

The Persistence of Tacit Collusion During Cartel Periods: Evidence from South Korean Public Procurement

Hong Lee*

Jungmin Kim[†]

October 15, 2024

[Preliminary Draft: Please Do Not Distribute]

Abstract

Firms involved in collusion often claim that some procurement bids during the cartel period were conducted competitively. Collusive price signaling, however, suggests that they implicitly learn each other's types during explicit conspiracy, enabling tacit collusion in allegedly competitive bids. This paper examines this phenomenon of "During-Cartel Tacit Collusion (DCTC)" hypothesis in the context of government public procurement for water purification industry in South Korea. We test this hypothesis using a difference-in-difference method to evaluate whether there is any significant drop in bids allegedly made in a competitive environment when cartel collapses. Our analysis is based on comprehensive administrative bidding data from 2000 to 2024. The findings suggest that cartel overcharges might be underestimated if the subnormal markup created by DCTC is not properly accounted for in antitrust litigation.

*Department of Business Economics and Public Policy, Kelley School of Business, Indiana University Bloomington, email: hgle@iu.edu.

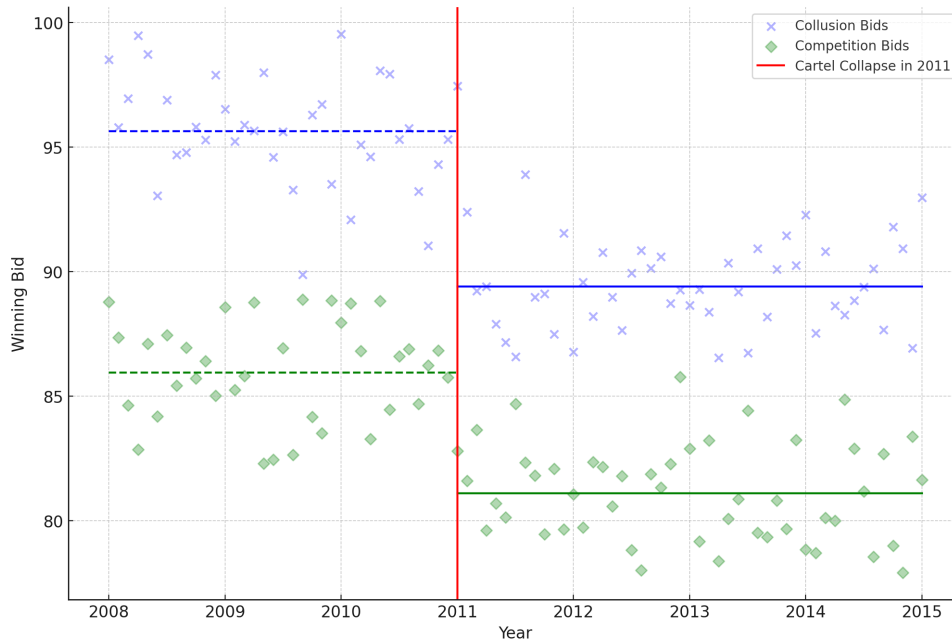
[†]Associate Research Fellow, Seoul Institute, email: zjminkim@gmail.com.

1 Introduction

Collusion among firms to fix prices or allocate markets is a significant concern for competition authorities worldwide. Cartels, which are formal agreements among competing firms to control prices or exclude entry of new competitors, have been extensively studied due to their detrimental impact on market efficiency and consumer welfare (Green and Porter, 1984; Rotemberg and Saloner, 1986). While much attention has been given to the formation and operation of cartels, the behavior of firms during the cartel period, particularly in allegedly competitive bids, is less understood. During-Cartel Tacit Collusion (DCTC) refers to the subtle, unspoken agreements and strategies that firms use to maintain collusive behavior even when they claim that competitive conditions exist.

This paper investigates DCTC within the context of government public procurement in South Korea. Despite the claims by firms that some procurement bids during the cartel period were conducted in a competitive environment, it is possible that firms implicitly learn about each other's behavior through explicit conspiracy, enabling tacit collusion in these bids. By examining these dynamics, we aim to provide insights into the presence of tacit collusion during the cartel period and its impact on bidding outcomes.

Figure 1. Winning Bids Over Time: Collusion vs Competition



Our primary objective is to explore whether firms involved in collusion behave differently in supposedly competitive procurements during the cartel period compared to truly competitive procure-

ments. Specifically, we aim to understand if there are significant differences in bidding ratios between pre- and post-collusion periods for collusion-affected constructions and non-collusion-affected constructions. By analyzing these differences, we seek to identify the presence of tacit collusion during the cartel period.

To test our hypothesis, we utilize comprehensive administrative bidding data from 2000 to 2024 in South Korea. This dataset includes all procurement bids, providing a rich and detailed view of the bidding behavior of firms across various projects and over a substantial period. The extensive nature of the dataset allows us to draw robust conclusions about the presence and persistence of DCTC.

Our empirical methodology involves using a difference-in-differences (DiD) approach to evaluate whether there is a significant drop in bids that were allegedly made in a competitive environment when the cartel collapses. The DiD method is particularly well-suited for this analysis as it allows us to compare the changes in bidding behavior between collusion-affected and non-collusion-affected constructions before and after the collapse of the cartel. This approach helps isolate the effect of the cartel's collapse on bidding behavior and assess the persistence of collusive pricing.

The findings from our analysis have several important implications. First, they provide empirical evidence on the existence and nature of DCTC in public procurement. By showing that firms continue to engage in tacit collusion even when claiming competitive behavior, our results challenge the assumption that the mere presence of competitive bids ensures market efficiency. Second, our findings suggest that cartel overcharges might be underestimated if the subnormal markup created by DCTC is not accounted for in antitrust litigations. This has significant implications for the calculation of damages and the design of antitrust penalties. Finally, our study contributes to the broader literature on collusion by providing new insights into the behavior of firms during the cartel period and the persistence of collusive pricing strategies.

Overall, this research enhances our understanding of collusion in public procurement and offers valuable policy recommendations for regulators. By identifying the presence of DCTC and its impact on bidding outcomes, we highlight the need for more effective and targeted interventions to prevent and detect collusive behavior in public procurement markets.

The remainder of this paper is organized as follows: Section 2 reviews the previous research on secondary markets. Section 3 explains the theoretical framework. Section 4 introduces the policy change in South Korea used to examine the empirics. Section 5 discusses the data, and Section 6

presents the main results. Section 7 explores alternative mechanisms and Section 8 concludes.

2 Literature Review

The study of collusion has long been a central topic in industrial organization and antitrust economics. Traditional models of collusion, such as those discussed by [Green and Porter \(1984\)](#) and [Rotemberg and Saloner \(1986\)](#), emphasize the conditions under which firms can sustain collusive agreements. These models highlight the importance of factors such as market concentration, product homogeneity, and the frequency of interactions among firms. However, the behavior of firms during the cartel period, especially when they claim to engage in competitive bidding, remains less explored. [Harrington \(2004\)](#) provides a theoretical framework for understanding post-cartel pricing during litigation, showing that firms have incentives to maintain high prices to reduce expected damages. His work suggests that prices can remain elevated due to strategic pricing aimed at minimizing legal penalties. [Erutku \(2012\)](#) tests some of these predictions using data from a retail gasoline cartel in Quebec, finding evidence that supports Harrington's theory. Their findings indicate that firms' pricing strategies are influenced by the anticipated legal consequences and the duration of the cartel.

The concept of tacit collusion, where firms coordinate their behavior without explicit communication, is crucial for understanding collusive dynamics during the cartel period. As discussed by [Green et al. \(2014\)](#), tacit collusion can occur in oligopolistic markets where firms can predict each other's actions based on historical pricing patterns. This type of collusion is more likely to persist in markets with fewer firms, where coordination is easier and more effective. Empirical studies on collusive behavior during the cartel period have provided valuable insights into the persistence of collusive behavior. [Igami and Sugaya \(2022\)](#) and [Kovacic et al. \(2007\)](#) provide empirical insights into the persistence of collusive behavior in the vitamins market. Their findings suggest that market structure and firm characteristics significantly influence the likelihood of continued collusion. In particular, their research highlights the role of market concentration and the number of competitors in facilitating or hindering tacit collusion.

Moreover, [Harrington \(2004\)](#) and [Erutku \(2012\)](#) suggest that tacit collusion generates a downward bias in the estimated cartel overcharges because prices remain elevated, masking the true competitive baseline prices. This bias can lead to underestimating the economic harm caused by cartels and subsequently to insufficient antitrust penalties. Our study builds on this literature by focus-

ing on the public procurement sector in South Korea, examining how firms involved in collusion behave during the cartel period. By distinguishing between collusion-affected and non-collusion-affected constructions, we contribute to the understanding of tacit collusion dynamics. Additionally, we utilize unique bidding data from government public procurement projects, which provides a rich context for analyzing collusive behavior in a real-world setting.

3 Theory

To understand the dynamics of During-Cartel Tacit Collusion (DCTC) in public procurement, we develop a theoretical model based on the framework provided by [Harrington \(2004\)](#) and extended by [Erutku \(2012\)](#). Our model considers the behavior of firms during the cartel period and compares it to non-collusion periods.

3.1 Assumptions

1. Market Structure:

- Collusion-Affected Constructions: Projects where firms have been found to collude.
- Non-Collusion-Affected Constructions: Projects where firms claim to have engaged in competitive bidding.

2. During-Cartel Behavior:

- Firms aim to maximize profits while maintaining the appearance of competitive bidding.
- Collusion-affected constructions should exhibit no significant difference in bidding ratios pre- and post-collusion if DCTC is present.
- Non-collusion-affected constructions should exhibit significant differences in bidding ratios if competitive conditions exist.

3. Price Dynamics:

- Firms set prices based on the expected reaction of competitors and potential legal repercussions.
- Bidding ratios are influenced by the duration of the cartel and the concentration of the market.

3.2 Model

Let P_c be the collusive price during the cartel period, P_{bf} the but-for price (the price that would have prevailed without collusion), and P_{dctc} the price during the DCTC period. Following [Harrington \(2004\)](#), the DCTC price P_{dctc} can be influenced by the weight firms put on maintaining the appearance of competition, denoted by λ .

In collusion-affected constructions, the price during DCTC $P_{dctc}^{\text{collusion}}$ is modeled as:

$$P_{dctc}^{\text{collusion}} = P_{bf} + \lambda(P_c - P_{bf}) \quad (1)$$

where $0 < \lambda < 1$.

In non-collusion-affected constructions, the price during DCTC $P_{dctc}^{\text{non-collusion}}$ is modeled as:

$$P_{dctc}^{\text{non-collusion}} = P_{bf} \quad (2)$$

assuming that competitive conditions prevail.

3.3 Predictions

1. Bidding Ratios:

- There should be no significant difference in the bidding ratios for collusion-affected constructions pre- and post-collusion if DCTC is present.
- There should be significant differences in the bidding ratios for non-collusion-affected constructions if competitive conditions exist.

2. Price Rigidity:

- Prices in collusion-affected constructions exhibit higher rigidity during the cartel period compared to non-collusion-affected constructions.

3. Duration of Tacit Collusion:

- Tacit collusion persists longer in collusion-affected constructions due to easier coordination among fewer firms.

By empirically testing these predictions using the South Korean public procurement data, we aim to provide insights into the mechanisms and persistence of DCTC and collusive price hysteresis in different market structures. Our findings will have important implications for antitrust enforcement and policy design in public procurement markets.

4 Institutional Background

(Later added)

5 Data

(Jungmin Add)

6 Empirics

6.1 Empirical Results

We develop

7 Discussion

Here we discuss

- Robustness check
- Alternative mechanism

8 Conclusion

Conclude and introduce the limitation of our approach

References

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A Appendix Title A