior, because the collusion in auctions can take many forms. Thus, a simple regression based approach may be misleading without full recognition of strategic behaviors and the market environment.

However, even if finding a uniform test procedure to detect bid rigging is not feasible, we can set up systematic steps of bid rigging detection by utilizing some stylized theoretical predictions. It is common that cartel firms and non-cartel firms coexist in a bid-rigged market.[9] The presence of a cartel induces asymmetry in the procurement auction since the selected cartel bidder is bidding as a representative of a group.

We can statistically secure circumstantial evidence of collusion by distinguishing between bidding behavior of cartel firms from bidding behavior of non-cartel firms. Some empirical findings are consistent with three theoretical predictions in this type of asymmetric auctions.

The first is that the mean of submitted bids is higher in cartel bids. The cartel firms appear to bid less aggressively than non-cartel firms. The second is that the variance of cartel bids is less than that of non-cartel bids. The distribution of cartel bids first order stochastically dominates the distribution of non-cartel bids. The final finding is that the frequency with which bidders together take part in a project is greater for cartel bids than non-cartel bids. Cartel firms are more likely to

9) This classification is usually based on the conversations with apprehended colluders or whistle blowers at the initial stage of formal investigation by antitrust agencies.

participate in an auction if other cartel members bid as well.

These three theoretical findings are exactly confirmed in the investigation of cartel and non-cartel bidding behavior in the North Carolina highway construction industry by Feinstein, Block and Nold (1985), and in the research on Florida and Texas school milk markets by Pesendorfer (1994).

Porter and Zona (1993) devised a ground breaking method to detect the presence of bid rigging in auction for state highway construction contracts on Long Island in the early 1980s, based on the multinomial logit approximation and the log linear approximation of a characterization of equilibrium bidding strategies. The bidding data indicates that the bids of non-cartel members, as well as their rank distribution, were related to cost measures, such as how much backlog a firm was carrying.

In contrast the bids of cartel members, as well as their rank distribution, were unrelated to similar cost measures. So they reject the hypothesis that there was no collusion. Their test method does not work particularly in case of non-cooperative tacit collusion. Through careful statistical analysis of dairy companies' bidding behavior in Dallas-Ft. Worth school milk market, Lee (1999a) shows that cooperation based on rationality and repetition satisfy the conditions for a kind of Folk Theorem.

It is observed that certain milk processors tend to win the same school districts over time. Fairly strict tit-for-tat strategies actually keep firms from defecting and maintain

stability in market share dispersion among firms over time, and thus raise prices far in excess of the competitive level. Data also strongly suggest that all major milk processors have engaged in complementary bidding to allocate consumers geographically and enjoyed a statistically significant incumbency premium in their incumbent districts.

2. Antitrust Damage Estimation

The assessment of damages is often a principal issue in litigation. Because the interests of the plaintiff and defendant directly conflict. The primary objective of the plaintiff is usually to collect as much as possible and that of the defendant is to pay as little as possible. In order to recover antitrust damages in a bid rigging case, the plaintiff must be able to prove the amount of price change suffered as a result of a conspiracy.

In proving damages, the plaintiff is not usually held to as high a standard of proof as for proof of injury-in-fact, since the economic harm complained of is frequently intangible and difficult to quantify. The U.S. Supreme Court has long held that while the damages may not be determined by mere speculation or guess, it will be enough if the evidence shows the extent of the damages as a matter of just and reasonable inference, although the result be only approximate.

Although the proof of damages is obviously critical to

plaintiffs and defendants alike, there are as yet only few empirical studies on this subject. Three alternative techniques can be successfully used for preparing damage cases. The first is a cost method approach that looks at the relationship between the winning bid and the professional's estimates of a competitive bid based on the basis of sketch cost data. The second is the dummy variable technique, by which estimations are made over the pooled sample of rigged and unrigged contracts with a dummy variable which is equal to one if the job is rigged and equal to zero if it is nor rigged. The third is a forecasting approach using only unrigged bids as a control group to estimate the model and then plugging the data points for each rigged bid into the estimated model. However, it these estimates are poor substitutes for estimates based on reliable cost data.

Howard and Kaserman (1989) and Nelson (1993) propose a regression-based method for estimating damages in bid rigging cases of the sewer construction industry and used car market, respectively. They estimate damages based on three statistical approaches. The average damages by conspiracy turned out to be robust to the selection of the three statistical approaches in both papers. Howard and Kaserman (1989) show that damage ratios amount to 32% to 38% in bid rigging cases of the sewer construction industry.

Nelson (1993) provides empirical evidence that a price overcharge due to bid rigging amounts to about 20% of the price. McMillan (1991) estimates the cost of the collusive

scheme of *dango* to Japanese taxpayers by numerical simulation. He shows that excessive profits from collusion are rife in Japan's public work contracts typically amount to 16% to 33% of the price. Froeb et al. (1993) study the collusion in frozen seafood contract auction for the Department of Defense. They gauge the effect of bid-rigging on prices and show that the actual winning bids prices averaged 23% and 30.4% by period higher than the backcast predicted price. Lee (2000) shows that the estimated overcharge in the Dallas-Ft. Worth school milk market represents 11.74% of the estimated total expenditures, using the forecasting approach.

IV. Market Background and Data

1. Public-works Market Background

The relevant market in this study is the bidding competition market of large-scale public-works contracts of more than 10 billion won.[10] The National Contract Law and Qualification Judgement Rule governing the bidding process in this market require that firms contracting to carry out public-works project must be selected by competitive bidding if and only if these winners meet some minimum requirement. Clause 7 and 8 of the Qualification Judgement Rule state that the lowest bidder must be first judged for eligibility, and is then selected as the final winner by the Public Procurement Service (henceforth, PPS) if its integrated score is greater than 75 percentage.[11] In other words, the award will be made to the lowest, qualified and responsible bidder conforming to the requirements specified in the bidding documents, taking into account price, delivery time, quantity, specifications and terms advantageous to the Government. Written notification of the award to the successful bidder will cause the contract to become effective.

Let's briefly discuss the structural change in the Korea construction market. The size of the Korean construction market has greatly shrunk in the aftermath of the financial crisis of 1997.

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10) Twenty two construction types in which contract size is more than 10 billion won are applied to pre-qualification (PQ) system. In these types of contacts, only pre-qualified contractors can submit bid to the Public Procurement Service.

11) Integrated scores take into account construction experience, technology capability, management status, credibility, propriety of construction planning, and bid price.

Table 2. Total Contract Size over 1997-1999 by Order Source and Construction Type

(unit: billion won)

		1997	1998 (changes, %)	1999 (changes, %)
Order Source	Total	74,924	47,080(-37.2)	47,168 (0.2)
	Public Sector	30,721	26,690(-13.1)	25,789 (-3.4)
	Central Government Agency	6,562	7,693 (17.2)	7,667 (-0.3)
	Local Government Agency	13,262	11,177(-15.7)	10,114 (-9.5)
	State-owned Firm	10,897	7,820(-28.2)	8,008 (2.4)
	Private Sector	41,637	17,434(-58.1)	19,979 (14.6)
	Etc.	2,566	2,956 (15.2)	1,400(-52.6)
Construction Type	Civil Engineering	27,145	21,925(-19.2)	20,282 (-7.5)
	(SOC)	13,266	13,639 (2.8)	12,082(-10.7)
	Architecture	45,352	23,674(-47.8)	25,387 (7.2)
	(Housing)	20,445	10,969(-46.3)	12,327 (12.4)
	(Commercial)	958	2,474(-72.7)	13,061 (2.8)
	Industrial Equipment / Landscape	2,428	1,474(-39.1)	1,498 (1.3)

Table 2 shows that the total construction contract size of 1998 amounts to 47,080 billion won, sharply declining by 37.2% compared to 74,924 billion won of 1997. While the contract size in the public sector decrease moderately by 13.1%, in the private sector this declines significantly by 58.1%. The contract size proportion by order source in Table 3 illustrates that for the first time in 1998 the magnitude in the government's outlay on procurement exceeds that of the private-works contract size.

Table 3. Contract Size Proportion by Order Source

(unit: percent)

	1995	1996	1997	1998	1999
Public Sector	31.8	35.8	41.0	56.7	54.7
Private Sector	64.5	60.9	55.6	37.0	42.4
etc.	3.7	3.3	3.4	6.3	3.0

The large decrease in the size of the private-works construction market has direct impact on the degree of collusion and pushes down the ratio of the contract price to estimated price. As seen in Table 4, average contract price ratios for all types of construction have been significantly lowered since the third quarter of 1998. This sharp drop in the contract price ratio has been consistent ever since.

Table 4. Average Contract Price Ratio by Construction Type over 1995-2000

Construction Type	1995		1996		1997		1998		1999		2000 Jan.-Apr.
	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	
Road	94.95	82.33	81.30	82.34	89.18	81.66	84.74	72.79	70.13	73.40	73.03
Architecture	89.51	84.36	87.57	85.96	82.26	82.04	83.91	73.55	73.23	73.09	73.03
Railroad	-	79.23	86.96	88.73	87.36	90.10	85.82	69.69	69.72	73.01	73.29
Civil-engineering	92.04	87.56	90.40	88.47	95.01	93.68	93.80	85.27	85.14	-	72.99

The ratio of contract price to estimated price for the sample period of January 1995 through April 2000 is shown in a scatter diagram (Figure 1). The scattered plot shows two structural bands of contract price ratios, high and low, which appear until the second quarter of 1998. After then, the two structural bands of contract price ratios collapse to the low band of contract price ratios. As Table 4 shows, the contract price ratios range between 70% and 73% by construction type

after the second quarter of 1998. The observed phenomenon that contract price ratios lie around 70% to 73% is due to the bidding system itself applied to large-scale public-works contracts more than 10 billion won.

According to the Qualification Judgement Rule, the lowest bidder must be first judged for eligibility as a final contractor, and is chosen as the final winner if its integrated score is greater than 75 percentage points. So construction firms have to submit low bid prices, equivalent to at most 70% to 73% of the contract price ratios to win a contract on auction because they have almost similar levels of integrated scores and are only distinguished by their bid price.

Discussion on the point at issue

We need now to clarify the point of dispute that the contract prices over the period of June 1998 through April 2000 reflect the competitive bid price or dumping prices. As mentioned before, the ratios of contract price to estimated price have structurally changed from a high and a low band to a single low band between 70% and 73% since the second quarter of 1998. It has been argued that this phenomenon was due to the financial crisis in 1997, when all construction firms had to submit bid prices that were as low as possible, equivalent to at most 70% to 73% contract price ratios, to survive the crisis. In fact, in 1998 the total contract value dropped by more than 37.2% due to the sharp decrease in construction investment, severely damaging the already oversized industry.

Moreover, faced with an interest rate higher than 20%, many contractors went bankrupt and the rest were struggling for their survival. After the second quarter of 1998, therefore, the low contract price ratios may reflect partially dumping prices to overcome the short run liquidity constraints. However, it is not appropriate to generalize low contract prices as dumping prices. Here are a few of reasons. Construction industry is characterized by low fixed costs and thus does not have incentive to spread overhead costs over more units of construction during business downturn (Table 5).

Table 5. The Yearly Trend of Construction Cost Composition

(unit: percent)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Material	34.32	34.00	31.58	30.08	29.73	30.25	28.50	28.57	25.38	24.57
Labor	21.07	19.08	18.92	17.85	16.72	14.58	13.63	12.85	11.89	11.11
Outsourcing	31.52	35.72	37.73	41.02	42.66	44.46	46.69	47.53	51.37	51.83
SiteExpense	13.09	11.20	11.77	11.05	10.90	10.71	11.18	11.05	11.36	12.50
(equipment)	(4.94)	(3.98)	(4.26)	(4.12)	(3.95)	(3.11)	(3.22)	(3.05)	(3.19)	(3.22)
Total Cost	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

A high variable cost proportion in cost composition implies that winning contracts with a series of dumping prices in the long run is severely detrimental to the construction firms. In fact, the low contract price ratios were sustained for two and half years. If the winning bids were dumping prices, destructive competition would have occurred and almost all construction firms would not survive. In light of this argument, 16 construction firms, which were final winners both in 1996 and in 1999, are sampled and the contract price ratios and the financial indicators are compared (Table 6 & 7 respectively).

Table 6. Average Ratio of Contract Price to Estimated Price in 1996 and 1999

1996		1999	
All Bidding Firms	16 Selected Firms	All Bidding Firms	16 Selected Firms
85.32%	88.72%	72.43%	73.40%

Table 6 shows the average contract price ratios of all bidding firms and the 16 selected firms. The average ratios of

all bidding construction firms fell to 72.43% in 1999 from 85.32% in 1996, while those of the 16 selected firms from 88.72% to 73.40%. In particular, the average contract price ratios of the 16 selected firms in 1996 and 1999 are statistically different (t-value: -7.1360). This indicates that competitive pressure has increased and the contract price ratios has indeed dropped after the financial crisis in 1997.

Table 7 demonstrates that there is no statistical difference between 1996 and 1999 in terms of economic performance, such as net income to total assets and net income to stockholders' equity. From this statistical result, it is inferred that the surviving construction firms, including the 16 selected firms, could have maintained financial profitability and submitted the bidding prices as low as possible.

Some financial indicators concerning growth and some ratios with regard to assets, liabilities, and stockholders' equity showed statistically significant changes. This reflects the cyclical change in demand over business cycle and the structural reform to improve capital structure by lowering debt-equity ratio after the financial crisis in 1997.

However, in public-works contracts market more than 100 billion won in contract size to which the lowest price system is applied, dumping price is clearly observed. Contractor D and contractor C won the contracts for infrastructure construction of Incheon New City at 58.05% and 59.74% respectively of contract price ratio, where the lowest price auction was first carried out on March 28, 2001. These contract price ratios far fall short of 70 to 75%, which is supposed to be normal contract price ratio.

Table 7. Financial Indicators in 1996 and in 1999

		1996		1999	
		All[1)]	Selected	All[1)]	Selected
Indicators of Growth	Growth rate of sales**	16.45	19.85	-2.27	4.19
	Growth rate of total asset**	14.53	12.38	-0.76	-10.71
	Growth rate of stockholders' equity	9.19	-1.09	24.26	19.64
Indicators of Economic Performance	Net income to total assets	0.11	-0.24	-1.32	2.88
	Ordinary income to total asset	0.67	0.93	-2.34	0.84
	Operating income to operating asset	6.22	6.40	0.00	5.06
	Net income to stockholders' equity	0.68	-64.59	-7.41	2.34
	Net income to sales	0.10	-0.63	-1.73	2.78
	Ordinary income to sales	0.67	0.54	-3.07	-2.00
	Operating income to sales	5.13	5.94	2.38	3.51
	Financial expenses to sales	5.91	7.56	6.32	7.53
A Varity of Ratios with regard to Assets, Liabilities, and Stockholders' equity	Stockholders' equity to total assets*	15.09	18.43	19.77	25.63
	Debt ratio	562.67	1175.97	405.94	1783.88
	Total borrowings and bonds payable to total assets**	49.87	48.89	42.88	42.23
	Current liabilities ratio	420.71	627.67	235.49	654.37
	Fixed assets to stockholders' equity and long-term liabilities	74.44	75.62	67.91	68.76
	Fixed ratio	180.11	332.19	183.66	781.18
	Current ratio*	114.28	129.50	136.85	177.06
	Quick ratio**	69.88	92.93	93.90	137.85
Turnover Ratios of Assets, Liabilities, and Stockholders' equity	Operating assets turnover	1.21	1.42	0.92	1.50
	Total assets turnover	1.01	1.10	0.76	1.10
	Receivables turnover	6.89	5.84	4.32	4.31
	Inventories turnover	4.96	10.65	3.58	14.06
	Payables turnover	7.00	8.47	5.99	7.71

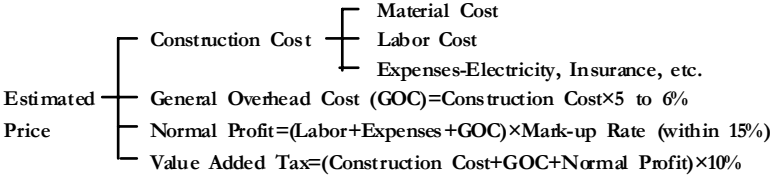
Note: 1) All financial indicators are from The Bank of Korea (1997-2000).
* Significant at the 10 percent level, ** Significant at the 5 percent level

2. Data Description

The main data are from the summarized bid documents of the PPS.[12] This study investigates public-work contracts of more than 10 billion won, awarded between January 1995 and April 2000. The variables used in our analysis are as follows.

- ***Bid*** is a winning bid, which is a dependent variable. The natural logarithm of ***Bid*** is used in the model.
- ***Eprice*** is estimated contract price, which is a proxy variable to control for the change in construction cost. Raw data for material cost, labor cost, and general overhead cost are not accessible. However, detailed cost information is systematically nested in estimated price. Detailed estimated price structure are as following.

< Composition of Estimated Price >



Source: Chang (1995), *Government Contract System,* p.317.

Before the PPS advertises a project for bidding, an in-house or engineer's estimate is made on the basis of

12) Recent data are collected from the homepage of Public Procurement Service (http://websvr1.sarok.go.kr/html/index.html).

standard specification, and the calculation rule.[13] PPS approximates what it should cost the average contractor to complete the project and add what it considers to be reasonable profit for a total estimated contract price. Financial officers finally turn in the estimate contract price, taking into account budget and auditing. Another reason to use estimated price as a proxy variable for construction cost is to enhance the predictability and robustness of the empirical model. The natural logarithm of ***Eprice*** is used in the model.

• ***Headquarter*** is a dummy variable, which equals one if the headquarter of a bidder is located near the site on auction, and zero otherwise. Specifically, the dummy variable is one if a firm whose headquarter is located in a province submits a bid for a construction site in the same province and wins the contract, and zero otherwise. For convenience of data analysis, pubic-works sites are geographically divided into 9 areas according to the official boundary of the province.

Most large construction firms have their headquarters in Seoul and have national networks. So, even if a firm whose headquarter is located in Seoul submits a bid for an auction for a construction site in Seoul and Kyonggi Province and wins the contract, then I regard the value of dummy variable as zero. This variable is designed to control for incumbency effect.

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13) For example, material cost is calculated by the following formula: Material cost = necessary amount per unit (standard specification) x unit price (PPS investigation price) x quantity (on draft).

• ***Regime*** is a dummy variable to control for structural change in the construction industry. From the third quarter of 1998, the ratio of contract price to estimated price precipitates by more than 20%. Before the third quarter of 1998, scattered distribution of the ratios of contract price to estimated price forms two strong bands; high contract price and low contract price relative to the estimated price. After the turning point, the two bands of the distribution converge into one low contract price ratio band.

The frozen private-works construction market following deep cuts in the yearly total order size triggered off fierce competition in the public-works construction market and shook hard the widely accepted collusive structure in the public-works construction market.

The estimated coefficient on this dummy variable automatically explains the percentage difference in the contract price between cooperative and non-cooperative regimes.

• ***Construction Type*** is a binary variable that controls for the cost difference among different types of construction. We add construction variables into the model because estimated contract price does not fully take into account cost differential due to different construction technology by construction type. There are four types of construction: ***Road*** (national highway and local highway), ***Architecture*** (building and facility), ***Railroad*** (including subway), ***Civilengineering*** (including bridge). This factor is represented by binary variables in the model.

V. Theoretical Model

For expositional purposes we describe an independent and private value auction model in which bidders know that costs are independently distributed across firms and firm i knows its own costs and only the distribution of the costs of its competitors on contract j at time t, i.e., $[c_{jt}^{\min}, c_{jt}^{\max}]$. Further assumptions are that the set of bidders in any particular contract is common knowledge and that firms are risk neutral. The function describing how likely the bid of firm i, b_i, will be less than any other particular amount of bid b is the cumulative distribution function with parameter vector σ_i: $F_i(b; \sigma_i) = prob(b_i \leq b)$. We will let σ denote the vector of all contract specific parameters to capture implicit or explicit collusion in auction. Let us examine the problem of just one of the contractors. If it bids b and if its cost of completing the contract is c, then its profit will be b-c; if it loses in the auction, its profits will be zero.

The contractor's bid of b precisely wins when all the other contractors submit higher bids. Thus if there are N bidders, the probability that a bid of b beats them all, given σ, is $p(b) = [1 - F(b; \sigma)]^{N-1}$ and the contractor's expected profit is equal to that probability times the profit margin of the bid, $p(b; \sigma)(b-c)$. A bidder determines his bid to maximize this expected profit.

$$\max_{b} E\Pi(b; \sigma) = p(b; \sigma)(b-c) \qquad (1)$$

In equilibrium, the bid from firm i on contract j at time t will satisfy the first order condition.

$$p_{ijt}(b_{ijt};\ \sigma)+(b_{ijt}-C_{ijt})\ \partial p_{ijt}(b_{ijt};\ \sigma)\ /\ \partial b = 0 \qquad (2)$$

The first order condition determines the equilibrium relationship between a firm's probability of winning and the level of its bid. The equilibrium to this model is characterized as the solution to a system of differential equations with boundary conditions. We assume that the equilibrium bidding function follows a log-linear bidding rule as follows;

$$log(b_{ijt})= \beta X_{ijt}+ \varepsilon_{ijt}, \qquad (3)$$

where X_{ijt} is a vector of observable variables affecting firm i's probability of winning the contract j at time t, and ε_{ijt} denotes private information, such as idiosyncratic cost effects for firm i on contract j at time t. The dependent variable is the logarithm of winning bids.

VI. Empirical Results and Discussion

1. Statistical Evidence of Collusion

All estimated coefficients on the set of cost-related and structural variables were found to be statistically significant at the 0.1% level. The estimated coefficients also have the hypothesized signs. The estimated coefficient on *Eprice* is almost one, which implies a unit elasticity of bid price with respect to cost. In other words, contractors systematically take into account the change in cost when they submit their sealed tenders. As for the construction types, contract price can vary by construction type because PPS ask for bids on different construction types. With respect to cost effects, *Civilengineering* is the most expensive, followed in order by *Railroad, Architecture and Road*. The average winning bid in civil engineering contract, after controlling for other effects, is 12% higher than that in highway construction contract.

After controlling for cost and structure factors, contractors win public-works contracts with on average 6.2% higher price in the incumbent sites in which contractors have their headquarters. Statistical results show that local construction firms enjoy statistically significant incumbency premium in their incumbent sites. Competitors submit high bids in incumbent sites so that an incumbent contractor can win a

contract at a relatively higher price.[14] Thus, it is inferred that contractors engage in complementary bidding, in which all bidders, except one, submit high bids to lose.

Table 8. Estimation Result (Sample: winning bids)

Explanatory Variable	Estimated Coefficient	Standard Error	T-value	Prob > | T |
Intercept	-0.98729	0.17358	-5.688	0.0001
Eprice	1.02627	0.00703	145.859	0.0001
Headquarter	0.06242	0.02146	2.908	0.0038
Regime	0.13328	0.01252	10.644	0.0001
Architecture	0.03931	0.01202	3.270	0.0011
Railroad	0.04773	0.01462	3.263	0.0012
Civil-engineering	0.12003	0.02260	5.309	0.0001
Obs.	584			
R^2	0.9779			
F Value	4253.336			
Prob > F	0.0001			

The learning-by-doing hypothesis suggests that an incumbent firm with the lowest cost for a particular project should be designated the winner because it is working on other projects or had construction experience near the site on auction. If the learning-by-doing hypothesis holds and other competitors follow the competitive bidding process, then a significant incumbency premium may not be observed. The

14) Lee (1999a) shows in his Texas school milk market study that the average second lowest bids in the contracts (incumbent contracts) continuously won by the same firm are significantly higher than those in the overturned contracts (non-incumbent contracts); 3.50% to 4.13% gaps in absolute prices by the milk item and 5.68% to 8.68% gaps in relative prices by the milk item. Thus milk processors in their incumbent districts tend to win a contract at relatively higher price.

bid-rigging case in Seohae highway construction contracts in 1999, in which three winners distributed to potential competitors a so-called 'Call Letter', is an anecdotal episode that the cost advantage due to construction experience near the site on auction is not necessarily reflected into the lower winning bid.

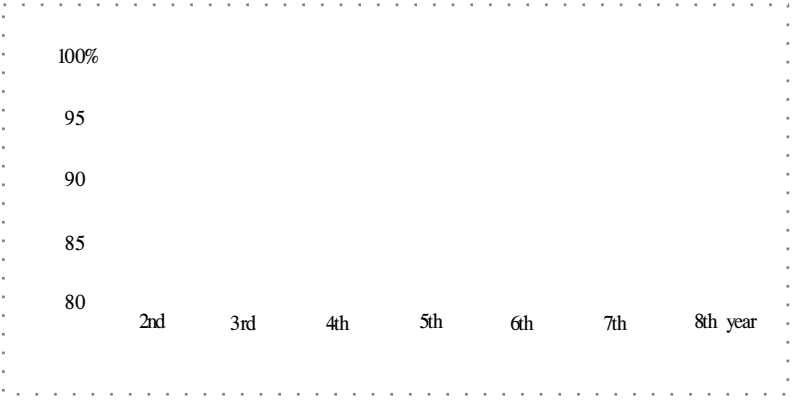
The statistical evidence of the effect of incumbency is also confirmed in long-run continuous construction contracts, which are carried out over several years. These long-run continuous construction contracts are put under bidding competition every year. A contractor tends to win the same long-run continuous construction contract every year. We set up a subcompact sample, consisting of bid data of the 1999 long-run civil engineering construction contracts. The mean value of contract price ratios by difference in year is monotonically increasing (Table 9 & Figure 2).

On the contrary, standard deviation overall decreases over the years. Interestingly enough, the incumbency effect is statistically confirmed and entrenched over the years in this subcompact sample.

Table 9. Mean Value of Contract Price Ratios by Difference in Year

Difference in Year	obs.	Mean (%)	Std Devi (%)
The second year	16	80.94	12.7777
The third year	23	86.06	12.2566
The fourth year	16	86.93	10.1384
The fifth year	26	87.45	9.3822
The sixth year	14	89.81	9.7276
The seventh year	5	94.81	2.0013
The eighth year	1	97.23	-

Figure 2. Trend of Contract Price Ratio over Difference in Year



As noted earlier, the public-works construction market has experienced significant structural change, in the degree of competition. Since the financial crisis of 1997, precipitation in the size of the private-works construction market disturbs severely the structural collusive regime deeply fixed in public-works construction market, and in turn lowers considerably the ratio of contract price to estimated price. To test for structural change, we divide the full sample period into two sub-periods: the first quarter of 1995 to second quarter of 1998, and the third quarter of 1998 to April 2000. We statistically reject the hypothesis of no structural change between the two sub-periods, based on F (6, 593) = 31.41. The estimated coefficient on *Regime*, the variable put into the model to control for structural change in the construction market tells us that the winning bid prices in the cooperative

regime are, on average, 13.33% higher than in a non-cooperative regime. This numerical value is equivalent to the potential damage ratio of pervasive bid-rigging based on the dummy variable approach, estimating over the pooled sample of rigged and unrigged contracts with a dummy variable which is equal to one if the job is rigged and equal to zero if it is unrigged.

2. Damage Estimation

Utilizing the transition from cooperative regime to non-cooperative regime, we also estimate potential damage of structural bid rigging in public-works contract by year, contractor and construction type. The forecasting approach using only unrigged bids (or competitive bids) as a benchmark group to estimate the model and then plugging the data points for each rigged bid into the estimated model makes this possible.

Performing the forecasting approximation with ordinary least squares (OLS) on the basis of equilibrium bidding function leads to the following results.

$$Bid_{ijt} = -0.29723 + 0.99884 Eprice_{ijt} + 0.00275 Architecture_{ijt} - 0.01142 Railroad_{ijt} + 0.10331 Civilengineering_{ijt} \quad (4)$$

Adj R-square = 0.9947

F = 6275.654

N = 134

The F-statistic for the equation as a whole is highly significant, and the R-square indicates that approximately 99.5% of the observed variation in winning bids is explained by the model. The standard error of the model is 0.3, indicating that one standard deviation limits for this model are only about ±0.3%. The distribution of the residuals is approximately normal: symmetric and bell-shaped. The model's residuals reveal no problem with the assumptions that support the statistical inferences based on the model.

Predicted competitive bids are obtained by substituting the observed values of independent variables for the first sub-period, the first quarter of 1995 to second quarter of 1998, into equation (4). This is the price that is then compared to the actual price to determine the extent of overcharges for the particular construction contract. The total overcharges for the four types of construction contracts is then calculated by summing up differences between the actual bid price and the predicted competitive bid price.

The total expenditures, potential overcharges and overcharge ratios by the year are summarized in Table 10. The estimated overcharge is 3,775,301 million won which represents 15.5% of the total expenditures of 24,386,554 million won in this market from January 1995 through June 1998.

Table 10. Estimated Potential Overcharge and Damage Ratio

(unit: won, %)

Year	# of Contracts	Government Expenditure	Estimated Potential Damage	Damage Ratio (%)
1995	103	4,121,497,827,500	589,690,782,950	14.3
1996	151	7,673,387,559,600	1,181,925,018,751	15.4
1997	163	9,387,314,897,255	1,528,051,951,439	16.3
1998.1-6	53	3,204,354,554,400	475,633,970,387	14.8
Total	470	24,386,554,838,755	3,775,301,723,527	15.5

Estimated overcharges and damage ratios by construction type are presented in Table 11. Over the period of January 1995 to June 1998, road construction contractors gain supra-competitive profits equivalent to about 2 trillion won. On the other hand, contractors cause the highest damage ratio amounting to 16.87% in railroad and subway construction.

Table 11. Damage Estimate & Damage Ratio by Construction Type

(unit: billion won, %)

	1995		1996		1997		1998(Jan.-June)		Total	
	Damage Estimate	Damage Ratio	Damage Estimate	Damage Ratio	Damage Estimate	Damage Ratio	Damage Estimate	Damage Ratio	Damage Estimate	Damage Ratio
Road	392	14.67	558	14.73	742	16.67	368	14.87	2,059	14.81
Architecture	147	15.98	409	17.99	270	11.80	43	11.19	870	15.39
Railroad	41	10.16	158	18.12	457	20.34	60	19.10	715	16.87
Civil-engineering	10	7.68	56	7.66	59	14.75	5	14.60	131	10.03

The estimated damage ratios range from about 14% and 16% over the sample years, which are relatively lower than those in other case studies (Table 12). Even though the 15.5% damage ratio in this study is higher than that in Texas school market study, this damage ratio is lower than those in other construction case studies, the sewer construction case of USA and the public works-construction case of Japan.

Table 12. Comparison of Estimated Damage Ratios in Different Auctions

	Howard & Kaserman (1989)	McMillan (1991)	Nelson (1993)	Froeb et al. (1993)	Lee (2000)	Lee and Hahn (2001)
Market	Sewer Construction (USA)	Public-works Construction (JAPAN)	Used Car (USA)	Frozen Seafood for DOD (USA)	School Milk (USA)	Public-works Construction (KOREA)
Damage Ratio	32-38%	16-33%	20%	23-30%	12%	15.5%

The estimated damage ratios by the firm are listed in Table 13. Eighty-four firms causing damage ratios of more than 10% are summarized. Firm 1 shows the biggest overcharge ratio, 24.68%, with further forty-five firms having overcharge ratios exceeding 20%. The estimated overcharges by the firm may offer a guideline for the proper allocation of the total overcharges to construction contractors, if contractors are charged with bid-riggings and convicted to be guilty. Sixty-three firms incur estimated economic harm of more than 10 billion won and, among them, eleven big contractors inflict estimated economic damage of more than 100 billion won upon government and eventually tax-payers.

Table 13. Estimated Damage Ratio by Firm

(Unit: %)

Bidder	Damage Ratio	Bidder	Damage Ratio	Bidder	Damage Ratio
firm1	24.68	firm29	21.97	firm57	17.92
firm2	23.98	firm30	21.89	firm58	17.91
firm3	23.72	firm31	21.84	firm59	17.87
firm4	23.68	firm32	21.75	firm60	17.63
firm5	23.46	firm33	21.49	firm61	17.41
firm6	23.39	firm34	21.42	firm62	17.38
firm7	23.38	firm35	21.09	firm63	16.89
firm8	23.29	firm36	20.90	firm64	16.58
firm9	23.15	firm37	20.84	firm65	15.87
firm10	23.03	firm38	20.79	firm66	15.42
firm11	23.01	firm39	20.76	firm67	15.14
firm12	22.86	firm40	20.71	firm68	15.07
firm13	22.80	firm41	20.60	firm69	14.59
firm14	22.74	firm42	20.49	firm70	14.51
firm15	22.73	firm43	20.44	firm71	14.41
firm16	22.72	firm44	20.37	firm72	14.18
firm17	22.54	firm45	20.02	firm73	13.82
firm18	22.52	firm46	19.90	firm74	13.64
firm19	22.49	firm47	19.87	firm75	13.57
firm20	22.46	firm48	19.84	firm76	13.50
firm21	22.43	firm49	19.69	firm77	13.40
firm22	22.38	firm50	19.69	firm78	13.04
firm23	22.33	firm51	19.63	firm79	12.86
firm24	22.32	firm52	19.61	firm80	12.51
firm25	22.28	firm53	19.04	firm81	12.37
firm26	22.11	firm54	18.48	firm82	12.06
firm27	22.05	firm55	18.47	firm83	11.96
firm28	22.03	firm56	18.46	firm84	10.52

VII. Concluding Remarks with Public Policy Recommendation

Empirical researches on the detection of the bid-rigging and damage estimation are few even through explicit collusion and tacit collusion are pervasive practices in bidding for contract in Korea. This research is the first rigorous empirical study to find some solid statistical evidence of collusion in auction and to gauge the possible effects of bid-rigging on auction prices in Korea.

With limited information contained in the sketch bid data, we show that local construction firms enjoy statistically significant incumbency premiums in their incumbent sites. Competitors submit relatively high bids in incumbent sites so that an incumbent contractor can win a contract at a higher price in incumbent sites than in non-incumbent site. Thus, it is inferred that contractors engage in complementary bidding, in which all bidders, except one, submit high bids to lose.

The statistical evidence of the incumbency effect is also confirmed in long-run civil engineering construction contracts, which are carried out over several years. The monotonic increase in the mean value of the contract price ratios by difference in year suggests that incumbency premium has continuously grown over years. Utilizing the transition from cooperative regime to non-cooperative regime, we also estimate potential damage ratio of structural bid rigging in public-works contract by year, contractor and construction type.

The total estimated overcharge based on the forecasting approach is 3,775 billion won which represents 15.5% of the

total expenditures of 24,386 billion won in this market from January 1995 to June 1998. We also present potential damage estimates ratio by the firm. The estimated overcharge by contractors may offer a guideline for the proper allocation of the total overcharges to construction contractors in court cases where contractors are charged with bid-riggings and are proved to be guilty.

The monetary penalty system in the Korea Fair Trade Act (KFTA) is characterized by administrative sanctions, and not by a full collection of unjust profit due to bid-rigging. Thus, the current monetary penalty system is not effective to deter the repeatedly occurred collusion in auction. Under the current monetary penalty system, the Korea Fair Trade Commission (KFTC) only levies on bid-riggers less than the fixed percentage point of annual sales (within 5%), which is to a great extent short of the true damage.

The simple monetary penalty system should be changed from administrative measure to retrieval of unjust gains. The ex post downward estimation and inappropriate recovery of true harm will induce bidders to more actively involve in a bidding ring in the next period if the ex ante expected benefit out of collusive behaviors is at least equal to the ex ante expected cost of detection and punishment. Some anecdotal episodes supporting this line of inference have been observed in the school milk market, electrical equipment industry and construction industry across the countries.[15)]

15) See Lee (2000) for a detailed story.

The ex post accurate measure of true harm in court induces ring members to be more cautious about risks before colluding in the next period if the ex ante expected benefit out of bid rigging is at most equal to the ex ante expected cost of detection and punishment.

To recover fully the antirust damage, Korean competition agency needs to develop a variety of statistical programs involving advanced damage estimation techniques. Because more accurately estimated damage and appropriate extra charge are imposed on firms accused of collusion in a market, then antitrust agency can more effectively deter firms from engaging in a bid rigging.

In the long run Korean government should revise the KFTA so that a private individual can easily raise antitrust damage suit. Even though Clause 56 of the KFTA articulates that wrongdoers are liable for victim's damage, Clause 57 of the KFTA stipulates that the victim can demand a claim for damage only after the settlement of the KFTC corrective measures.

Accordingly, it is very difficult that sufferer, on whom economic harm is inflicted, recovers economic injury through the other way than KFTC channel. We can say that the enforcement of the KFTA is almost monopolized by the KFTC. According to Clause 750 of the Civil Law, an injured party can demand compensation for damage incurred by unlawful act.

However, the victim can not recoup the proper damage

payment because tort liability in the Civil Law is based on the negligence rule, and thus she must prove the injury in fact and the causality between concerned tort and economic harm. So the KFTC needs to revise or delete Clause 57 of KFTA in such a way that private agent may have an incentive to voluntarily detect illegal acts and make a civil damage suit. Under the current KFTA, civil damage suit is barred by the prescription lapse of one year. The period of prescription limited to one year after the corrective measure of the KFTC is shorter than the prescription lapse of three years in Korea Civil Law as well as the prescription lapse of three to four years in Japan and US antitrust law.

The negative prescription period of one year should be extended to three years. These measures for the activation of civil damage suit will be supplemental to the limited law enforcement capacity of KFTC's own, and effective in deterring the illegal acts in market.

Recently, the government announced that in principle it would gradually go back to the lowest price auction system. As earlier noted, starting from 2001, the lowest bid will win a contract for construction works more than 100 billion won in contract size. Gradually the coverage of lowest bid system will be extended to other projects.

The extension of lowest price auction to other projects will depend on the successful establishment of supervision and guarantee system for the completion of construction. Government policy direction set on the lowest price auction

system is in principle right. However, the lowest price auction system is highly likely to lead to dumping price and shoddy construction. The lowest bid system can be working well if and only if the surety certificate and supervision system is well equipped and strictly enforced. The issuer of surety certificate for the completion of construction should set up a fair and transparent standard to curb the dumping price.

The letter of guarantee should not be issued if the contract price ratio is fall short of a bid price at least covering construction cost and normal profit. Construction supervision is strictly enforced toward shoddy construction, for which the concerning constructor is penalized in such a manner that it is barred from the bidding competition for a fixed period of time.

Even in the case of inevitable cost overrun due to the change in construction draft, the government need to share the cost overrun with the concerning contractor, just like risk-sharing contract. The fixed price contract with bidding competition should be generally applied to most projects, where-as the cost-plus contract with bidding competition should be exceptionally permitted.

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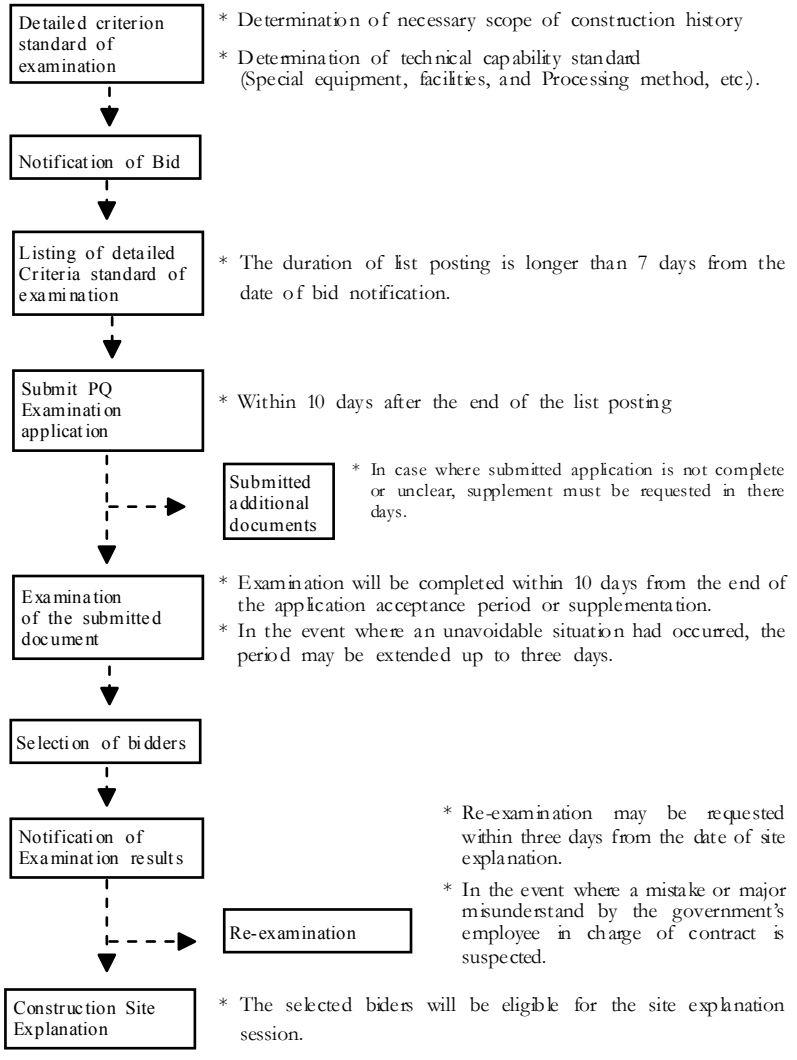
<Appendix 1> Pre-qualification (PQ) Procedures



<Appendix 2> 1995 Market Share

Bidder	Market share	Bidder	Market share
firm71	9.84	firm25	1.35
firm11	5.75	firm35	1.25
firm27	4.59	firm88	1.24
firm43	4.28	firm67	1.08
firm81	3.68	firm14	1.07
firm48	2.93	firm33	1.02
firm63	2.91	firm36	1.00
firm55	2.82	firm30	0.80
firm52	2.46	firm76	0.78
firm78	2.42	firm145	0.74
firm87	2.38	firm41	0.71
firm56	2.36	firm148	0.65
firm61	2.34	firm77	0.63
firm90	2.33	firm62	0.58
firm83	2.28	firm124	0.54
firm74	2.22	firm140	0.51
firm94	2.19	firm54	0.47
firm44	2.11	firm16	0.42
firm70	1.87	firm128	0.39
firm75	1.76	firm158	0.39
firm85	1.76	firm107	0.38
firm40	1.75	firm111	0.34
firm20	1.68	firm150	0.34
firm86	1.63	firm134	0.34
firm29	1.57	firm130	0.32
firm18	1.57	firm158	0.32
firm58	1.55	firm64	0.31
firm13	1.53	firm65	0.29
firm53	1.53	firm39	0.26
firm61	1.49	firm129	0.26
firm7	1.37	firm131	0.24

1996 Market Share

Bidder	Market share	Bidder	Market share
firm71	12.40	firm73	0.59
firm52	7.04	firm67	0.57
firm56	5.35	firm16	0.56
firm48	5.34	firm99	0.54
firm42	4.43	firm94	0.52
firm70	3.90	firm109	0.52
firm65	3.22	firm92	0.51
firm54	2.71	firm37	0.50
firm74	2.57	firm80	0.50
firm14	2.52	firm24	0.48
firm69	2.10	firm31	0.46
firm88	1.99	firm142	0.37
firm64	1.90	firm143	0.37
firm11	1.77	firm32	0.36
firm63	1.71	firm3	0.35
firm81	1.67	firm100	0.34
firm17	1.64	firm82	0.34
firm46	1.58	firm112	0.33
firm58	1.53	firm140	0.31
firm4	1.52	firm57	0.28
firm43	1.43	firm44	0.27
firm152	1.43	firm95	0.27
firm61	1.42	firm135	0.25
firm20	1.39	firm124	0.24
firm55	1.33	firm105	0.22
firm34	1.27	firm83	0.21
firm5	1.19	firm47	0.21
firm90	1.15	firm114	0.20
firm87	1.03	firm50	0.19
firm104	1.01	firm28	0.19
firm19	0.98	firm116	0.18
firm59	0.91	firm66	0.18
firm139	0.87	firm76	0.17
firm84	0.84	firm148	0.17
firm35	0.80	firm126	0.15
firm86	0.78	firm157	0.15
firm75	0.73	firm106	0.15
firm45	0.69	firm153	0.14
firm40	0.65	firm68	0.14
firm60	0.62	firm117	0.13

1997 Market Share

Bidder	Market share	Bidder	Market share
firm152	0.34	firm85	0.19
firm56	0.14	firm58	2.95
firm132	0.34	firm5	0.67
firm83	0.24	firm43	5.69
firm7	1.43	firm110	0.26
firm31	1.36	firm115	0.76
firm20	1.59	firm127	0.14
firm78	0.56	firm16	0.74
firm61	1.52	firm94	0.19
firm6	1.12	firm3	1.05
firm89	0.56	firm70	1.55
firm95	0.67	firm87	3.05
firm81	0.53	firm107	0.83
firm79	0.93	firm147	0.35
firm101	0.23	firm8	0.21
firm44	2.70	firm133	0.17
firm120	0.37	firm119	0.98
firm48	4.76	firm49	0.18
firm108	0.91	firm51	0.13
firm96	0.15	firm62	0.96
firm12	0.15	firm149	0.24
firm65	1.39	firm151	0.17
firm136	0.41	firm9	0.72
firm1	0.94	firm121	0.20
firm26	0.54	firm140	0.20
firm118	0.14	firm91	0.40
firm75	2.05	firm2	0.77
firm125	0.81	firm137	0.13
firm52	3.70	firm76	0.12
firm25	1.02	firm155	0.42
firm46	3.55	firm60	0.33
firm97	0.50	firm55	1.06
firm23	0.12	firm122	0.21
firm143	0.15	firm98	0.17
firm102	0.18	firm144	1.01
firm113	0.46	firm156	0.29
firm21	2.15	firm146	0.11
firm104	0.22	firm19	0.89
firm59	0.17	firm14	4.86
firm111	0.32	firm54	1.02
firm154	0.28	firm71	9.31
firm88	4.62	firm74	3.46
firm42	5.88	firm105	0.20
firm93	0.42	firm38	0.25
firm17	0.57	firm64	0.96
firm77	0.25		

1998 Market Share

Bidder	Market share	Bidder	Market share
firm65	6.21	firm115	0.94
firm11	5.20	firm62	0.82
firm6	5.12	firm142	0.79
firm14	4.75	firm159	0.69
firm74	4.49	firm15	0.64
firm37	4.10	firm42	0.61
firm71	3.96	firm70	0.60
firm106	3.94	firm113	0.56
firm27	3.68	firm160	0.56
firm48	3.64	firm161	0.53
firm93	3.41	firm162	0.50
firm87	2.68	firm163	0.49
firm3	2.58	firm55	0.47
firm58	2.51	firm164	0.44
firm89	2.50	firm7	0.44
firm86	2.43	firm10	0.32
firm103	2.41	firm104	0.31
firm22	2.19	firm99	0.28
firm95	1.94	firm72	0.28
firm85	1.94	firm123	0.27
firm94	1.94	firm92	0.27
firm31	1.81	firm80	0.26
firm25	1.72	firm165	0.26
firm56	1.65	firm110	0.25
firm107	1.60	firm166	0.25
firm114	1.58	firm19	0.21
firm1	1.34	firm167	0.21
firm141	1.32	firm168	0.21
firm4	1.29	firm138	0.21
firm77	1.01	firm169	0.20
firm108	0.99	firm170	0.20
firm125	0.96		

1999 Market Share

Bidder	Market share	Bidder	Market share
firm194	7.52	firm160	1.09
firm70	5.72	firm177	1.05
firm42	5.54	firm120	0.96
firm103	5.14	firm167	0.96
firm85	4.82	firm141	0.85
firm7	3.41	firm44	0.84
firm106	3.20	firm184	0.79
firm15	3.17	firm71	0.76
firm56	3.09	firm78	0.72
firm144	2.91	firm168	0.66
firm14	2.84	firm80	0.66
firm31	2.73	firm182	0.61
firm195	2.72	firm178	0.61
firm92	2.47	firm180	0.58
firm188	2.46	firm183	0.56
firm22	2.35	firm179	0.56
firm89	2.14	firm181	0.48
firm123	2.08	firm187	0.47
firm196	1.99	firm176	0.46
firm164	1.86	firm40	0.46
firm55	1.86	firm175	0.45
firm90	1.70	firm189	0.43
firm117	1.68	firm171	0.42
firm57	1.64	firm191	0.39
firm193	1.61	firm173	0.38
firm186	1.56	firm174	0.37
firm52	1.54	firm190	0.35
firm172	1.39	firm68	0.32
firm185	1.31	firm192	0.32

<Appendix 3> Average Ratio of Contract Price to Estimated Price by Province

		1995	1996	1997	1998	1999	2000 Jan - Apr
Kyonggi	Road	75.62	85.32	94.24	76.31	73.67	73.01
	Architecture	87.98	85.09	81.85	77.49	72.51	72.99
	Railroad	95.00	91.40	89.20	73.28	-	-
	Civil engineering	88.43	88.10	94.68	88.24	-	-
Chungnam	Road	80.58	76.99	87.85	83.27	69.03	-
	Architecture	85.33	89.90	78.87	70.09	88.78	-
	Railroad	-	90.59	89.40	-	72.98	73.24
	Civil engineering	-	-	92.70	-	-	-
Chungbuk	Road	84.30	84.01	68.70	69.03	73.04	-
	Architecture	71.11	-	94.27	69.09	-	-
	Railroad	-	-	-	-	-	-
	Civil engineering	-	94.81	-	-	-	-
Gyeongnam	Road	81.77	83.94	80.62	83.12	70.01	73.05
	Architecture	78.08	87.08	80.79	76.92	72.97	72.97
	Railroad	74.52	70.41	92.30	72.02	73.06	-
	Civil engineering	92.15	92.27	93.51	-	85.14	73.00
Kyongbuk	Road	76.61	75.84	84.90	74.98	70.98	-
	Architecture	85.88	86.93	87.01	80.87	73.23	-
	Railroad	-	92.60	92.05	-	72.97	-
	Civil engineering	-	-	91.84	-	-	-
Kangwon	Road	93.44	89.99	90.25	69.04	73.70	-
	Architecture	92.60	89.23	94.55	-	-	-
	Railroad	-	68.88	-	-	-	-
	Civil engineering	91.22	-	-	93.41	-	72.97
Jeonnam	Road	90.17	90.66	84.46	79.67	71.68	-
	Architecture	67.44	91.02	76.22	77.68	70.11	-
	Railroad	81.16	85.50	77.00	83.31	69.72	73.39
	Civil engineering	92.04	-	94.93	-	-	-
Jeonbuk	Road	81.41	74.73	79.63	82.19	71.18	-
	Architecture	92.15	-	93.44	93.32	71.04	73.38
	Railroad	-	-	94.70	-	-	-
	Civil engineering	72.95	-	-	-	-	-
Cheju	Road	69.51	70.20	67.32	69.05	70.21	-
	Architecture	90.68	90.45	-	-	-	-
	Railroad	-	-	-	-	-	-
	Civil engineering	-	-	-	-	-	-