

ESSAYS ON CARTELS IN KOREA

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## ABSTRACT

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The first essay “An Empirical Study of Anti-Cartel Enforcement Policies in Korea” investigates and compares the impacts of the anti-cartel policies on stabilizing cartels and voluntarily revealing incriminating evidence. The three policies, which were innovated in Korea around 2005, are the following: i) a more generous and predictable leniency program, ii) expansion of resources, and iii) a harsher maximum fine ceiling. In order to identify these policy effects, hazard rate models are used with a sample of 327 cartel cases determined by the Korea competition agency from 2000 to 2010. The results show that the new leniency program and the resource expansion have a significantly positive impact on destabilizing cartels in the short run, while the long run effects for both policies are ambiguous. Also, the announced harsher fine rule, as well as the actual fines imposed by the competition authority, decrease the duration of discovered cartels. Pertaining to evidence disclosing sthe effects of the three policies, a raised fine ceiling shows significantly greater impact than the new leniency program. However, the expansion of resources fails in disclosing incriminating evidence.

The second essay “An Empirical Study of Cartels with Ringleaders in Korea” explores how a cartel organization strategically chooses its structure to alleviate cheating and to sustain collusion. It focuses on organizational roles of cartel ringleaders. Using a choice model with a sample of Korea’s 327 cartel cases from the 2000 to 2010, the research identifies the features of cartel ringleaders, and then analyzes in what kinds of situations they tend to appear. The findings indicate that cartel ringleaders are more prevalent in the circumstances where a cartel is more difficult to sustain. The probability of ringleader-involved cartels increases as more firms, greater size asymmetry, or less product homogeneity exists in a cartel. It is probable that a cartel endogenously develops its organizational structure in response to market circumstances. By choosing a

ringleader-based cartel structure, firms can make incentive-compatible constraints less binding by reducing distrust among themselves. This finding is confirmed for aggressive ringleaders who play an active role in cartels (i.e., determining cartel plans) compared to organizational ringleaders who play an administrative role in cartels (i.e., convening meetings). Last, the findings indicate that ringleaders are significantly less likely chosen in cartel structures under the circumstances where other alternative monitoring mechanisms, such as an industry association, exist.

Finally, the third essay “What Governs Cartels?: Evidence from Korea” explores what actually governs a cartel. Even though multiple firms cooperate to manage a cartel, the cartel frequently develops additional monitoring mechanisms to sustain it. This study investigates what types of monitoring mechanisms a cartel has, and whether they effectively stabilize a cartel or not. The study also compares the impact of different types of monitoring on cartel stability. Expectedly, mechanisms controlling a cartel significantly decrease the likelihood of cartel death. However, involvement of an industry association is less effective in stabilizing a cartel than existence of regular meetings composed of cartel firms. Also, an industry association increases stability less in cases of “death by anti-trust” cartels than in cases of “natural death” cartels. However, a regular meeting in a cartel decreases the likelihood of death more in “death by anti-trust” cartel cases than in “natural death” cases. Last, involvement of a higher level of personnel in each firm with a cartel stabilizes “natural death” cartels, while it destabilizes “death by anti-trust” cartels.

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# CHAPTER 1

## An Empirical Study of Anti-Cartel Enforcement Policies in Korea

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### 1.1 Introduction

There have been debates over how mindful an anti-trust agency should be when intervening in a market to regulate collusive agreements. However, one of the important fields of anti-trust policies today, in practice, is to detect cartels in the market. Stigler (1964) questions the sustainability of collusive agreements because of the enforcement problems such as detection and punishment. Along this vein, it is not always necessary for governments to intervene in the market to deter collusion because collusion ends in a natural death due to firms' strong temptation to cheat. However, in recent studies on cartels- especially since a leniency program was introduced in the US in 1978- many economists and policy-makers agree that cartels such as price fixing or market allocation behaviors should be regulated through anti-trust intervention to enhance market competition and consumer welfare.<sup>1</sup> In reality, despite continuous efforts of anti-trust agencies, firms still form cartels in various and secretive ways. They have incentives to collude if long-run forgone future profits responding to the retaliation by other firms are greater than short-run deviation profits, even though their behaviors can be adjusted for costs and probability of capture. Therefore, many anti-trust agencies worldwide have cultivated policy environments by innovating anti-cartel policies and enhancing detecting capabilities.<sup>2</sup> The change of policy parameters has an effect on a firm's

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<sup>1</sup>See Motta and Polo (2003), Spagnolo (2004), Hammond (2004), Harrington and Chang (2009), and Miller (2009). They show theoretical framework or empirical analysis on anti-trust interventions. According to the FTC (Fair Trade Commission), about 130 jurisdictions have antitrust or consumer protection laws. (<https://www.ftc.gov/policy/international/competition-consumer-protection-authorities-worldwide>)

<sup>2</sup>Harrington and Chang (2008) argue that when a competition policy is made tougher with a higher detection rate and a harsher penalty rate, the value to forming a cartel is reduced.

incentive compatibility constraints (ICC) regarding colluding versus deviating. In other words, firms face different long-term benefits from colluding and short-term benefits from deviating as the anti-cartel policy parameters change.

The most successful innovation against cartels is a leniency program, which originated in 1978 from the US Anti-trust Division of the Department of Justice (DOJ). However, it was not so effective until it was revised in 1993. The main change was that the eligibility of granting leniency is wider and the requirements have become more predictable. A full automatic fine reduction to a first informant and a criminal amnesty for individuals are provided when reported *before* an investigation has been launched.<sup>3</sup> After the success of the US DOJ in 1993, many competition authorities in other countries began to introduce the program.<sup>4</sup> Anti-trust agencies also increase maximum fines and resources such as budget and workforce for detecting and deterring cartels. Motta and Polo (2003) argue that if resources are sufficient to deter collusion, utilizing full fines is preferred over a leniency program for maximizing social welfare. However, they also argue that a leniency program may be optimal due to limited resources.

It is difficult to discover whether or not these anti-cartel policies are effective as expected, since we observe only discovered cartels, not a potential population of cartels. For example, even though anti-trust agencies have been discovering more cartels since the changes in the anti-trust policy, it might result from the success of the policy (where detection rates increase) or its failure (where formation rates increase). To specify, innovation of the leniency program can increase cartel formations because a reduction of expected fines is granted if firms report when or before cartels are detected. In contrast, the program can lead cartels to collapse by increasing the probability of detection. *À priori*, it is difficult to conclude which impact dominates. If the current detection capability of the anti-trust agency is high enough, enhancing its capability may have less effect

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<sup>3</sup>There are three major changes. First, amnesty is automatic if there is no pre-existing investigation. Second, amnesty is also available even if cooperation begins after an investigation is underway. Third, if a corporation qualifies for automatic amnesty, then all directors, officers, and employees who come forward with the corporation and agree to cooperate also receive automatic amnesty. Refer to “The modern leniency program after ten years” presented by James M. Griffin in 2003. (<https://www.justice.gov/atr/speech/modern-leniency-program-after-ten-years-summary-overview-antitrust-divisions-criminal>)

<sup>4</sup>The European Commission sets up an LP in 1996, Korea in 1997, UK in 2000, France and Germany in 2001, Japan in 2005.

on the ICC that a firm faces. However, if the detection capability of the anti-trust agency is low enough, the policy change can disrupt cartels by enhancing the agency's detection capability even a little. Also, it is not simple to determine which policy between increasing resources and a leniency program contributes more to disrupting cartels. In addition, it is conventional wisdom that increasing penalties may make firms more likely to deviate by raising the expected cost of collusion, holding other things constant. However, if the current fine level imposed on cartels is too low, and still below the current maximum fine ceiling, increasing the ceiling may not necessarily change a firm's incentive. Thus, evaluating the efficacy of anti-cartel policies is an empirical issue.

Around 2005, the Korea Fair Trade Commission (KFTC) innovated anti-cartel policies toward more aggressive enforcements. These policies can be categorized into three groups: i) revising a leniency program more generously and predictably, ii) enlarging a cartel investigation organization with more staff and budgets, and iii) raising the maximum fine ceiling against cartel behavior. These changes of the policy environment with time and case-variations can be a favorable opportunity for a natural experiment, where the impact of anti-cartel policies on cartels can be empirically estimated. The main objective of these policy changes is to destabilize and deter cartels by modifying firms' incentives. Additionally, when the KFTC investigates and prosecutes the violation, these policies can contribute to enhancing the conviction probability by making firms voluntarily provide more hard evidence necessary for establishing the wrong-doing. This article mainly attempts to obtain adequate answers to the following questions: i) Do the three anti-cartel policies have sufficient impact on disrupting cartels in the market before cartels are detected? ii) Do these policies make cartel members voluntarily disclose their incriminating evidence after cartels are detected?

In the current paper, the impact of both the new leniency program and empowered resources on cartel stability are explored and compared, using survival analysis. Also, an increased fine ceiling against cartels is investigated, which is compared to the effect of an actual fine amount on cartel behaviors to derive more abundant conclusions. Second, the effect of the policies on revealing incriminating evidence is also tested using OLS. Previous studies mainly focus on the effect of a

leniency program. Even though anti-cartel policies such as the leniency program usually tend to be planned and enforced with the change of fine rule and organizational resources of the anti-trust agencies, those studies do not distinguish the impact of these policies. For example, Brenner (2009) tests Harrington and Chang's (2009) hypotheses with EC (European Commission) cartel data from 1990 and 2003 without considering the change of "Guidelines on the method of setting fines", which became effective on January 14, 1998. Also, Choi and Hahn (2014) examine the impact of the corporate leniency program using Korea data from 1981 and 2012. However, neither the restructuring of the cartel investigation organization in December 2005, nor the revised guideline which doubled the fine ceiling against cartels is explicitly considered. It may be because it is apparently difficult to divide the policy effects. However, without isolating the individual effects, there may exist the possibility that the impact of the leniency programs is overestimated if other policies modified with the leniency program also have disruptive effects on cartels. Exceptionally, Zhou (2012) isolates the effect of the leniency program in the EU from that of other institutional changes by restricting the sample to the cartel cases that dissolved before the major change in the EU's anti-cartel regime.<sup>5</sup> However, the study does not compare the effect of the leniency program and other institutional change. Also, the revision of "Guidelines on the method of setting fines" in 2006 has not been examined.<sup>6</sup>

The present paper extensively tests the main hypotheses that Harrington and Chang (2009) propose regarding anti-cartel policies. This study might be one of the first empirical papers that separately compare impacts of a leniency program and increased resources on cartel sustainability. The results show that both the newly revised leniency program, which grants an automatic full fine reduction to a first reporter, and the increased resources with a fourfold increase in investigation workforce have significantly positive effects on destabilizing cartels in the short run. "Marginal cartels," rather than stronger and longer duration cartels, are more likely to dissolve, and so we

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<sup>5</sup>The White Paper, announced in April 2, 2008, "suggests specific policy options and measures that would help giving all victims of EU antitrust infringements access to effective redress mechanisms so that they can be fully compensated for the harm they suffered." See <http://ec.europa.eu/competition/antitrust/actionsdamages/index.html> for details.

<sup>6</sup>The detailed EC's guideline can be available in the website, <http://ec.europa.eu/competition/antitrust/legislation/fines.html>

observe the longer durations of discovered cartels as Harrington and Chang (2009) predict. These results are consistent with Motta and Polo (2003), who argue that, when a competition authority has limited resources, a leniency program can be optimal in a second-best perspective.<sup>7</sup> However, in the long run, both policies show ambiguous results. A possible interpretation is that the increased cartel durations in the short run due to marginal cartel break-down seem to be almost offset with the reduced cartel duration due to the deterrence effects in the long run. The results cannot significantly confirm, for the sample period, which effect is dominant between the deterrence effects (decreasing cartel durations) and the short run effects (increasing cartel durations). Another possibility is that a cartel may endogenously develop its alternative collusive governance to facilitate collusion through learning-by-doing effects or some trustworthy tools such as industry associations or ringleaders in the long run. If so, an antitrust policy desisting current collusive agreements may fail in deterring future collusion in the long run. The third policy that raises the fine rate ceiling, as well as the actual fine imposed by the KFTC shows positively significant effects on disrupting cartels. This result implies that when a firm considers the expected cost for collusive behavior, not only the history of penalty, but also the announced fine rule affects the behavior.

For the incriminating evidence effects, the revised leniency program and the harsher maximum fine ceiling have significantly positive effects on revealing information. Leniency program effects are smaller. This result is possibly because a leniency program applies to only leniency applicants, while a general fine guideline applies to all cartel members. However, the increased resources do not show any significantly positive effects on evidence revealing.

The remainder of the paper is organized as follows. The next section reviews the previous literature on the impact of anti-cartel policies. Section 3 explains institutional backgrounds and offers a simple model that shows how an anti-trust agency changes an incentive compatibility constraint that a firm may face. In Section 4, the data set is described. In Section 5, effects of the anti-cartel policies on cartel stability are explored before of those policies on revealing incriminating evidence are presented in Section 6. Finally, Section 7 concludes the paper.

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<sup>7</sup>They argue that when a competition authority has sufficient resources, using a full fine is the best for maximizing social welfare rather than implementing a leniency program.

## 1.2 Literature Review

From the perspective of firms, the antitrust agency's policy enters through policy parameters such as a fine rate, the probability of detection and prosecution, monitoring resources, etc. (Aubert et al, 2006; Harrington and Chang, 2009; Motta and Polo, 2003). Theoretically, a leniency program has ambiguous impact on the sustainability of cartels, as it has two opposite effects. A leniency program can make enforcement more effective by *ex-post* destabilizing cartels (Harrington, 2008; Spagnolo, 2004), while it might also induce collusion by *ex-ante* decreasing the expected cost of violation of anti-trust law (Chen and Harrington, 2007; Ellis and Wilson, 2003; Spagnolo, 2000). Motta and Polo (2003) further argue that a leniency program is supposed to be the second best in detecting cartels. In other words, if the investigation resources available to an anti-trust agency are sufficient to prevent collusion using full fines, a leniency program had better not be used. However, a leniency program may be socially desirable because investigation by an anti-trust agency requires scarce resources, which may be saved by making cartel participants reveal any incriminating evidence (Kaplou and Shavell, 1944). These concerns should be empirically tested in order to resolve them adequately.

However, as many previous empirical papers on cartels indicate, studying the efficacy of anti-cartel policies on cartel stability has a few inherent limitations for the following reasons. Since we cannot observe the potential population of cartels in the market, there can be a sample selection bias (Brenner, 2009; Harrington and Chang, 2009; Levenstein and Suslow, 2006; Miller, 2009). We only perceive cartels discovered by anti-trust agencies, but do not exactly know how many undiscovered cartels exist in the market. For instance, even though the number of detected cartels following policy changes increases, we cannot argue that the new anti-cartel policy is efficacious. It is because the number of detected cartels can decrease with more effective policy than before. If the new policy is semi-successful, such that the cartel formation rate decreases but the detection rate remains unchanged, the number of detected cartels can decline. Thus, adequate proxies and conditions to analyze the effectiveness of the policies are needed. Miller (2009) and Harrington and

Chang (2009) independently developed theoretical frameworks with which to study the efficacy of anti-cartel policies.<sup>8</sup> Both of their frameworks argue that the short-term and long-term efficacy of the policy should be considered separately. Miller (2009) shows that if a leniency program is effective to deter cartels, the number of detected cartels will increase in the short run, and then decrease to below the pre-lenieny level in the long run. On the other part, Harrington and Chang (2009) show that an efficacious leniency program should increase cartel durations in the short run while the long run effect is ambiguous. The intuition is somewhat simple. Assume that before a leniency program is introduced or revised more leniently, there were marginal cartels, where firms were indifferent between colluding and competing because long-term profits from colluding and short-term profits from deviating were equal. Now, if a new or innovative leniency program is introduced and has destabilizing effects on current cartels, then the marginal firms' deviating benefits exceed colluding benefits, which leads the marginal cartels to dissolve. These short-run effects make the average durations of discovered cartels longer. However, in the long run, even strongly sustainable cartels can collapse because of the forceful deterring effects of the leniency program, which shorten the cartel duration. Thus, the total effect depends on the magnitude of both short-run and long-run impacts. However, unlike a leniency program, the policy that increases detecting probability shortens the duration of discovered cartels as the industry goes from short-run to long-run.

Miller (2009) also empirically predicts the impact of the new leniency program on the US cartel cases. The introduction of the new leniency program was implemented on August 10, 1993. Under the old leniency program, the DOJ approved leniency status only on a discretionary basis and for cartel members who had reported their violation before an investigation started. He finds that cartel detection and deterrence capabilities are enhanced under the new leniency pro-

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<sup>8</sup>Miller (2009) develops a theoretical model that provides empirical predictions and moment conditions to analyze the effects of the new leniency program revised in 1993 in the US. He assumes that the formation rate, the detection rate, and the dissolution rate of cartels are constant and are determined outside of the model, while Harrington and Chang (2009) assume that those rates are endogenized in the model. Also, Miller (2009) focuses on the frequency of cartel, whereas Harrington and Chang (2009) argue that the frequency of cartel cannot be representative proxy in evaluating the success of some policies such as a leniency program and detecting capability, because they can increase or decrease the number of discovered cartels.

gram by showing that the number of cartel discoveries increases in the short run and then falls below the pre-leniency level. He uses Poisson regression with finally identified 40 DOJ cases from January 1, 1985 to March 15, 2005. Brenner (2009) explores an empirical evaluation of the initially introduced EC's leniency program in 1996 with 61 cartel cases between 1990 and 2003 to test Harrington and Chang's (2009) hypotheses. He finds that the duration of discovered cartels insignificantly increased since introducing the initial leniency program. However, he finds that this program had a significantly positive effect on reducing the investigation and prosecution costs. Zhou (2012) develops an empirical framework of Cox hazard model and uses 144 cartel cases between 1985 and 2012 to estimate the impact of newly revised EC's leniency program in 2002.<sup>9</sup> He finds the destabilizing efficacy of the new leniency program of the EC.<sup>10</sup> Choi and Hahn (2014) show the empirical evidence of the effectiveness of the new leniency program revised in 2005 on cartel stability with the 619 cases decided by the KFTC from 1981 to 2012. Also, Oindrila De (2010) and Feinberg et al. (2016) conduct duration analyses to extensively study the determinants of a cartel including leniency programs in the EU and Korea, respectively. Both studies find the programs are effective, even though the leniency programs are not the primary focus. However, as suggested above, these previous empirical papers do not separately consider the effects of other anti-cartel policies that might have affected cartel stability, even though those policies were changed and enforced with the leniency program at about the same time, with some interval. To identify and compare the individual policy effects on cartel firms' behaviors, it is desirable to separately evaluate those policies.

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<sup>9</sup>Like the US leniency policy prior to August 1993, the EC's policy did not provide automatic and complete amnesty from monetary fines. However, in February 2002, the program was revised to provide more generosity and less discretion of the authority. A first leniency applicant became given full fine reduction without uncertainty when a firm reports a cartel before the EC opens an investigation. This key change is very similar with the policy the US revised in 1993.

<sup>10</sup>He also finds the effectiveness of the US DOJ leniency program on cartel stability, using 294 DOJ cases from 1985 through 2005.



## 1.3 Background

### 1.3.1 The Collusion Game

#### 1.3.1.1 Timing

The setting of this model is based on Aubert et al. (2006). Two firms play an infinitely repeated game. Both firms have the same discount factor  $\delta \in (0, 1)$  and maximize the expected discounted sum of their profits. An Anti-trust Agency (AA) can impose fines on colluding firms and mandate corrective orders to prohibit them from colluding.<sup>11</sup> The timing is as follows:

1. At  $t = 0$ , the game begins with an AA setting the three policy parameters, which are the amount of full fine ( $F$ ), the degree of leniency ( $L$ ), and the amount of resources to detect a cartel ( $R$ ).

2. At  $t = 1$ , when an AA launches an investigation, firms decide whether to sustain collusion or to deviate for applying for leniency.

- i) If a firm deviates, it obtains a deviation profit,  $\pi^D$ , and pays a reduced fine,  $f$ . Also, it has to comply with AA's corrective order to cease collusion, which thereafter makes the firm obtain a competing profit,  $\pi^C$ , by continuing to compete.<sup>12</sup> However, the other firm gets  $\underline{\pi}$  when a firm deviates, and thereafter obtains  $\pi^C$ .

- ii) If a firm colludes, it continuously enjoys a collusion profit,  $\pi^M$ , and faces the expected fine,  $\rho F$ , where  $\rho \in (0, 1)$  is a conviction rate.

We assume that firms gain from collusion, but each firm benefits at the expense of the other from deviation, i.e., from competing when the other colludes. This implies the inequalities,  $\underline{\pi} \leq \pi^C < \pi^M < \pi^D$  and  $\underline{\pi} + \pi^D < 2\pi^M$  by efficiency effect. We moreover assume that a full fine is not

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<sup>11</sup>An anti-trust agency attempts to maximize consumer surplus by imposing fines on colluding firms. Moreover, the agency spends budgets and workforce to detect cartels. However, for simplicity, government's constraint is not considered here.

<sup>12</sup>It can be plausible if a firm who has a penalty history might face a substantially heavy fine and indictment. However, it may not be empirically plausible because a firm can re-negotiate its agreement, rather than reverting to  $\pi^C$ . Also, according to Green and Porter (1984), on-and-off cartels or periodic price wars can be an equilibrium without defecting from collusive agreements.

enough to deter collusion if it is imposed with probability  $\rho$ , implying that  $\rho F < \pi^M - \pi^C < F$ . The reduced fine is assumed to be lower than the expected fine from the AA's random investigation, meaning that  $f < \rho F$ .

### 1.3.1.2 AA's Policy Parameters

The AA exogenously sets  $F$ ,  $L$ , and  $R$  to deter collusion by revising anti-cartel policies. Moreover, we assume the following:

- i) The reduced fine,  $f$ , is decreasing in the degree of leniency,  $L$ , i.e.,  $f'(L) < 0$ .
- ii) The detection rate,  $\rho$ , is increasing in resources,  $R$ , i.e.,  $\rho'(R) > 0$ .<sup>13</sup>

### 1.3.1.3 Comparative Statics

The collusion is sustainable only if

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$$\delta \geq \delta^+ = \frac{\pi^D - \pi^M + \rho(R)F - f(L)}{\pi^D - \pi^C - f(L)} \quad (1.1)$$

If anti-cartel policies are made tougher, implying a higher value for a detection rate and a penalty, the value to forming a collusive agreement is reduced due to the increase of the expected fine. Also, when a leniency program grants larger leniency for a reporter, the deviating payoff increases. Therefore, the following comparative statics can be drawn from the model.

i) AA can reduce a discounted fine,  $f$ , by enhancing the extent of leniency,  $L$ . This policy can be implemented by introducing a leniency program or increasing the generosity and predictability of the old program. Then, the threshold,  $\delta^+$ , will increase, implying that firms are more likely to deviate from collusion, i.e.,  $\partial \delta^+ / \partial L = (\partial \delta^+ / \partial f)(\partial f / \partial L) > 0$ .<sup>15</sup>

ii) AA can also improve a detection capability,  $\rho$ , by increasing budgets and workforce to detect cartels implying expanding resources  $R$ . Then, the threshold,  $\delta^+$ , will increase, implying

<sup>13</sup>For simplicity, it is assumed that a detection probability depends on resources an anti-trust agency has. However, it might be possible that changes in the degree of leniency endogenously affect the probability of detection.

<sup>14</sup>The collusion is sustainable only if a long-term benefit from colluding is greater than a short-term benefit from deviating.  $[\pi^M - \rho(R)F] + \delta [\pi^M - \rho(R)F] + \delta^2 [\pi^M - \rho(R)F] + \dots \geq [\pi^D - f(L)] + \delta \pi^C + \delta^2 \pi^C + \dots$

<sup>15</sup> $\partial \delta^+ / \partial f = \frac{-[\pi^D - \pi^C - f(L)] + [\pi^D - \pi^M + \rho(R)F - f(L)]}{[\pi^D - \pi^C - f(L)]^2} = \frac{\pi^C + \rho(R)F - \pi^M}{[\pi^D - \pi^C - f(L)]^2} < 0$

that collusion is more likely to be destabilized, i.e.,  $\partial\delta^+/\partial R = (\partial\delta^+/\partial\rho)(\partial\rho/\partial R) > 0$ .

iii) AA can set a higher ceiling for maximum fine,  $F$ , which increase the threshold,  $\delta^+$ , meaning that cartels might become unstable, i.e.,  $\partial\delta^+/\partial F > 0$ .

### 1.3.2 Anti-Cartel Policy Innovations in Korea

Since the enactment of the anti-trust law in Korea, the Monopoly Regulation and Fair Trade Act (MRFTA) in 1980, and the KFTC the following year, anti-cartel policies have experienced many variations. The KFTC had introduced the initial leniency program in 1997, but the KFTC seemed to have difficulties in detecting secretive cartels until 2005, when it was revised. Before 2005, the KFTC did not have a publicly formal guideline on how to enforce a leniency program. Instead, the program had been operated based on related provisions of the MRFTA, which wrote only the basic principles and the maximum fine reduction rate for a leniency applicant. Therefore, it would be at the KFTC's discretion whether to grant leniency to a reporter or not and, if granted, how much of a discount in the fine would be provided. Also, the size of the organization for investigating a cartel was small, such that only one team with seven staff members oversaw cartel investigations. However, the KFTC, around 2005, experienced the three major innovative breakthroughs on anti-cartel policies toward tougher enforcements. The policies can be divided into three categories: a more generous and predictable leniency program, a deeper cartel investigation organization with more staff, and an increased maximum fine rate ceiling against cartels.<sup>16</sup>

At first, the new leniency program, on April 1, 2005, was overhauled to ensure leniency applicants a clear understanding of the program's procedures. Before then, the first leniency applicant was eligible for reduction of a fine by 75 percent or more only in the pre-investigation stage, while the reduction rate was reduced to less than 50 percent if the first applicant cooperated with the KFTC after an investigation was launched. More importantly, the KFTC had a wide range of discretion in granting leniency and deciding on the amount of discounted fines. Even worse, a leniency applicant did not know how much fine reduction would be granted until the case was finally

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<sup>16</sup>The related information on these three anti-cartel policies can be obtained from the news release of the KFTC. (<http://eng.ftc.go.kr>)

determined. Under the new program, as soon as a firm applies for leniency, the KFTC has to notify the firm of the eligibility of the leniency application. The discretion of the KFTC is minimized in judging the eligibility. Even before a leniency applicant confesses, the applicant can predict an automatic full leniency only if the applicant firm is eligible for a first reporter. In addition, this automatic full leniency becomes granted even after an investigation is already opened. The range of fine reductions also becomes widened and steeper. Under the new program, a first applicant gets a 100 percent fine reduction for sure, while the second one receives a 30 percent reduction. Overall, the predictability and transparency of the leniency program improve compared to the previous regime by making new guidelines on a leniency program that specifies standards and conditions as to procedures and eligibility for leniency application and approval.<sup>17</sup>

The KFTC had underwent organizational restructuring on December 19, 2005.<sup>18</sup> While many structural changes were made, the most remarkable variation was the birth of the "Cartel Bureau." It grew from a division-size with only seven staff members to a bureau-size with 31 staff members composed of three divisions: the Cartel Policy Division, the Manufacturing Industry Cartel Division, and the Service Industry Cartel Division.<sup>19</sup> This restructuring was designed to allow the KFTC to concentrate on cartel detecting tasks with more resources. If the KFTC's detecting capability had been very low, this resource expansion possibly increased the KFTC's enforcement capability in detecting cartels, which could result in changing cartel firms' IC constraints.

Finally, in December 2004, the announcement that the cartel fine ceiling rates would be doubled was made by revising the MRFTA.<sup>20</sup> To enhance cartel deterrence, the fine ceiling was raised to ten percent from five percent of the amount of the related sales. This increase may serve as a disincentive for a cartel if cartel firms regard it as raising the expected costs related to collusive

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<sup>17</sup>The guideline is titled "Public notification on implementation of leniency program including corrective measures against voluntary confessors, etc. of unfair cartel activities." For more details, refer to the link, [http://ftc.go.kr/data/hwp/Commssionnews\(2005may\).doc](http://ftc.go.kr/data/hwp/Commssionnews(2005may).doc)

<sup>18</sup>The previous hierarchical and vertical structure was replaced by a more horizontal and function-oriented structure. Investigation Bureau, Anti-trust Bureau, and Competition Bureau were combined altogether to create Headquarter for Competition Law & Policy Enforcement and Cartel Bureau. Headquarter for Competition Law & Policy Enforcement is in charge of correcting abuse of market dominance, anti-competitive M&As, and other unfair business practices, while Cartel Bureau detects cartels.

<sup>19</sup>A bureau of the KFTC is made up of 3-5 divisions, where one division has about 6-10 staff members.

<sup>20</sup>This new fine rule was implemented in April 2005.

Table 1.1 KFTC's Leniency Filed Cases and Total Cartel Fine Amount ('01-'10)

Year	LP* filed case (percent <sup>†</sup> )	Fine amount (billion KRW <sup>‡</sup> )
'01	0 (0)	27.7
'02	1 (7.1)	53.1
'03	1 (9.1)	109.8
'04	0 (0)	29.2
'05	6 (26.1)	249.3
'06	6 (22.2)	110.5
'07	10 (41.7)	307.0
'08	20 (46.5)	197.5
'09	13 (61.9)	52.9
'10	17 (68.0)	585.8
Total	74 (31.6)	1,722.8

Source: 2011 KFTC Annual Report

\*Leniency Program

<sup>†</sup>[Number of cases with the LP plus a fine/ Number of cases with a fine] x 100

<sup>‡</sup> one billion Korean Won can approximately be converted into one million US dollars

behaviors. As displayed in the simple model above, the increase in expected fines can tighten the ICC and raise the threshold for colluding by decreasing the long-term benefits from colluding, other things being equal. That is, the increase in the maximum fine ceiling can cause cartel members to change their cartel behaviors if they accept this change as the higher expected cost for colluding, which makes cartels unstable. However, it is also possible that cartel firms do not change their behaviors if the changed fine ceiling does not affect their expected costs.

These policy changes observably seemed to be more effective in detecting cartels than before. It is easily noticed in Table 1.1 that both the fined/leniency filed cases and the total amount of fines dramatically increased since 2005. According to the KFTC, out of the 163 total fined cases from 2005 to 2010, 72 cases (44 percent) were leniency-filed. The percentage has been on the rise almost every year. Also, the annual cartel fines imposed by the KFTC soared from roughly 30 million to 250 million US dollars in 2005 when the policies changed. This trend is very similar to that of the US, where the revised Corporate Leniency Program resulted in a surge in amnesty applications. Under the old policy, roughly one amnesty application per year is obtained, while under the new policy, the application rate has jumped to more than one per month.<sup>21</sup>

<sup>21</sup>"The modern leniency program after ten years" was presented by James M. Griffin in 2003. (<https://www.justice.gov/atr/speech/modern-leniency-program-after-ten-years-summary-overview-antitrust-divisions->

## 1.4 Data

### 1.4.1 Data and Sample Information

This paper covers the data set of finalized 327 cartel cases filed for violations of Article 19 (1) of the MRFTA between January 1, 2000 and December 31, 2010.<sup>22</sup> At first, 396 cases are collected from public decision reports released on the KFTC's website. However, out of them, 69 cases are excluded because they are not original cases. They are only related to the cases on recalculating fines or for prosecuting alleged conspirators. If one or more cartel members are dissatisfied with the KFTC's decision, they can appeal to a higher court. If the higher court reverses the KFTC's decision and orders it to recalculate overly-imposed fines, the KFTC should redeliberate its original decision. Moreover, the KFTC is supposed to decide whether or not to prosecute cartel members when the Prosecutor's Office requests that the KFTC accuse them.<sup>23</sup> The number of cases is consistent with the number of decision reports.<sup>24</sup>

After 327 decision reports are closely read, the relevant variables for this research are chosen and drawn based on the previous theoretical predictions and empirical analyses. Even though this unique data set has some limitations, it has a few advantages over previous empirical studies on the cartel cases of the EU and the US because it includes a larger number of case samples and provides richer, more extensive, and detailed information on cartel characteristics. The data set covers the number and names of cartel members, whether or not they are large companies,<sup>25</sup> the

criminal)

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<sup>22</sup>Some English-version documents of the cases filed during the periods are available for downloading from the Commission website, [www.eng.ftc.go.kr](http://www.eng.ftc.go.kr).

<sup>23</sup>Korea has the 'Criminal Complaint Exclusive System' under anti-trust law, implying that the Korea Prosecutor's Office alone may not bring a criminal antitrust lawsuit under the MRFTA. Instead of independent prosecuting, the office should request the KFTC consider the decision whether to prosecute or not. Then, the KFTC makes a decision after deliberating anti-competition effects of the case in the related markets. However, the KFTC now has little discretion on prosecuting since the MRFTA was amended in 2014. However, even though this institution is weakened, the Prosecutor's Office still should depend on the KFTC, when prosecuting.

<sup>24</sup>For example, if the KFTC divides one cartel case into two sub-cases depending on related product markets, two decision reports are produced and this cartel is formally counted as two cases.

<sup>25</sup>In Korea, there is a unique 'Large Business Group Policy' to prevent too much concentration of economic power. That is, 'Institution of designating large business group' applies to conglomerates whose affiliates' combined assets amount to about 5 billion US dollars or more. The minimum asset requirement doubled up to about 10 billion US

type of cartel,<sup>26</sup> whether or not it is fined, the related industry, the affected geographic and product market, the start- and end-date of cartels,<sup>27</sup> the involvement of industry associations, the amount of fines imposed pre- and post-stage where leniency scheme is applied, fine rates, fine reduction rates, etc.

Even though it is still difficult to know the exact identities of leniency applicants due to the strict confidentiality of the KFTC, much information on the leniency program is inferred through a matching process, where the information of anonymous firms and final fines charged to the cartel firms are paired to identify the relevant firms. The cartel duration, which is one of the most important variables in testing cartel stability, completely depends on the KFTC's decision. The duration of each firm in a cartel can be different due to the dates of entry and exit. So, the value of each firm's duration is averaged. Because the KFTC does not operate a plea bargaining process, it might be relatively cleaner, compared to the DOJ data. The cartel duration information may have some inherent measurement issues because it is completely dependent on the KFTC's decision.<sup>28</sup> However, due to the limitation of data, a cartel duration is used in this study as a proxy for cartel success as many previous cartel literature uses the duration. The number of cartel firms implies maximum value of the variable in each cartel case. That is, even though there are some changes in the number of firms during the cartel period due to entry and exit, the number of firms includes all the firms involved in the case. Even though there are eight types of violations regulated by the MRFTA, most agreement types fall into either price fixing or market sharing. Previous papers

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dollars in September 2016. If a conglomerate falls into this category, and is annually designated as 'Large Business Group' by the KFTC, it faces very extensive regulation such as restrictions on stock holding and finance, stricter disclosure obligations in a stock market, differentiated tax burdens, limitations on entry to specific small industry, etc.

<sup>26</sup>There are eight types of violation regulated by the MRFTA. They are price fixing, restriction of the transaction term, production quantity restriction, market allocation, restriction of product specification, establishment of a joint company, interfering with business and a bid rigging.

<sup>27</sup>The start- and end-date of a cartel are identified, based on the KFTC's decision reports. In case where those dates does not explicitly defined in the reports, the first meeting date of any cartel firms is used for the start-date, and the end-date is either the date when the case is finally decided by the KFTC, or the date when firms self-correct the violation, whichever is earlier.

<sup>28</sup>As Levenstein and Suslow (2006) point out, the cartel duration based on dates of formal dissolution, which are written in cartel contracts, might overestimate the true economic duration of cartels. In contrast, cartel durations determined by a anti-trust agency also can be mostly conservative estimates supported by the hard-core evidence produced in the court. For example, the KFTC can guess prior starting date that is before the one in document, but the KFTC cannot confirm the starting date due to lack of hard evidence. Also, in the context of Green and Porter (1984), it is hardly distinct an apparent on-and-off cartel from some episodes of repeated cartels.

argue that cartel duration can be affected by industry concentration and the market share of the collusion (Dick, 1966; Ellis and Wilson, 2003; Hay & Kelley, 1974; Selten, 1973). However, that information is not included in the data set for the following reasons: There are too much missing information on industry concentration and market shares in the publicly opened decision reports. And, they might have endogeneity problem because they result from cartel durations. This missing information may be covered to some extent by industry effects and a large firm dummy to some extent.<sup>29</sup> The amounts of cartel fines are included in two ways, which are fines pre and post-leniency scheme. The fine amounts of the two types are the same for a non-applicant, while the fines can be different for a leniency applicant. That is, for an applicant, fines after applying a leniency scheme are smaller than those before the leniency scheme, if the applicant is eligible for granting leniency. Fine rates are different, depending on the severity of violations. If the severity is more substantially significant rather than minor, higher fine rates are applied within the maximum fine ceiling. When the KFTC calculates the final fine amount before a leniency scheme, the KFTC can adjust the fine amount depending on other factors. For example, compliance with the authority decreases fines, while recidivism increases them.<sup>30</sup> That is, even though firms are not eligible for leniency, all firms are granted fine reduction if they cooperate in revealing more evidence. In final stage, leniency applications are considered, where firms' names cannot be identified for confidentiality.

Table 1.2 compares descriptive statistics for the cartel cases identified. Note that the number of cases, the cartel duration, and annual fines sharply increased, even though considering the slightly longer period covered after the policies changed. In particular, the number of total cartel cases (cases without bid-rigging) increased by 66 percent (31 percent). The bid-rigging cartels relatively increased more than the non-bidding cases. The KFTC detected fined cases about three times more than before from 51 to 156. The proportion of fined cases increased from 41.5 to 76.5 percent

<sup>29</sup>The one-digit industry dummy is used, which is based on the Korea Standard Industry Classification. The large business group dummy is based on the list of the large business group when the case is determined.

<sup>30</sup>The KFTC, in order to calculate cartel fines, firstly defines the sales amount of the cartel-related products. Second, it obtains the basic fine amount through multiplying the cartel-related sales by fine rates, which are determined depending on the severity or importance of the violation. Then, it adjusts the basic fine in accordance with a firm's cooperativeness and history of recidivism. Finally, a leniency scheme is applied under confidentiality and anonymity.



Table 1.2 Descriptive statistics of detected cartels in Korea (2000 - 2010)

	2000 - 2004	2005 - 2010
Number of total cases	123	204
Number of cases (without bid-rigging)	94	123
Number of fined cases	51	156
Number of leniency filed cases	3	70
Number of price fixing cases	97	166
Average number of firms	6.59 (4.70)	5.86 (4.42)
Annual fines* (million KRW)	82,097	269,976 [175,300] <sup>†</sup>
Fines per case* (million KRW)	8,377	10,728 [6,966] <sup>†</sup>
Average cartel duration (month) <sup>‡</sup>	13.95 (19.50)	32.58 (34.36)
Average investigation duration (month)	5.11 (3.09)	16.42 (10.96)
Average fine rate (percent)	2.75 (8.63)	4.36 (1.97)
Average fine reduction rate for compliance (percent)**	0.11 (0.59)	3.74 (6.6)

Remark: Standard deviations in parentheses

\*Fines are averaged and expressed in million KRW, where 1,000 KRW can be approximately converted into 1 US dollars.

<sup>†</sup> The average fine amounts after the leniency scheme is applied are expressed in the bracket.

<sup>‡</sup> The average cartel duration is obtained except for bid-rigging cartels.

\*\* Prior to the application of leniency scheme, the KFTC discounts fines for firms who cooperate into its investigation through providing incriminating evidence.

during the same periods. It seems that the KFTC discovered more serious cartel cases after the anti-cartel policies were revised. The new anti-cartel policies probably resulted in the discovery of underground cartels discovered that might not have been discovered otherwise. Most of all, the number of leniency filed cases soared from 3 to 70 when comparing cases before and after 2005.<sup>31</sup>

The average annual fine amount from 2000 to 2004 was only approximately 82 million dollars.

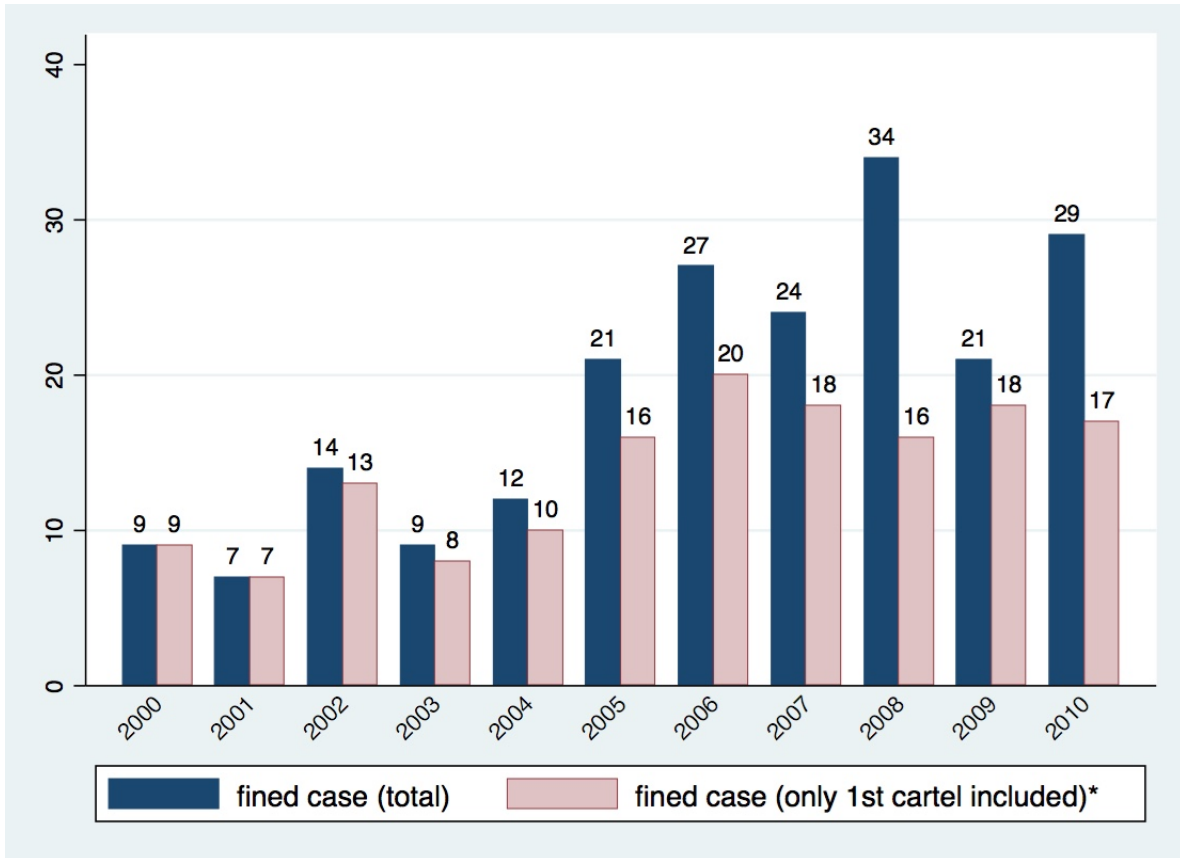
<sup>31</sup>These figures might be little different from the exact number from the KFTC. The KFTC does not disclose the individual information pertaining to a leniency program for each case. However, when compared to the aggregated figures that were announced in 2011 annual report(<http://www.ftc.go.kr/policy/whitebook>), it is not much different.

But, it increased more than threefold to 270 million US dollars since 2005, whereas the averaged fines per case increased only slightly. Therefore, it may be possible to think the increase in total fine amount is mainly attributed to the expansion of those cartel cases that were discovered.

Excluding 110 bid-rigging cartels, the average cartel duration is obtained because bid-rigging cartels tend to be a one-time event, rather than continuous or repeated like normal price-fixing or market allocation agreements. The average cartel duration increased more than two times from 14 to 33 months during the same periods. It seems to be apparently consistent with Harrington and Chang's (2009) prediction that cartel durations, if an anti-cartel policy is in effect, are reduced in the short run due to breaking down of marginal cartels. However, more rigorous analyses are needed to draw confident conclusions. One of the interesting points pertaining to cartel duration is that the duration is very short, compared to that of the US or EU data. According to Levenstein and Suslow (2006), the cartel duration in prior research ranges from 3.7 to 10 years. The current data set divides a geographic market into three categories; local, entire nation, and international markets. As the scope of markets becomes larger, a cartel organization may require higher monitoring cost, which can reduce cartel stability. However, it shows the contradictory results. The average cartel duration for local, entire nation, and international markets are 13 months, 32 months, and 67 months, respectively. There possibly exists a monitoring mechanism to facilitate collusion in a larger geographic market. Or, multi-market contact can improve firms' ability to sustain higher prices by combining the incentive compatibility constraints (Bernheim and Winston, 1990).

The increasing rate of investigation durations is even larger than that of cartel durations, which is about a threefold increase. It contradicts Brenner's (2009) findings, where investigation duration, used as a proxy for revealing information, decreased since the EC leniency program was introduced. On the one hand, the KFTC's anti-cartel policies apparently seem to fail at inducing cartel firms to reveal information. However, on the other hand, investigation duration may not be representative of revealing information. I would lean toward the possibility of an less proper proxy. The investigation periods can increase in the amount of revealed evidence. For example, if cartel members do not disclose any evidence, an anti-trust agency has few sources to verify cartel firms'

Figure 1.1: Number of Fined case (2000-2010)



Remark: When one cartel case is documented with multiple cases for some administrative convenience reasons, only the first case is counted to avoid a nuisance.

violations. In contrast, if more complex and detailed evidence is disclosed, an anti-trust agency has to spend more time in investigating and finalizing the cartel case. The lengthier investigation duration could result from longer cartel duration with more abundant and complicated incriminating evidence. Rather than the investigation duration, a fine reduction rate in return for cooperative compliance would be more appropriate for a proxy for revealing information. The KFTC adjusts basic fines depending on how cooperative cartel firms are. This fine reduction rate due to revealing information soared since anti-cartel policies were revised around 2005. It seemed that the policy changes led cartel firms to disclose more incriminating evidence when they are detected.

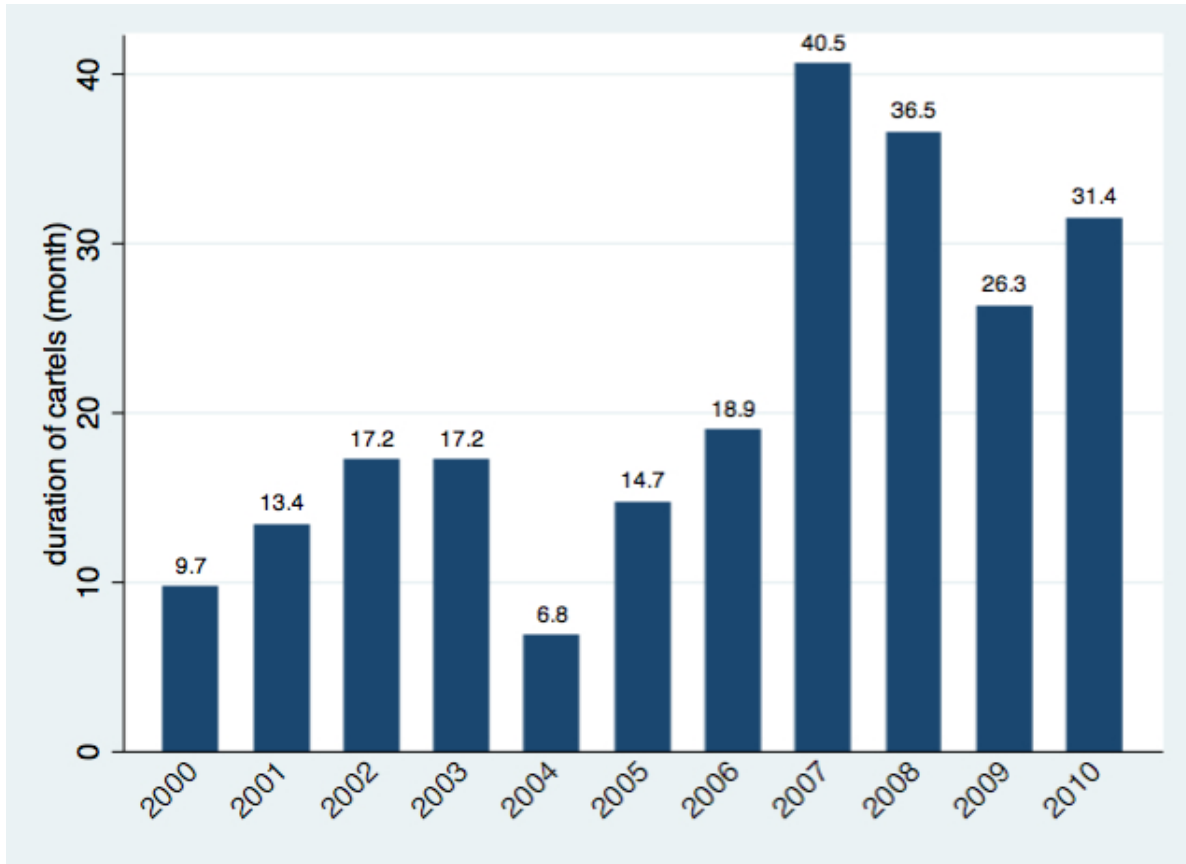
Figure 1.1 shows that the number of fined cartel cases increased since 2005 in Korea.<sup>32</sup> The trend is partially in line with Miller's (2009) findings. Using DOJ's data set, he shows theoretically

<sup>32</sup>The number of total cases including non-fined ones also shows increasing trend, but it is more clear in the fined cases.

and empirically that the number of discovered cartels rises in the short run and drops below a pre-leniency level if a leniency program is effective. However, the trend in Korea does not show that the number of discovered cartels drops below pre-leniency levels in the long run. In 2008 and 2010, the number of fined cartel cases discovered soared than in previous years. In those years, there was a nuisance issue. Some cartel cases, which were discovered in an industry at the same time, were documented as multiple decision reports for some administrative and convenience reasons. For example, the chemical cartel case which falls into 2008 was split into seven decision reports depending on product types such as toluene, ethylene, xylene, etc. Also, the bid-rigging cartel case for constructing apartment complexes in 2010 was also documented in seven decision reports, based on the districts of construction. If these cartel cases over the sample periods are regarded as only one case to avoid this sort of noise, the trend becomes more consistent with Miller's (2009) findings, even though it seems to require a larger sample period in order to confirm long-run decreasing trends to below the pre-policy change level.

The cartel duration of the discovered cartels in this paper is one of the most important dependent variables in analyzing cartel stability, despite some of its limitations, as stated above. Regarding this duration, Figure 1.2 demonstrates a similar trend in Figure 1.1. The raw data offers some preliminary insight. The average duration of cartels peaked in 2007, and then there was a decreasing trend. Harrington and Chang (2009) argue that the duration of discovered cartels increases in the short run because if an anti-cartel policy is effective, marginal cartels among population cartels begin to break down. However, in the long run, even strong cartels can collapse so that the duration of discovered cartels either rises or drops. Note that in order to determine the year that a cartel case falls into, a decision date is used. That is, the cartel is categorized based on when it was decided, regardless of when the cartel actually started. If a cartel's duration is categorized based on the cartel start date, a different trend can be displayed. Choi and Hahn (2014) analyzed the effects of Korea leniency programs on cartel deterrence, using basically Zhou's (2012) methodology. They found that if a cartel case is grouped by a cartel start date, the average duration of discovered cartels that started on and after 2005 is shorter than one that started before 2005.

Figure 1.2: Cartel durations (2000-2010)

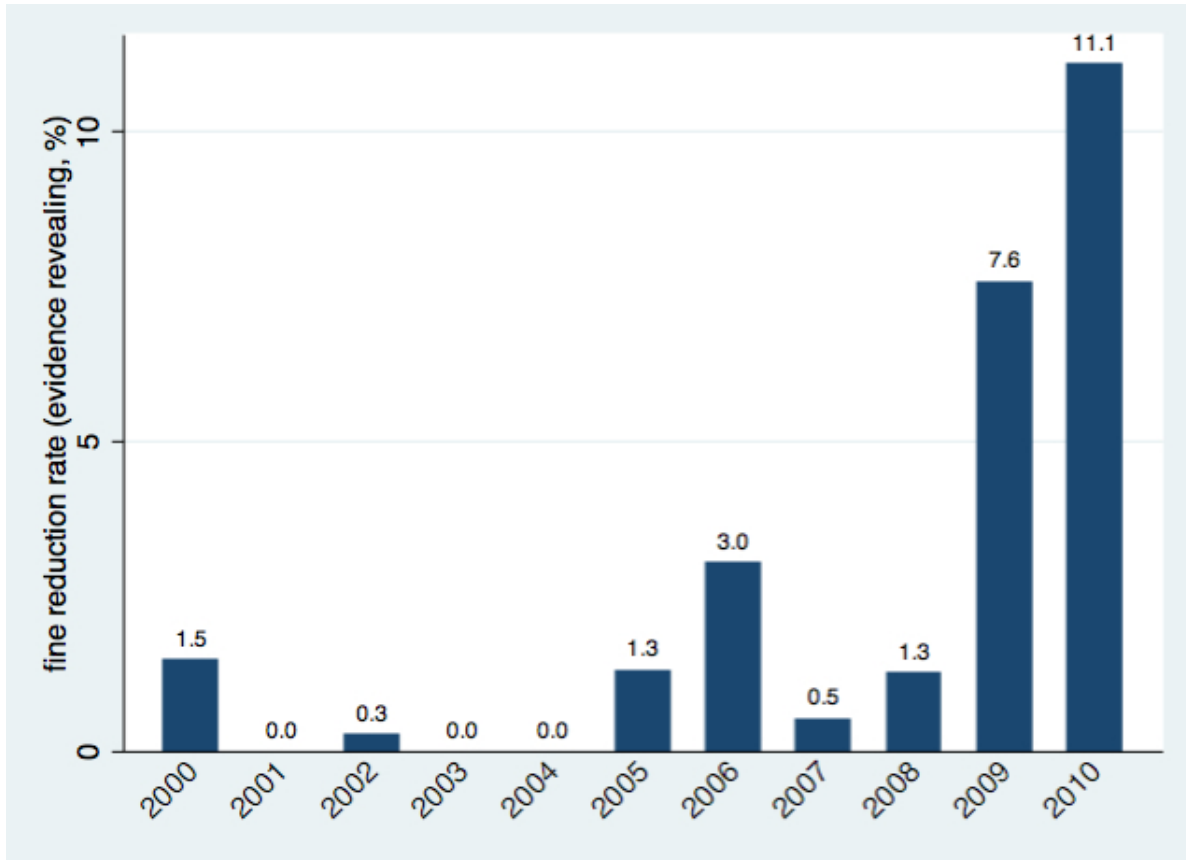


Remark: Bid-rigging cartels are excluded

Figure 1.3 displays the time trend of the average fine reduction rate due to complying with investigation, which is used as a proxy for revealing evidence. Before 2005, firms were not willing to disclose incriminating evidence to the KFTC. One possible reason is that cartel firms have less incentive to voluntarily reveal hard evidence on their side. It might be because that the KFTC had very low prosecution capability to prove a firm's violation even after a cartel behavior had been detected.<sup>33</sup> However, the fine reduction rate increased since 2005. If anti-cartel policies are effective, the KFTC can be provided with more incriminating evidence, implying a higher fine reduction rate due to complying with the KFTC. The descriptive results show the possibility of the effectiveness of the KFTC's anti-cartel policy innovations around 2005. However, we cannot argue that the changes in anti-cartel policies around 2005 have any significant effects on destabilizing a

<sup>33</sup>There were less fined cases before 2005. During those periods, about 60 percent of total cases were finalized without imposing fines, which is far higher proportion comparing to about 25 percent from 2005 to 2010.

Figure 1.3: Fine reduction rates (2000-2010)



Remark: The fine reduction rates is related to how well cartel members comply with anti-trust agency's investigation. More cooperations result in higher fine reduction rates, where the rates are ranged from 0 to 20 percent.

cartel and saving investigation costs with these descriptive statistics. A more rigorous analysis will be conducted later in this paper.

### 1.4.2 Empirical Issues

Note that when we compare the impact of anti-cartel policies on cartel stability, we should check whether there have been some significant changes in cartel organization before and after policy changes to avoid mistaken interpretations. If they are largely different under each regimes, we can have another selection bias and should be cautious when interpreting the impact of the changed policies. Because there may exist structural changes in forming cartels other than duration or number of cartels, we cannot conclude whether the policies make cartels unstable or not. In the

current paper, the comparison test is conducted to alleviate this issue by checking the differences in the characteristics of the discovered cartels. The number of cartel members, the geographic scope of cartel markets, and the type of cartels are compared between pre- and post-2005 when anti-cartel policies were revised. The differences of the every mean are not statistically significant at conventional levels of significance. The t-values of the mean comparison test with the three variables are 1.406, 1.501, and 0.553 with  $df=324$ , respectively. These results show that there are no distinguishable changes in the structural characteristics of cartels before and after 2005 when anti-cartel policies were innovated. With this finding, we have fewer problems in estimating the effectiveness of the anti-cartel policy changes.

Also, some measurement issues are addressed in empirically analyzing anti-cartel policies. The duration determined by an anti-trust agency is mostly the length of a single event. The duration data used in this study, like most previous cross-section duration analyses, can be regarded as a legal definition rather than an economic definition. As mentioned above, it is possible that the duration supported by incriminating evidence can either overestimate or underestimate the true value of an actual duration. In addition, as Miller (2009) points out, the cartel duration information reported by the DOJ may be distorted due to the negotiation of a plea bargaining process. However, the KFTC does not operate a plea bargaining institution unlike the DOJ. So, the relatively less contaminated data set as to cartel durations can be obtained from the publicly opened decision reports even though this issue cannot be completely eliminated. Therefore, in spite of a possibility of selection bias that can be unavoidable in empirical research on cartels, the KFTC's duration data is used in the current study. The theoretical framework of Harrington and Chang (2009) is applied using the KFTC's public data set.

## 1.5 Cartel Deterrence

### 1.5.1 Hypotheses

Brenner's (2009) methodology is adopted and modified to test the hypotheses of Harrington and Chang's (2009) model. According to their theoretical framework, the increased detection rate may raise the duration of the population of discovered cartels because "marginal cartels" start to collapse first, and thus the surviving cartels tend to be stronger and longer in the short run. First, the new leniency program that grants an automatic full leniency to a first confessor and the enlarged resources with a larger investigation organization and more staff are considered. If the two anti-cartel policies have been effective in enhancing the KFTC's detection and conviction capabilities, then the duration of discovered cartels increases in the short run. Hence, this section first focuses on analyzing the short-run predictions of the two anti-cartel policies.<sup>34</sup> In addition, Motta and Polo's (2003) argument is tested by comparing the impact of the two anti-trust policies. They conclude that even though using a full fine to deter cartels should be preferred when the resources are enough, a leniency program may be an optimal enforcement for the second best when the anti-trust agency's resources are not sufficient.

In addition, the impact of the aggressive new fine rule on cartel deterrence is investigated. It is conventional wisdom that higher penalties destabilize current cartels and lead firms to form fewer cartels because this change can tighten the incentive compatibility constraints a firm faces, given other factors fixed. However, as Harrington and Chang (2009) point out, if an intensified penalty is perceived by a cartel firm, and so can increase its incentive to deviate from cartels or not to form a cartel, cartels are more likely destabilized. However, in spite of a policy change, if a firm feels indifferent and has the same expected cost as before, this policy may be ineffective in disrupting

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<sup>34</sup>The long run effects of the two anti-cartel policies are different. The effects of a leniency program, in the long run, are ambiguous because this program also has a pro-collusive impact as well as a destabilizing one. That is, the average duration of discovered cartels can increase or decrease. However, an enlarged resources in investigation manpower can decrease the duration of discovered cartels if it is effective in improving an anti-trust agency's detection and conviction capability. For more details, refer to Harrington and Chang (2009)



cartels. This may happen if a maximum fine ceiling is raised but proves to fail in affecting firms' expected penalties.<sup>35</sup> To test this prediction, the effect of the new fine rule - doubling the fine rate ceiling - on cartel stability is explored. The result is also compared to the effect of actual fine amount imposed in the previous year, because firms may build their expectations based on the past.<sup>36</sup> Therefore, the following three hypotheses are proposed.

**[Hypothesis 1]** The new leniency program with certain full immunity to a first reporter increases the duration of discovered cartels in the short run.

**[Hypothesis 2]** More cartel detection resources with upsized organizations increases the duration of discovered cartels in the short run.

**[Hypothesis 3]** The increase in a maximum fine rate decreases the duration of discovered cartels.

## 1.5.2 Empirical Frameworks

While Cox's semi-parametric hazard model is used in many previous analyses of cartel durations (Choi and Hahn, 2016; De, 2010; Zhou, 2012; Zimmerman and Connor, 2005), Brenner (2009) uses a Weibull specification, where the shape of the hazard is parametrically estimated.<sup>37</sup> An accelerated failure-time (AFT) parametric survival model with Weibull distribution rather than a proportional hazard (PH) model is mainly applied in the current paper, but the Cox model is also employed to investigate the robustness of the results.<sup>38</sup> In this paper, unlike the previous empirical

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<sup>35</sup>Based on the fact that the averaged fine rate during the sample periods is only 3.88 percent, increasing maximum fine rates ceiling from five percent to ten percent might not affect cartel firms' behaviors.

<sup>36</sup>Here, the time-dependent effect of the new fine rule is not investigated. It would be more informative to compare the general effects of the maximum fine ceiling to ones of the actual fines imposed by the KFTC rather than comparing time-dependent effects.

<sup>37</sup>Cox regression is considered a 'semi-parametric' procedure since the baseline hazard function,  $h_0(t)$  does not have to be specifically assumed, while a fully proportional parametric hazards model should assume the baseline hazard function. Hazard rates can be parameterized according to the survival times whose distributions are mainly exponential, Weibull and Gompertz. The advantages of Cox hazard model in analyzing durations have been widely recognized. (Meyer, 1990)

<sup>38</sup>Zhou (2012) points out that the Weibull specification used by Brenner (2009) is likely to be plagued by unobserved heterogeneity that might cause biased estimates as Meyer (1990) indicates. He argues that Cox approach may have advantages in controlling for unobserved heterogeneity. In Cox model, the hazard function for cartel is  $h_i(t; \mathbf{X}_i) = h_0(t) \times \exp(\mathbf{X}_i\beta)$  where  $t$  is the elapsed time since the start of a cartel, and  $\mathbf{X}_i$  is a vector of observed explanatory variables. The parameter vector  $\beta$  is the vector of coefficients, measuring the influence of observed characteristics. The term  $\exp(\mathbf{X}_i\beta)$  shifts the baseline hazard function  $h_0(t)$ , and a positive coefficient indicates that the observed charac-

estimation where only a leniency program is considered, the impacts of other important anti-cartel policies are also separately tested. This paper may be one of the first empirical papers that directly compare the impact of a leniency program and enlarged resources of an anti-trust agency. Previous studies do not separately identify the effect of a leniency program from the effect of other anti-cartel policies, even though each policy affects cartel stability. Those effects should be individually evaluated when a leniency program is planned and enforced at a similar time with the change of fine rules and organizational resources. If not, the effect of a leniency program can be overestimated. The following model is estimated to test Hypothesis 1 to 3:

$$\ln(DC_i) = \beta_1 + \beta_2 LPD_i + \beta_3 LPST_i^n + \beta_4 RD_i + \beta_5 RST_i^n + \beta_6 NFR_i + \mathbf{X}_i \beta + \varepsilon_i \quad (1.2)$$

where for a particular cartel case  $i$ ,  $DC_i$  is the average duration of the cartel.  $LPD_i$  is the duration of the cartel that lasted since the new leniency scheme had been introduced in April 1, 2005.  $LPST_i^n$  equals one if the cartel was discovered within the first  $n$  periods since the new leniency program had existed, and equals zero otherwise. In this variable,  $n$  periods can be three years or nine months. At first, Brenner's (2009) short-term definition, three years is used. However, the same estimation is also conducted except for setting the short-term nine months in order to avoid overlapping periods of the two policies' short-terms and to isolate the impact of the new leniency program from that of the enhanced resources.  $RD$  is the duration of the cartel that lasted since the KFTC's Cartel Bureau with more resources was initiated on December 19, 2005.  $RST_i^n$  is also a dummy variable that takes the value of one if the cartel was discovered during the first  $n$  period since the time that the cartel detecting resources were upsized.  $NFR_i$  is the new fine rule dummy, which is one if case  $i$  was subject to the new fine rule that doubled the fine ceiling.  $\mathbf{X}_i$  is the row vector variables affecting the duration of cartels, including the following variables: the number of cartel members ( $NF_i$ ), the large business group dummy ( $LBG_i$ ), the price fixing cartel dummy ( $PF_i$ ), the annual total cartel fines imposed by the KFTC one year before the observed cartel starts

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teristics increase dissolution hazard rates and reduce cartel durations. And the ratio of the hazard rates does not depend on time but only depends on  $\mathbf{X}_i$  and  $\beta$  like the following:  $h(t, x_1)/h(t, x_2) = h_0(t) \times \exp(\beta x_1)/h_0(t) \times \exp(\beta x_2) = \exp\{\beta(x_1 - x_2)\}$  (Zhou, 2012). When controlling for other variables, the coefficients shift the hazard rates of cartels at time  $t$ .

( $F_i$ ), the geographic market dummy ( $Geo_i$ ), and the industry dummy ( $IND_i$ ).<sup>39</sup>  $\varepsilon_i$  is an error term following an extreme value distribution. We call a  $\beta$  the parameter to be estimated. According to Hypotheses 1, 2, and 3, the positive  $\beta_3$  and  $\beta_5$ , and the negative  $\beta_6$  are expected, respectively. These coefficients capture the differences between the durations of cartels that failed before the related anti-cartel policies that were introduced and those under the policies after controlling for other factors. Therefore, the positive coefficients increase the durations of discovered cartels while the negative ones decrease the durations.<sup>40</sup>

### 1.5.3 Results

In this subsection, the regression analyses for the Equation 1.2 are performed in two steps. First, a survival analysis is conducted after setting the short-term three years as Brenner (2009) does. The impact of anti-cartel policies on cartel stability is estimated in both Weibull and Cox specifications, so that Harrington and Chang's (2009) hypotheses are tested. In the second step, the same regression is re-run, except that here a short term is nine months to avoid the overlapping effects between the new leniency program and the expanded cartel organization.

In Table 1.3, the first step - with a three-year short-term - regresses four specifications of survival analyses, which consist of two short models without  $\mathbf{X}_i$  and two full models with  $\mathbf{X}_i$ . The short and the long equations are regressed using both the parametric hazard model with a Weibull specification and the semi-parametric Cox model. Note that in an AFT parametric model with the Weibull distribution [(1) and (3)], a positive coefficient means increasing cartel durations, which says a covariate extends the time until failure. However, the interpretation of the coefficients, in the semi-parametric Cox model [(2) and (4)], should be the opposite. In these models, a positive coefficient increases the hazard ratio, therefore decreasing durations, the time until failure.

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<sup>39</sup>The large business group dummy equals one if at least one of cartel members falls under designated large business group in the year when the case is finalized. The price fixing cartel dummy equals one if the type of the cartel is price fixing, and equals zero otherwise such as market allocation, restriction of product quantity, etc. The geographic market dummy is categorized into local, entire nation, and global. The industry dummy is based on the Korea Standard Industry Classification.

<sup>40</sup>Note that in Cox model, positive coefficients mean increasing hazard ratios, while negative ones decrease the ratios, after controlling for other factors.

Table 1.3 Impacts on Cartel Stability(Survival model with 3-year short term)

Variables	(1) Wei(S) <sup>3y</sup>	(2) Cox(S) <sup>3y</sup>	(3) Wei(F) <sup>3y</sup>	(4) Cox(F) <sup>3y</sup>
<i>LPD</i>	-.001 (.001)	.001 (.001)	-.0003 (.001)	-.001 (0.002)
<i>LP-ST<sup>3yrs</sup></i>	1.171*** (.239)	-1.189*** (.249)	.487** (.215)	-.862** (.304)
<i>RD</i>	.002 (.002)	-.002 (.002)	.001 (.001)	-.001 (.002)
<i>R-ST<sup>3yrs</sup></i>	-.039 (.262)	.126 (.259)	.14 (.206)	-.016 (.288)
<i>NFR</i>	-.317 (.323)	.261 (.309)	-.336 (.224)	.555* (.309)
<i>F</i>			-.331*** (.042)	.536*** (.07)
<i>NF</i>			.012 (.013)	-.014 (.017)
<i>LBG</i>			.064 (.156)	-.053 (.21)
<i>PF</i>			-.338* (.173)	.404* (.232)
<i>Geo</i>			.705*** (.13)	-.966*** (.182)
<i>IND</i>	No	No	Yes	Yes
<i>Cons.</i>	6.084*** (.098)		8.506*** (.526)	
<i>Chi<sup>2</sup></i>	50.13	47.67	175.59	181.08
<i>n</i>	211	211	210	210

Remark: Standard errors in parentheses. Significance levels: \*<10 percent, \*\*<5 percent, \*\*\*<1 percent.

The estimated results for the Equation 1.2 are suggested in Table 1.3. First, the coefficients of main interest are  $\beta_3$  (the coefficient of the the leniency program dummy, *LP-ST<sup>3yrs</sup>*) and  $\beta_5$  (the coefficient of the resource expansion, *R-ST<sup>3yrs</sup>*). They are the short-term effects of two anti-cartel policies on cartel stability. Most importantly, the new leniency program, from Specifications (1) and (3), has a positive effect on dissolving cartels as Hypothesis 1 predicts. The new leniency program causes the duration of discovered cartels to increase in the short run because it breaks down the “marginal cartels.” The program moves the fragile cartels from a population of sustainable cartels to a population of unstable ones. Both the short and the full model specifications estimate the

statistically significant coefficient at a conventional level of significance. These findings are not consistent with Brenner (2009) and O. De (2010). In those studies, the EC's leniency program did not have a significant impact on disrupting cartels. However, our study is in accord with Zhou (2012) and Choi and Hahn (2014), in which the new leniency programs of the EC and Korea significantly affected cartel stability in the short run, respectively. For robustness, Cox regressions are also employed in Specifications (2) and (4). The relevant coefficients from the Cox model show similar results to Weibull specifications. However, concerning Hypothesis 2, no significant estimate is obtained both in the short and the full model. Even worse, they show a mixture of opposite signs. Thus, we cannot argue that the upsized workforce for detecting cartels is successful. Relating to Hypothesis 3, we cannot strongly argue that the aggressively changed penalty scheme (the new fine rule dummy, *NFR*) does not increase the expected cost that cartel participants face. All of the coefficients of interest on Specifications (1) through (4) are insignificant at a conventional level of significance, even though the signs seem to reduce cartel durations. That is, increasing a fine ceiling from five to ten percent of the related sales amount does not significantly affect cartel firms' incentives to deviate. Rather than the fine ceiling, the actually imposed fines seem to be more effective to deter cartels. The coefficients of the variable  $F_i$ , the annual total cartel fines imposed by the KFTC one year before firms join cartels, are negatively associated with cartel durations at a conventional level of significance.

However, as mentioned above, the first step with a three-year short term may have serious overlapping period issues. In other words, the estimated effects of the new leniency program on cartel stability might be from the new leniency program or the expanded cartel organization. Because there is a nine-month time gap between the new leniency program and the KFTC's organizational restructuring, the three-year short term may be too lengthy to isolate two different policies. It might be difficult to separate the impact of two different anti-cartel policies, because the policy of upsizing resources were operated in the following nine months since the innovation of the new leniency program, which is within the first three years after the leniency policy changed. Thus, in order to address this issue, two actions are taken. First, the short term is shortened to nine months

in the second step regressions, meaning that  $n$  equals nine months in Equation 1.2. Also, either of two cartel spans spent under two policies, which are variables  $LPD$  and  $RD$ , is excluded in the full specifications. By doing so, two benefits are obtained. The impacts of the two anti-cartel policies can be separately estimated. That is, technically, there might be fewer overlapping problems between the two anti-cartel policies. On top of that, the long-run effects of the policies can be estimated. If the detecting capability is enhanced through upsizing resources, more time spent under the policy should have a negative effect on cartel durations in the long run. However, regarding a leniency program, the long-run effects are ambiguous (Harrington and Chang, 2009).<sup>41</sup>

The estimation results for the second step are given in Table 1.4. The new leniency program significantly increases the duration of discovered cartels like the first step. Here, however, unlike the results shown in Table 1.3, the signs of  $\beta_3$  (the coefficient of variable  $R-ST^{9m}$ ) under Specifications (1) through (4) - the effects of the expanded resources on desisting cartels - also become significant. This finding significantly supports Hypothesis 2. After isolating the two anti-cartel policies, the results display not only the new leniency program, but also increasing investigation resources with more staff is also successful in disrupting collusion in the short run. These findings are compatible with Harrington and Chang (2009), who argue that both enhancing detection probability and a leniency program increase cartel durations in the short run. Interestingly, when comparing the effect of the new leniency program of the KFTC to the results of Choi and Hahn (2014), the value of related estimate is smaller in the current paper.<sup>42</sup> It leaves the possibility that the previous results overestimate the impact of the leniency program because two anti-cartel policies are not isolated. The results pertaining to the impact of the two anti-cartel policies are also confirm Motta and Polo's (2003) conclusion. They argue that when an anti-trust agency has insufficient resources, it is desirable to use a leniency program with other policy tools for disrupting collusion. However, it is difficult to argue which policy is more effective in the short run. Compar-

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<sup>41</sup>It is because marginal cartels will be dissolved or not be formed in the short run, causing an increase in discovered cartel durations. However, in the long run, even strongly sustainable cartels are finally destabilized, decreasing the duration of the detected cartel, if anti-cartel policies are effective.

<sup>42</sup>According to Choi and Hahn (2014), the coefficients, related to the short-run effects of the new leniency program, range from -24.008 to -1.203. They employ Cox model.

Table 1.4 Impacts on Cartel Stability(Survival model with 9-monthshort term)

	(1)	(2)	(3)	(4)
Variables	Wei_LP(F) <sup>9m</sup>	Cox_LP(F) <sup>9m</sup>	Wei_R(F) <sup>9m</sup>	Cox_R(F) <sup>9m</sup>
<i>LPD</i>	.001*** (.0001)	-.001*** (.0002)		
<i>LP-ST<sup>9m</sup></i>	.365** (.203)	-.761** (.308)	.484** (.205)	-.918*** (.309)
<i>RD</i>			.001*** (.0002)	-.002*** (.0003)
<i>R-ST<sup>9m</sup></i>	.504*** (.196)	-.665** (.265)	.599*** (.198)	-.793*** (.266)
<i>NFR</i>	-.439** (.213)	.71** (.293)	-.406* (.21)	.638** (.285)
<i>F</i>	-.335*** (.042)	.526*** (.069)	-.329*** (.042)	.511*** (.068)
<i>NF</i>	.007 (.013)	-.007 (.016)	.004 (.013)	-.004 (.016)
<i>LBG</i>	-.068 (.154)	.124 (.206)	-.106 (.154)	.171 (.205)
<i>PF</i>	-.328** (.167)	.387* (.223)	-.319 (.168)	.379* (.223)
<i>Geo</i>	.798*** (.12)	-1.072*** (.172)	.822*** (.12)	-1.092*** (.171)
<i>IND</i>	Yes	Yes	Yes	Yes
<i>Cons.</i>	8.405*** (.532)		8.33*** (.536)	
<i>Chi<sup>2</sup></i>	175.44	179.49	172.77	176.07
<i>n</i>	216	216	216	216

Remark: Standard errors in parentheses. Significance levels: \*<10 percent, \*\*<5 percent, \*\*\*<1 percent.

ing the magnitudes of the coefficients of LP-ST<sup>9m</sup> and R-ST<sup>9m</sup>, in Specifications (1) and (3), upsizing resources increases cartel durations more than the new leniency program does, while Specifications (2) and (4) display the opposite results.<sup>43</sup> Even though the two policies are significantly effective in destabilizing cartels in the short run, it is not evident whether the revised leniency program is superior to the increased resources or not.

According to Brenner (2009) and O. De (2010), cartel life under an anti-cartel policy can be

<sup>43</sup>For example, when hazard ratios are compared in Specification (1) AFT model, the ratio of the LP-ST<sup>9m</sup> (0.619) is larger than the one of the R-ST<sup>9m</sup> (0.515), implying that expanding resources increases the duration of discovered cartels slightly more than the new leniency program does. However, in Specification (2) Cox model, the hazard ratio of the LP-ST<sup>9m</sup> (0.467) is less than the one of the R-ST<sup>9m</sup> (0.514).

interpreted as a long run effect of the policy. If a policy is effective, more time spent under the anti-cartel policy should have a negative effect on the cartel duration. Here, the coefficients of the variables, *LPD* and *RD* can be considered as the long-run effects of the two anti-cartel policies. The results are not much different from zero, even though they are statistically significant at the conventional level of significance. One possible reason is that the short-term effects, which increase discovered cartel durations due to the demise of “marginal cartel,” can be offset with the long-term effects that decrease the cartel durations due to the effectiveness of the anti-cartel policies. Also, there is a possibility that cartel governance may endogenously respond to the external policy changes. That is, a cartel may develop its alternative collusive agreements and facilitate sustaining the IC constraint through either learning-by-doing effects or some trustworthy tools, such as industry associations or ringleaders. If so, an anti-trust policy desisting current collusive agreements may fail in deterring future collusion in the long run. Last, but not least, it is possible that a five-year period after the policy changes is too short a time to evaluate long-term effects. More sample periods might be needed to test it.

In addition, as Hypothesis 3 predicts, the harsher fine rule increasing a fine ceiling as well as the actual fine amount imposed by the KFTC shows the positively significant impact on disrupting cartels. These findings are also consistent with the predictions of Harrington and Chang (2009), that harsher penalties lead industries to the cartelized state for a shorter period. It seems that cartel firms perceived increased costs for collusive agreements due to the revised fine rules, even though the average fine rate before 2005 is only 2.42 percent, which is still below the old regime, five percent of related sales. In fact, the average fine rate increased to 4.55 percent under the revised fine rules with a ten percent fine rate ceiling. Therefore, it can be understood that cartel firms consider their expected penalties based on both the actual fines imposed by an anti-trust agency in the past and the announced guideline for future penalty.

In addition, the coefficients of the number of cartel members, *NF*, fail to show the conventional wisdom that more cartel members destabilize collusion. As Levenstein and Suslow (2006) pointed out, it might be because the number of firms are endogenously determined when they form cartels.



The coefficients of the Large Business Group dummy, *LBG*, are not significant. It implies that even though one of the cartel firms belongs to a conglomerate, called Chaebol in Korean, it is not evident whether a firm joining a cartel stabilizes collusion. On the contrary, it even reduces the duration of discovered cartels, even though the estimates are not significant. The results are consistent with Robert et al. (2016), where they attribute the results to the overly-broad definition of the Large Business Group. Or, as Motchenkova and van der Lann (2005) argue, reputation concerns are more important for large firms so that the large firms have shorter cartel duration. The price fixing dummy, *PF*, significantly reduces the duration of discovered cartels. This result is in accordance with the findings of O. De (2010). Price fixing cartels are more difficult to monitor, and they are exposed to the risk of entry and cheating than are market sharing cartels. A larger scope of geographic market seems to increase cartel durations, even though the cartel needs more monitoring costs under the circumstances. One possible reason is that there exists a monitoring mechanism to save the costs. Or, multi-market contact can improve firms' abilities to sustain higher prices by combining the incentive compatibility constraints. (Bernheim and Winston, 1990). If so, international cartels and domestic cartels that cover a whole country have longer durations of the discovered cartels comparing local markets.

## **1.6 Incriminating Evidence Revelation**

### **1.6.1 Hypotheses**

This section explores another policy effect of cartel members voluntarily revealing evidence. Another important goal of anti-cartel policies is obtaining hard evidence to succeed in proving a violation and convicting wrong-doers when a cartel is detected. It does not matter whether an investigation is initiated by a leniency program or not. The change of external policy environments affecting firms' incentives can make it more valuable to reveal their information related to the involved cartel case. For example, introducing a leniency program can lead firms to store more evidence and submitting it for leniency benefits when detected. Improving detection capabilities or increasing penalties, absent a leniency program, may decrease the extent of revealing information because any evidence reported to the authority causes higher cost by helping the authority substantiate its claim. However, on the other hand, if cartel firms think a prosecution or a conviction is highly unavoidable due to the evidence from a leniency applicant, and an anti-trust agency provides a non-applicant with benefits of additional fine reductions in return for complying with the authority, they are likely to provide more evidence even under a higher penalty regime. The extent of revealed information depends on how an anti-cartel policy is designed and enforced. The effect of anti-cartel policies on revealing evidence is also an empirical issue.

Brenner (2009) finds that the EC's initial leniency program in 1996 was so successful that cartel members voluntarily reveal more incriminating evidence. Due to the problem of non-observability of revealing evidence, Brenner used the total amount of fines per case and investigation periods as proxies for the revelation. He finds that after introducing the leniency program, the amount of fines per case increases, but the investigation periods decrease due to the efficiency effects of the leniency program. However, two proxies might be less representative for revealing evidence. Regarding amount of fines, it mainly depends more on market definitions, seriousness of violations, fine rates, etc., rather than revealed evidence. That is, even though cartel members do not cooperate

in investigation with an anti-trust agency - if the relevant market size is large, the extent of the violation is sufficiently serious, or the fine rate in the case is high - the amount of fines can be large, with less evidence. Also, the investigation periods can increase or decrease at the level of revealed evidence. For example, if cartel members do not disclose any evidence, an anti-trust agency has few sources to substantiate a cartel firm's violations. In contrast, if more complicated but detailed evidence is disclosed, an anti-trust agency has to spend more time investigating and finalizing the cartel case, even though it is easier to establish the infringements.

So, here, a fine reduction rate proportional to the extent of investigation cooperation is used as a proxy for revealing incriminating evidence instead of the amount of fines and investigation periods. That proxy might be more reasonable in testing the direct impact of anti-cartel policies on revealing evidence. Hence, the following three hypotheses will be tested.

**[Hypothesis 4]** The new leniency program with certain full immunity to a first reporter raises the fine reduction rate for revealing evidence given detection of cartels.

**[Hypothesis 5]** More resources with upsized organizations under the new leniency program raise the fine reduction rate for revealing evidence given detection of cartels.

**[Hypothesis 6]** The increase in a maximum cartel fine rate under the new leniency program raises the fine reduction rate for revealing evidence given detection of cartels.

## 1.6.2 Empirical Framework

Here, the OLS regression model based on Brenner (2009) is applied with two modifications. First, as a proxy for revealing evidence, fine reduction rates due to cooperating with investigation are used instead of fine amounts and investigation periods. Second, the impact of the other two anti-cartel policies on disclosing evidence is also considered. In order to test the effect of the policies on disclosing incriminating evidence, the following equation is estimated.

$$FR_i = \alpha_1 + \alpha_2 NLP_i + \alpha_3 ER_i + \alpha_4 NFR_i + \alpha_5 F_i + \alpha_6 \ln DC_i + \alpha_7 NF_i + \alpha_8 IND_i + v_i \quad (1.3)$$

Table 1.5 Impacts on Revealing Evidence(OLS estimation)

Variables	(1)	(2)
NLP	3.932*** (.966)	2.135** (1.061)
ER	-.24 (1.026)	-.156 (.938)
NFR	4.507*** (1.039)	3.594*** (1.067)
F		.717** (.316)
NF		.108 (.087)
<i>lnDC</i>		.25 (.226)
IND	No	Yes
Constant	.751 (.613)	-9.28 (3.895)
$R^2$	.216	.231
Observations	204	192

Remark: Dependent variable is fine reduction rates for cooperating in the KFTC's investigation. Standard errors in parentheses. Significance levels: \*<10 percent, \*\*<5 percent, \*\*\*<1 percent.

where  $FR_i$  is the average fine reduction rates per case in return for cooperating with an investigation,  $NLP_i$  is a dummy for the new leniency program, which equals one if the new leniency program is applied to the case  $i$ ,  $ER_i$  is a dummy for enhanced resources, which equals one if an enlarged cartel organization is subject to the case, and  $v_i$  is a normally distributed error term. Note that  $DC_i$  is natural log transformed. The positive  $\alpha_2$ ,  $\alpha_3$ , and  $\alpha_4$  support Hypotheses 4, 5, and 6.

### 1.6.3 Results

In Table 1.5, the estimation results of Equation 1.3 are provided. Only policy variables are included in Specification (1). Then, to compare with the effect of the new fine rule, the annual total cartel fines imposed by the KFTC one year before the observed cartel begins are added in Specification (2). Also, the number of firms involved, cartel durations, and industry effects are included, following Brenner (2009).

As Hypothesis 4 predicts, the positive estimates are obtained at a significance level. The results

display that the new leniency program revised in 2005 increases the average fine reduction rates due to revealing evidence by roughly two percent points in the full model. Considering the average fine reduction rate for evidence revealing is 0.34 percent from 2000 to 2004, the revised leniency program had a substantial impact on revealing evidence by cartel members. Also, the estimate results regarding the new fine rule confirm Hypothesis 6. The relevant coefficients range from 3.6 to 4.5, which are larger than those of the new leniency program, implying that the harsher fine rule induced firms to disclose more incriminating evidence than the new leniency program did. It may be because the new leniency program affects only leniency applicants, while the new fine rule affects all cartel members involved in the case. When detected by the KFTC, there might be “race-to-the-court” effects to obtain eligibility for leniency. If a leniency applicant provides the KFTC with sufficient incriminating evidence, it may be more reasonable that even non-applicants reveal more evidence to benefit fine reductions in return for cooperating in the investigation. There also exists another possibility. Therefore, the results should be interpreted cautiously because it may be that the KFTC has become so generous that it has reduced more fines under the harsher fine rule. However, testing Hypothesis 5 proves to be a failure, implying that expanding a cartel investigation organization seems to be unsuccessful in getting cartels to voluntarily disclose incriminating evidence. Perhaps, from the perspective of cartel members, there is almost no difference between a small cartel division and a large cartel bureau. When detected, only one or at most two staff usually takes charge of a cartel case, irrespective of the size of the cartel organization. Thus, after a cartel has already been detected, a larger organization has an impact whether or not cartel members will reveal information.

## 1.7 Conclusions

This research investigates how a variety of anti-cartel policies affect firms' cartel activities and reporting behaviors. The results should be cautiously interpreted because the findings are based on cartels that were discovered by the competition agency. This cartel analysis cannot avoid inherent "selection bias" issues. Also, given that cartel durations are also determined by the competition agency, there is a possibility of "measurement error." Nonetheless, this study may be meaningful and humbly contribute to empirical research on cartel behaviors and anti-cartel policy effects. Many previous empirical papers regarding anti-cartel policies have mainly concentrated on the impact of a leniency program on cartel deterrence or desistance, even though a leniency program is introduced or revised with changes of other anti-cartel policies. The results of the current study show the possibility that some previous results on the impact of a leniency program might have been overestimated, because the program is not isolated from other anti-cartel policies. This paper explores the impact of the three important changes in anti-cartel policies of the KFTC around 2005 on cartel stability and evidence disclosure. The three policies are the following: *i*) a more generous and transparent leniency program, which gives automatic full immunity to a first reporter, *ii*) expanding resources with upsized Cartel Bureau, and *iii*) a harsher fine rule with a doubled maximum fine ceiling.

The empirical estimation results support Harrington and Chang's (2009) theoretical predictions that a harsher enforcement or policy can disrupt cartels by making them expect the shorter range of a firm's profit realization. The results can be categorized into two parts; impact on cartel stability and impact on revealing evidence. First, all of the three policies have positive impacts on destabilizing cartels. More specifically, the leniency program and resource expansion destabilize cartels in the short run through increasing the detecting capabilities of the anti-trust agency or reducing cartel formations in the market. As a result, the duration of discovered cartels increases due to breakdown of "marginal cartels." However, the long-term effects of those policies are ambiguous. Also, harsher penalties disrupt cartels, even though they do not directly affect the detection capa-

bility of anti-trust agencies. When determining collusive behaviors, firms consider the future fine amount based on announced fine rules, as well as actual fines imposed by the KFTC in the past. Second, the three policies each have more or less a different impact on how much of incriminating evidence a cartel firm discloses. The doubled maximum fine policy has a larger effect on revealing evidence than the revised leniency program does. However, we cannot argue that the expanded organization for detecting cartels has an impact on disclosing evidence. The implication of these results is that when policy-makers fine-tune anti-cartel policies, they should understand the impact of different policy instruments on regulating cartels. They first should specify the goal to achieve and match the effective policies with it in order to achieve better outcomes.

## REFERENCES



## REFERENCES

- Aubert, C., P. Rey, and W. E. Kovacic** (2006). The Impact of Leniency and Whistle-Blowing Programs on Cartels. *International Journal of Industrial Organization*, 24, 1241–66
- Bernheim, M.D. and D. Whinston** (2006). Multimarket Contact and Collusive Behavior. *Rand Journal of Economics*, 21 (1990), 1–26
- Brenner, S.** (2009). An Empirical Study of the European Corporate Leniency Program. *International Journal of Industrial Organization*, 27(6), 639–45
- Chen, J. and J.E. Harrington** (2007). The Impact of the Corporate Leniency Program on Cartel Formation and the Cartel Price Path. *The Political Economy of Antitrust*, ed. by Vivek Ghosal and Johan Stennek, Oxford: Elsevier 59–80
- Choi, Y.J. & Hahn, K.S.** (2014). How does a Corporate Leniency Program Affect Cartel Stability? Empirical Evidence from Korea. *Journal of Competition Law and Economics*, 10(4), 883–907
- Cox, D.R.** (1972). Regression Models and Life-Tables (with Discussions). *Journal of Royal Statistical Society Series, B*(34), 187–220
- Ellis, C.J. and W.W. Wilson** (2003). Cartels, Price Fixing, and Corporate Leniency: What Doesn't Kill Us Makes Us Stronger. *University of Oregon*, Manuscript <http://darkwing.uoregon.edu/wwilson>
- De, Oindrila** (2010). Analysis of cartel duration: Evidence from EC prosecuted cartels. *International Journal of the Economics of Business*, 17(1), 33–65
- European Commission Commission** (1996). Notice on the non-imposition or reduction of fines in cartel cases. *Official Journal of the European Commission C*, 207, 4–6
- European Commission** (1998). Guidelines on the method of setting fines. *Official Journal of the European Commission C*, 9
- European Commission** (2002). Commission notice on immunity from fines and reduction of fines in cartel cases. *Official Journal of the European Commission C*, 45, 3–5
- Green, E.J. and R.H. Porter** (1984). Noncooperative Collusion under Imperfect Price Information. *Econometrica*, 52(1), 87–100
- Hammond, Scott D.** (2004). Cornerstones of an Effective Leniency Policy. *Speech International Competition Network Workshop on Leniency Programs, Sydney, Australia*,
- Harrington, J.E. and M.H. Chang** (2009). Modeling the birth and death of cartels with an application to evaluating antitrust policy. *Journal of the European Economic Association*, 7(6), 1400–35
- Kaplow L. and S. Shavell** (1994). ptimal law enforcement with self-reporting of behavior. *Journal of Political Economy*, 102, 583–606

- Korea Fair Trade Commission** (2014). Commission notice on immunity from fines and reduction of fines in cartel cases. *Statistical Yearbook 2014*, <http://eng.ftc.go.kr/bbs.do>
- Levenstein, M. C. and V. Y. Suslow** (2006). What Determines Cartel Success? *Journal of Economic Literature*, XLIV, 43–95
- Meyer, B.D.** (1990). Unemployment Insurance and Unemployment Spells. *Econometrica*, 58, 757–82
- Miller, N. H.** (2009). Strategic Leniency and Cartel Enforcement. *American Economic Review*, 89, 750–68
- Motchenkova, E. and R. van der Lann** (2005). Strictness of leniency programs and cartels of asymmetric firms. *Discussion paper*,
- Motta, M. and M. Polo** (2003). Leniency Programs and Cartel Prosecution. *International Journal of Industrial Organization*, 21, 347–79
- Robert M. Feinberg et al.** (2016). The Determinants of Cartel Duration in Korea. *Review of Industrial Organization*, 48, 433–448
- Spagnolo, G.** (2000). Optimal Leniency Programs. *Fondazione Eni Enrico Mattei working paper*, 42
- Spagnolo, G.** (2004). Divide et impera: Optimal deterrence mechanisms against cartels (and organized crime). *Discussion paper*, 4840 Mimeo
- Stigler, George** (1964). A Theory of Oligopoly. *Journal of Political Economy*, 72(1), 44–61
- Zhou, Jun** (2012). Evaluating Leniency and Modeling Cartel Durations: Time-Varying Policy Impacts and Sample Selection. *Bonn University*,
- Zimmerman, J.E. and J.M. Connor** (2005). Determinants of Cartel Duration: A Cross-Sectional Study of Modern Private International Cartels. *Working paper* <http://ssrn.com/abstract=1158577>

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# CHAPTER 2

## An Empirical Study of Cartels with Ringleaders in Korea

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### 2.1 Introduction

A large amount of prior theoretical literature on oligopoly focuses on price leadership (e.g., Stackelberg leader). However, previous economics literature on cartels is less focused on cartel ringleaders despite their significant role in forming a cartel. Price leadership is an economic term related to price parallelism by using an instrument such as a dominant power or tacit collusion.<sup>1</sup> The term “cartel ringleader” is relatively close to a relevant legal term defined as a “leader,” an “instigator,” or an “originator” of the formal cartel by anti-trust authorities. More specifically, price leadership is different from a ringleader of an explicit formal cartel for the following reasons. First, a cartel ringleader restricts competition by conspiring and instigating explicit collusion, whereas parallel pricing incurred by a dominant firm or a barometric firm results from a limited market competition. Second, a cartel ringleader is based on an explicit agreement in a real-world cartel detected by an anti-trust agency, whereas collusive leadership based on tacit collusion uses public pre-announcements as a coordinating device.<sup>2</sup> Third, a cartel ringleader has been studied mainly in the context of a corporate leniency program due to the trans-Atlantic policy difference,<sup>3</sup> whereas price

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<sup>1</sup>Since Stigler (1947) and Markham (1952), three types of price leadership has been studied: dominant firm price leadership, barometric firm price leadership, and collusive price leadership.

<sup>2</sup>Despite the Tobacco Case, where parallel pricing is illegal regardless of being implemented by an agreement or not, it is generally recognized that tacit collusion in itself is difficult for an anti-trust agency to prosecute. Without explicit evidence of agreement, illegal firms are not easily convicted, even though there apparently exists parallel pricing among firms. Refer to *American Tobacco Co. v. United States* 328 U.S. 781 (1946) and *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209 (1993)

<sup>3</sup>The leniency program offers firms involved in a cartel—which self-report and hand over evidence—either total immunity from fines or a reduction of fines. Even though both regimes charge harsher penalty to a cartel ringleader, they treat a cartel ringleader differently. The US DOJ basically does not grant leniency to a cartel ringleader while

leadership has been studied to explain firms' behaviors in an oligopoly market. Fourth, the role of a cartel ringleader is related to a market allocation cartel as well as a price fixing cartel, whereas price leadership is mainly intended to parallel pricing. However, from the viewpoint of public policy, it is commonly important to understand what kinds of market environments determine the likelihood of those instrumental devices, which supports collusion or affects market structures.

This research focuses on finding adequate answers to the empirical puzzle about cartel organization by using the concept of a cartel ringleader. Conventional wisdom asserts that collusion is more sustainable with fewer firms and less asymmetries in the industry. However, we can easily observe cartels with relatively many firms and their considerable size asymmetries. There are a few possible reasons for this discrepancy between theoretical predictions and empirical results. Among these reasons is sample selection bias. Most empirical studies on cartels use policy-dependent data, which are determined by an anti-trust agency. The stronger cartel with few and symmetrical features is too secretive to be discovered by an anti-trust agency. Strong enforcement of anti-cartel policies drives those cartels underground. Another reason may be that theory and empirics use different types of collusion; theoretical literature usually focuses on tacit collusion, whereas empirical analysis uses a set of explicit cartel data.

Toward addressing this puzzle, this paper inquires deeper into the second possibility. Explicit collusive agreements can support a cartel by reducing distrust among firms. Also, a cartel can develop an organizational mechanism for monitoring and enforcing the agreement to offset the destabilizing forces resulting from more firms and greater asymmetries. If this mechanism is effective, we can observe cartels under certain environments where it would be difficult to sustain a

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the EC symmetrically treats a cartel ringleader with other regular firms. In the US, in order to apply for amnesty or leniency, the leniency policy requires that "the corporation did not coerce another party to participate in the illegal activity and clearly was not the leader in, or originator of, the activity" (US Department of Justice, Antitrust Division, Corporate Leniency Policy at A.6). The EU had adopted the discriminating regime following the US, but adopted a non-discriminating leniency program in 2006 and Canada changed in 2010. The Korea Fair Trade Commission revised its leniency program from the US-style to the EC-style regime in 2005. In a unique situation, China's State Administration for Industry and Commerce (SAIC) has a leniency policy with a discriminating regime (applying to "organizers of monopoly agreements") for non-price monopoly agreements while the National Development and Reform Commission (NDRC) has a non-discriminating regime in its leniency policy related to price-monopoly agreements. See Ye (2014). For more details for US and EU policy on leniency programs, refer to "Corporate Leniency Policy" of the DOJ (<https://www.justice.gov/atr/corporate-leniency-policy>) and "Commission Notice on Immunity from fines and reduction of fines in cartel cases" (2006, [http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52006XC1208\(04](http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52006XC1208(04))

cartel otherwise. Levenstein and Suslow (2006) suggest that organizational responses such as an industry association can help firms avoid the “cartel problems.”<sup>4</sup> That is, when cartel firms confront difficult situations where the incentive compatibility constraint becomes dissatisfied for some reason, the cartel strategically responds to the environment to alleviate the problem of cheating. This research focuses on the role of a ringleader as an organizational response in a cartel and finds relevant policy implications. A cartel ringleader can be one of the important factors in determining a cartel structure if it plays as an organizational solution to overcome cartel problems. The results of this study find that a cartel ringleader is more prevalent under circumstances where it is easier for cartel firms to deviate from collusion—with more firms, greater asymmetries and less product homogeneity.

This paper extracts some stylized facts about cartel ringleaders in Korean cartel cases, using a data set of 327 finalized cartel cases filed for violations of Article 19 (1) of the MRFTA (Monopoly Regulation and Fair Trade Act) between January 1, 2000 and December 31, 2010.<sup>5</sup> Here, a “cartel ringleader” is defined as a firm that instigates or leads a cartel based on its role stated in the case documents of the Korea Fair Trade Commission (KFTC). A cartel ringleader is basically categorized into two types: an organizational ringleader that instigates collusive behaviors by approaching other firms or convening a meeting for collusive agreements; or an aggressive ringleader that plays an active role in determining collusive plans regarding price, market allocation, bidding, etc. This research contributes to the literature by empirically showing that a cartel strategically chooses its structure in response to market characteristics. This is one of the first papers about cartel ringleaders using the 327 Korea cartel samples. The results confirm the argument of Levenstein and Suslow (2006) that an alternative monitoring mechanism can be an organizational solution to alleviate the issue of cheating. This study also confirms the findings of Davies and De (2013), which analyzes the effects of market characteristics on the incidence of a cartel ringleader, using the 89 European Commission’s (EC) cartel samples. The abundant organized facts about

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<sup>4</sup>Osborne (1976) argues that enforcing a cartel has inherent difficulties called “cartel problems” in locating firms’ contract surface, choosing an agreeable focal point on it, and monitoring possible deviation.

<sup>5</sup>Some major documents filed during the periods are available for download from the Commission website, [www.eng.ftc.go.kr](http://www.eng.ftc.go.kr).

a ringleader include how frequently they exist across cartel types (e.g. price-fixing, bid-rigging, etc.), the roles of ringleaders (i.e., organizational, aggressive, or both), the frequency of alternative monitoring mechanisms (i.e., industry association), and types of punishment/compensation mechanisms (e.g., side payments, bidding rotation, etc.). Three main estimations are conducted: a linear probability model (LPM) and two index models, a probit and a logit forms.

Three significant results are found. This study confirms that ringleaders are more likely to be identified in cartel structures with more cartel firms, greater asymmetries in size measured by the normalized Herfindahl-Hirschman Index (HHI), and less homogeneity of cartel products.<sup>6</sup> Using a multinomial logit shows that the choice of aggressive ringleaders is pronounced, compared to cases of organizing-only ringleaders or no ringleaders. Last, this study finds ringleaders are less likely chosen in cartel structures when other alternative monitoring mechanisms such as an industry association are involved in cartels. More specifically, when industry associations already play administrative roles in cartels, an organizing-only ringleader is preferred less than an aggressive ringleader. The cartel with involvement of the industry association tends to delegate an aggressive role to a ringleader in order to additionally enforce or monitor the cartel. The remainder of the paper is organized as follows. The next section reviews the previous literature. Section 3 describes the data set and distills the descriptive statistics and stylized facts about ringleaders in Korean cartel cases. In Section 4, empirical results are displayed, which is followed by a conclusion.

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<sup>6</sup>HHI is an index measuring the degree of competition or concentration in the industry, which is defined as the sum of the squares of the market shares of the firms within the industry. However, the normalized HHI is used because it is more suitable for symmetry or equality, while HHI is more suitable for concentration. The formula of the normalized HHI is  $H^* = [H - (1/N)] / [1 - (1/N)]$  if  $N > 1$ , and where  $H$  is HHI and  $H^* = 1$  if  $N = 1$ , where  $N$  is the number of firms in the industry, and market shares are calculated by using cartel shares.

## 2.2 Literature Review

Levenstein and Suslow (2006) point out that a cartel should continuously develop a beneficial structure to all cartel firms in order to sustain their collusive agreement through dealing with three key problems: coordination, cheating, and entry. If an incentive compatibility constraint is dissatisfied, like Stigler (1964) indicates, a cartel becomes exposed to the incentive to cheat. Many studies have examined the market characteristics that affect the incentive compatibility structure of a cartel member. These studies generally argue that more firms in collusion can decrease stability, other factors being equal (Tirole, 1988).<sup>7</sup> Intuitively, a coordination problem leads to more costly haggling, and makes it more difficult to maintain or enforce a cartel, as there are more firms in the industry. Asymmetries in the characteristics of firms also affect the firms' choices of whether to collude or not. The impact of asymmetry on cartel stability varies depending on model specification.<sup>8</sup> However, the theoretical literature has usually recognized that asymmetry resulting from multiple sources tends to destabilize collusion (Ivaldi et al, 2003).<sup>9</sup> Firm-level asymmetry can lead to asymmetric market shares, which make it more difficult for cartel participants to choose an agreeable focal point in the contract surface due to differential preferences.

However, contrary to theoretical expectation, much empirical research based on real-world formal cartel data displays more or less contradictory results (Posner, 1970; Dick, 1996a; Ganslandt et al, 2012).<sup>10</sup> A few possible reasons may account for these divergences, among them, sample selection bias which is unavoidable in empirical research on cartels. Only cartel data detected and

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<sup>7</sup>The threshold discount rate of expected future profits necessary to sustain collusion increases as the number of firms in the industry increases (Tirole 1988). Ralph M. Bradburd and MEad A. Over Jr. (1982) argue that the organizational costs of both cartel formation and cartel maintenance are expected to increase with the number of firms in the industry.

<sup>8</sup>For example, product homogeneity may have two conflicting effects on cartel stability; the homogeneity makes firms coordinate more easily while product differentiation facilitates collusion by decreasing the benefits to deviating.

<sup>9</sup>Motta (2004) argues that collusion is easier to sustain when firms in the market have a more similar distribution of assets because IC constraints become more relaxed. According to Ivaldi et al. (2003), the diversity of cost structures can make collusion unstable for two reasons: it exacerbates a coordination problem due to difficulties in finding an agreeable focal point; a low-cost firm can gain more from undercutting, and it is less threatened by a high-cost firm's potential retaliation. Compte et al. (2002) argue that asymmetries in capacity can make collusion more difficult to sustain when the aggregate capacity is limited.

<sup>10</sup>Posner (1970) and Dick (1996a) find cartel duration increases with the number of participants. Ganslandt et al. (2012) discuss how a certain amount of asymmetry within cartels may actually facilitate collusion.

prosecuted by an anti-trust agency can be used for research with the implication of non-random sampling. It is difficult to detect more strongly sustainable collusion with fewer firms and/or symmetrical features. Another reason may be that most theoretical literature on collusion assumes tacit collusion, which is possible without formal agreement. However, in the real world, an anti-trust agency detects and prosecutes a formal cartel only when sufficiently established evidence of an explicit agreement has been provided. This explicit agreement can make cartel firms' IC constraints less binding even in the market structure with many firms and considerable asymmetries among them.

Monitoring mechanisms can also play a similar role in organizing cartels. Levenstein and Suslow (2006) state that the most successful cartels develop organizational mechanisms (e.g., industry associations) that accommodate fluctuations in the external environment. They assert that firms probably make such a significant investment in building a more complicated collusive organization and in developing organizational skills in an effort to avoid the issue of cheating that undermines cartels. The endogenously changing structure of cartels may have an effect on market equilibrium. For example, an industry association can alleviate inherently unavoidable "cartel problems" suggested by Osborne (1976) in an un-concentrated industry. An endogenously chosen cartel structure possibly allows marginal firms to survive and to lower market concentration. If so, we observe that collusion is more sustainable even in the less concentrated industry that would, otherwise, be highly concentrated. Using the EC cartel data set, Davies and De (2013) focus on the role of a cartel ringleader to empirically show this organizational response of a cartel structure. They find a cartel ringleader instigates explicit collusive agreements or plays an important role in setting up the agreements. Ringleaders are more prevalent in situations where market features are difficult to sustain collusion,—i.e., more cartel firms and greater asymmetries in firm sizes.

As discussed above, previous theoretical research mainly pays attentions to a price leadership, rather than a cartel ringleader. Following Stigler (1947) and Markham (1952), the previous literature examined three types of price leadership. The first two, a most efficient dominant firm type and a representative barometric firm in the industry, commonly lead the price by moving first, and



then other firms in the industry set their price and quantity by paralleling the price determined by the leader. However, both of these cases are, especially when an anti-trust agency deals with a cartel case, legally less meaningful because the resulting equilibria are consequences of restrictive competition rather than adopting a strategic conspiracy to maximize their joint profit. That is, the two types of the price leadership are not intended to avoid price competition among rivals, but are instead an inevitable consequence of the industry's structure. Thus, effective corrective orders/remedial measures, which can be taken by an anti-trust agency to cease these behaviors, are limited. These types of price leadership can be corrected through reforming the industry structure, rather than correcting an individual firm's behavior.

Different from these two types, collusive price leadership comes from tacit adoption of a price leader to avoid price competition.<sup>11</sup> Markham (1952) argues that collusive price leadership assuming overt agreements with the implication of public pre-announcement of price is more likely under certain market features, such as fewer firms, restricted entry, product homogeneity, price inelasticity of demand, and similar cost structures among firms in an industry. However, considering a structural response in organizing collusion, empirical results based on real-world cartels exhibit findings that contradict these predictions. Rotemberg and Saloner (1990) argue that collusive price leadership facilitates collusion under asymmetric information; and if information is sufficiently asymmetric, the less informed firm prefers to follow the better-informed firm, so that the leader can emerge endogenously. Mouraviev and Rey (2011) show when firms face asymmetric cost structures or produce differentiated products, price leadership can enhance the profitability of collusion. In case of asymmetric cost, the less efficient firm acts as a leader because the incentive-compatible constraint of an inefficient firm is binding without collusion. Ishibashi (2008) shows that although setting a price early in a homogeneous good capacity-constrained setting is disadvantageous per se, a large firm has the incentive to move first, in order to demonstrate its commitment not to deviate. However, as already discussed above, these price leadership types are different from

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<sup>11</sup>Rotemberg and Saloner (1990) define "collusive price leadership" as a situation where "one of the firms announces a price change in advance of the date at which the new price will take effect, and the new price and date are swiftly matched by the other firms in the industry."

an explicit formal cartel with ringleaders.

Some papers have explicitly dealt with cartel ringleaders using EC data. Reviewing EC cartel data, Ganslandt et al (2012) find some case evidence of ringleaders in cartels with size-asymmetric firms. They build a theoretical model that predicts that a certain amount of asymmetry within cartels may facilitate collusion due to indivisible fixed costs of collusion borne by a leader. Grout and Sonderegger (2005) observed considerable heterogeneity in the market shares held by cartel members from 2002 to 2007, and they identified a ringleader in 10 out of 43 EU cartel cases. Davies and De (2013) used 89 European cartels between 1990 and 2008 to empirically estimate the frequency of ringleaders under the features of more firms and greater asymmetries in a cartel. They found a ringleader plays a critical role in reducing “cartel problems” under situations of many firms exhibiting substantial size asymmetries.

## 2.3 Data and Stylized Facts

This paper finds some stylized facts about ringleaders in Korean cartel cases using the data set of 327 cartel cases finalized between January 1, 2000 and December 31, 2010 filed for violations of Article 19 (1) of the MRFTA (Monopoly Regulation and Fair Trade Act). All of the case documents were read closely to collect relevant information. The detailed information largely covers market- and firm characteristics. Observation  $i$  represents each cartel case.

It is natural to ask how a ringleader cartel and a no ringleader cartel can be differentiated because any cartel is triggered by a certain form of involvement of at least one firm or its employer. Here, no ringleader cartel can be regarded as an alternative to a default where all cartel members share the legal responsibilities. In this default case, all cartel members should be fined equally, which implies that they are fined in proportional to their sales. In ringleader cases, all members of the cartel structure, willingly or sometimes reluctantly, agree to delegate the role of leader to a ringleader(s) who can be singled out.

The existence of a ringleader can be drawn by carefully reading the section of the “detailed process of agreement and coordination” or “calculating the amount of fines” in the case documents. Following the guidelines for calculating fines, the KFTC usually charges ringleaders more severe penalties.<sup>12</sup> However, not all cartel cases formally define a ringleader in the documents. Therefore, a “ringleader” is defined in this paper as any firm in a cartel case that plays an important role in organizing the cartel. In order to define a cartel ringleader, this paper follows the EC’s rule that distinguishes two broad types of behaviors in a cartel’s decisions—“instigation” and “leadership.”<sup>13</sup> While not all the anti-trust agencies always formally define the term, “cartel ringleader,” this standard is widely used to categorize various behaviors organizing cartels. Note

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<sup>12</sup>An actual fine amount imposed by the KFTC is determined following several steps. First, a basic fine is calculated based on sales amounts, and then the basic fine is adjusted according to certain factors. A final fine is determined after leniency discount is applied if needed. Basic Fine = Related sales of the cartel product x Fine rates (0 - 10%) where fine rates are determined by KFTC according to the seriousness and importance of violation. Adjusted Fine = Basic Fine x (100% - Fine reduction rate + Fine addition rate) where a fine can be reduced if firms cooperate in investigation (0 - 20%) or involvement is limited and it can be increased if firms are ringleaders or repeat violations. For more details, refer to <http://eng.ftc.go.kr/bbs.do>

<sup>13</sup>European Commission (2006), Case T-15/02 BASF v Commission Summary of Judgment, March 15, 2006.

Table 2.1 Incidence of (ringleader involved) cartel case 2000-2010

	00	01	02	03	04	05	06	07	08	09	10	Total
Total	30	22	34	14	23	30	31	28	39	38	38	327
RL*	6	3	5	7	8	8	12	9	17	12	19	106

\*\*RL” means the number of cartel cases with at least one ringleader.

that a ringleader, as discussed above, is not limited to price fixing cartels, unlike price leadership, but related to all cartel types. Davies and De (2013) also applied this approach to define ringleaders. First, an “instigator” is involved in the initial birth and/or subsequent enlargement of the cartel. In this study, an alternative term, an “organizational/organizing ringleader” is used for those behaviors. This type of ringleader plays an relatively moderate or mild role in organizing cartels by approaching potential members or convening a cartel meeting in the beginning of cartel coordination. Second, “leadership” implies an active or leading role in determining/suggesting a specific cartel plan or in designing a penalty/compensation mechanism. Likewise, an alternative term, an “aggressive ringleader” is used in the current research. The roles of these types, for the most part, are associated with a price/sales plan or bidding plan such as complementary- or rotating bidding. Sometimes, these ringleaders set up a punishment mechanism (e.g., monetary penalty) against the violator of the agreement, or a compensation mechanism (e.g., side-payment) for the firm that sacrifices its individual share of the joint profits in the cartel agreement.

As shown in Table 2.1, a single or multiple ringleader(s) are identified in 106 out of the 327 cases, which accounts for about 32% of cases. This frequency of the existence of a ringleader apparently seems to be greater than that found in previous studies, where 10 out of 43 (23%) ringleader cases in Ganslandt (2012) and 19 out of the 89 (21%) cases in Davies and De (2013) are ringleader-related in EC cartel cases. However, as Davies and De (2013) pointed out, it is probable that the actual incidence of ringleaders in the EU cases would be higher than their finding. Anti-trust agencies such as the EC officially identify a ringleader only when it feels sufficiently confident to name a ringleader explicitly with established evidence. Table 2.1 shows a sharply increasing trend of ringleader cartels since 2005. It might be because that the KFTC introduced the new leniency program around that time, which gave more benefits to ringleaders than prior to

the policy change. The new policy dummy will be included in the rigorous analysis to control for the impact of the policy modification.

Table 2.2 Comparison of cartels with/without ringleader

	RL cartels	Non-RL cartels
Total cases	106	221
Price fixing cases	87 [82.1%]	176 [79.6%]
Fined cases	82 [77.3%]	125 [56.6%]
Leniency filed cases	38 [35.9%]	35 [15.8%]
Incidence of industry association	9 [8.5%]	26 [11.8%]
Average number of firms	6.89 (4.71)	5.78 (4.41)
Average cartel share of the largest firm	50.61 (22.22)	50.3 (20.2)
Average range of market share	44.12 (21.89)	38.31 (20.6)
Average HHI	.39 (.22)	.39 (.19)
Average normalized HHI	.23 (.21)	.18 (.17)
Average fines* (million KRW)	10,116 (25,272)	10,175 (25,469)
Average fine rate (percent)	3.84 (2.37)	4.27 (4.39)
Average cartel duration (month) <sup>†</sup>	15.87 (23.39)	17.54 (22.68)

Remark: Standard deviations in parentheses, and the proportion of certain types of cartel cases to total ringleader cartels or total non-ringleader cartels are expressed in the bracket.

\*Fines before the leniency scheme is applied are averaged and expressed in million KRW, where 1,000 KRW can be approximately converted into 1 US dollars.

<sup>†</sup> The average cartel duration is obtained except for bid-rigging cartels.

Table 2.2 exhibits descriptive statistics that compare ringleader-related cartels with non-ringleader cartels. The number of participating firms in a cartel is at least two, and the maximum number of firms is 25. The average number of cartel firms is about 6.14. The longest cartel duration in the sample set is 110 months. The average one is about 17 months. Pertaining to cartel types

and whether fined or not, there is not much difference regardless of the existence of a ringleader. However, a ringleader-based cartel is more likely to apply for leniency. About 36% of ringleader cartels is leniency filed, whereas only 16% is for non-ringleader-involved cartels. Note that 77 cases conditional on being ringleader-involved are subject to post-2005, when the new leniency program allowed a ringleader to apply for leniency benefits, such as fine reduction and immunity. Even though this new anti-cartel policy might have had a positive impact on destabilizing cartels, it seems to have been highly associated with increasing ringleader involvement with cartel formation. Interestingly, an industry association is slightly less involved with a cartel in the presence of a ringleader. It implies that an industry association and a ringleader can be substitutive monitoring mechanisms when a cartel is formed or enforced. Also, ringleader-based cartels have on average more firms and greater asymmetries in a size. Note that a range of cartel share<sup>14</sup> between the largest and smallest firm, and normalized Herfindahl-Hirschman Index (HHI)<sup>15</sup> are used as proxies for asymmetry. Higher values imply greater asymmetries in firm sizes for both variables.

Table 2.3 displays how many ringleaders are involved in a cartel and how large they are.

The average number of cartel firms is about 6.14, which is a little less than the average in 7.25 of Hay and Kelley's (1974) study. On average, 1.68 cartel ringleaders are involved in cartels. Out of the 63 cartel cases with only two cartel firms, 47 cases (75%) are not involved with a cartel ringleader. It seems that a cartel structure with fewer firms is less likely to develop a special monitoring mechanism in order to sustain collusion. Rigorous analysis is needed to confirm this observation. It is easy to see more than one ringleader. Among the 106 ringleader-involved cases, multiple ringleaders appear in 41 cases. About 40% of ringleader-involved samples shows that

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<sup>14</sup>Here, a cartel is assumed to be all inclusive, even though it is still possible that some minor firms do not join the cartel. Cartel shares, the amount of sales related with goods and services in the cartel case, is used to calculate market shares of the related firms for two reasons. The first reason is inaccessibility of market share information. Even though some decision documents of the KFTC include market shares of the cartel firms in the industry, most public documents do not. Also, it is reasonable that if not all inclusive, the cartel is more likely to collapse.

<sup>15</sup>HHI is an index measuring the degree of competition or concentration in the industry, which is defined as the sum of the squares of the market shares of the firms within the industry. However, the normalized HHI is used because it is more suitable for symmetry or equality, while HHI is more suitable for concentration. The formula of the normalized HHI is  $H^* = [H - (1/N)] / [1 - (1/N)]$  if  $N > 1$ , and where  $H$  is HHI and  $H^* = 1$  if  $N = 1$ , where  $N$  is the number of firms in the industry.

Table 2.3 Number and size of cartel ringleaders

Average number of firm	6.14 (4.53)
Average number of RL	1.68 (1.09)
Average cartel share ratio of 2nd largest to largest firm	55.09 (26.87)
Average cartel share of the largest RL	41.57 (27.99)
Multiple RL cases	41
Largest firm RL cases*	57 [53.77%]
2nd largest firm RL cases*	14 [13.21%]
Smallest firm RL cases	9 [8.49%]

Remark: Standard deviations in parentheses.

\*In the case of multiple ringleaders, the largest ringleader among them is counted. The proportions of ringleader-related cases are expressed in the bracket where total number of ringleader-related cases is 106.

multiple ringleaders play important roles in cartel structure.<sup>16</sup> In three cartel cases with 25 firms, which is the largest in the data set, only one case is ringleader-related, with three ringleaders. However, an industry association is involved with the cartels in other two cases. It is probable that an industry association plays an alternative role in organizing cartels instead of a cartel ringleader. The cartel share of the second largest firm is on average 55% of that of the largest firm, which implies the existence of size asymmetry. In Ganslandt et al. (2012), market share of the second largest firm is about 70%. Average cartel share of the largest ringleader in the cartel is about 42%. Not surprisingly, cases where the largest firm in the cartel is the ringleader accounts for about 54% of ringleader-involved cases. This finding is in a line with Ishibashi's (2008) finding, where a firm with larger capacity is suitable for the role of a leader. In contrast, nine cartel cases are related to the smallest ringleader. It is possible that the incentive-compatible constraint of small—presumably the least efficient—firms binds without the explicitly collusive agreement (Mouraviev and Rey, 2011).

Table 2.4 summarizes ringleaders' roles across their types. As discussed above, the generally recognized rule is used to categorize a ringleader. Two broad types of behaviors are distinguished in

<sup>16</sup>The number of multiple ringleaders in the current research range from two to five. In Davies and De (2013), the maximum is seven.

Table 2.4 Incidence of ringleader by types and roles

Types	Roles	Frequencies
Organizational RL (Organizing- <i>only</i> *)		72 (28)
	approaching potential firms	46 (11)
	convening initial meeting	26 (17)
Aggressive RL <sup>†</sup>		78 <sup>‡</sup>
	determining price plan <sup>‡</sup>	30
	determining sales plan	8
	determining bidding plan	42
	- complementary bidding	35
	- rotating bidding	2
	- subcontracting	8
	- side-payment	3
	penalty scheme	3
	set-up joint firm	5

\* Many organizational ringleaders are also involved in aggressive roles. Out of the 72 cases, only 28 cases are subjected to organizing-*only* roles.

† Many ringleaders engage in more than one role. For example, out of the eight ‘determining sales plan’ cases, four cases are also related to ‘determining price plan.’ Four cases in ‘subcontracting’ are also associated with ‘complementary bidding.’ It also happens in ‘penalty’ and ‘set-up joint firm.’

‡ This role is only associated with non-bid-rigging cartels.

the KFTC’s decision documents. An organizational ringleader plays a role in organizing a cartel; however, its role is limited to a weakly initiating role such as approaching potential members or convening cartel meetings in the beginning of cartel coordination. In contrast, an aggressive ringleader plays a more active or leading role in the cartel by having a larger influence on the cartel by outlining a specific cartel plan or a penalty/compensation mechanism. In the 72 cartel cases in the sample set, single or multiple ringleaders are involved with organizational roles. However, 44 cases out of the total are also associated with aggressive roles. Thus, only 28 of the cases are subject to organizing-only. Second, 78 cartel cases show the existence of an aggressive ringleader(s). This type displays a variety of activities. Most of them are related to leading roles in designing specific cartel plans. Note that many ringleaders engage in more than one role. For example, four ‘determining sales plan’ cases out of eight are also related to ‘determining price plan.’ Four cases in ‘subcontracting’ are also associated with ‘complementary bidding.’ It also happens in ‘penalty’ and ‘set-up joint firm’ cases. Only three cases of penalty scheme—which are mostly monetary



Table 2.5 Incidence of ringleader types across agreement types

Types	No RL	RL involved			Total
		Organ. only	Aggres.	Subtotal	
Not bid-rigging	160	22	35	57	217(66.4%)
- Price-fixing*	127	20	31	51	178(54.4%)
- Others <sup>†</sup>	33	2	4	6	39
<u>Bid-rigging</u>	<u>61</u>	<u>6</u>	<u>43</u>	<u>49</u>	<u>110(33.6%)</u>
- Price-fixing*	49	4	32	36	85(26.0%)
- Others <sup>†</sup>	12	2	11	13	25
Total	221 (67.6%)	28 (8.6%)	78 (23.8%)	106 (32.4%)	327

\* The typology is based on the application of Article 19 (1) of the MRFTA, which implies that when firms' activities are related to price-fixing and market allocation together, this case is counted as 'price-fixing' case.

<sup>†</sup> 'Others' include non-price-fixing cartels such as market allocation, limit or control production or investment, etc.

penalty—are found. However, it is still possible that non-monetary penalty schemes such as a price war are implicitly agreed upon among cartel firms, and the related evidence is not discovered by the KFTC.

Table 2.5 reports the incidence of ringleader types across agreement types. A bid-rigging cartel has different features than a non-bid-rigging cartel, in that the latter usually has longer cartel duration, while the former is implemented only for one time bidding.<sup>17</sup> As we can predict, price-fixing cartels are the most prevalent one in the real world. Out of the 327 cartel cases, 263, or 80%, are cases of price-fixing.<sup>18</sup> Note that following the KFTC's method to classify violation types, when firms' activities are related to both price-fixing and market allocation, this case is counted as a 'price-fixing' case. In bid-rigging cartels, aggressive ringleaders are more likely to exist than organizing-only ringleaders do. In contrast, in cases neither price-fixing nor bid-rigging cartels, where market allocation types constitute the majority, a ringleader is less likely to appear. This situation raises the possibility that a market allocation cartel is less costly than a price-fixing or a bid-rigging cartel in the context of monitoring cheating. This finding is in line with Davies and

<sup>17</sup>Bid-rigging conspirators can have a long period of a collusive agreement to share multiple one-time projects. However, bid-rigging still has different features from non-bidding cartels from the perspective of impacts on the market.

<sup>18</sup>Some price-fixing cartels are combined with market sharing behaviors. Harrington (2006) shows many cartels are related to price-fixing or bid-rigging which can be combined with a market allocation scheme.

Table 2.6 Incidence of products homogeneity across RL types

Homogeneous products	No RL	Ringleader involved			Total
		Organ.-only	Aggres.	Subtotal	
<i>criterion<sub>a</sub></i> <sup>*</sup>	134	10	48	58	192
<i>criterion<sub>b</sub></i> <sup>†</sup>	87	9	27	36	123

\* Goods and services are considered homogenous if they are intermediate ones (Jacquemin et al., 1981).

† Based on the KFTC's identification strategy, goods and services are considered homogeneous if the KFTC identifies the related goods and services homogeneous ones, the proportion of raw material in cost structure is substantially higher, or only price rather than quality or brand is important factor to decide demand.

De (2013). However, as stated before, it should be noted that many aggressive ringleader cases are also instigated by organizing a process by at least one ringleader.

Table 2.6 displays how product homogeneity differs across ringleader types. Here, two different criteria for classifying homogeneous/heterogeneous products are applied. First, following Jacquemin et al. (1981), *criterion<sub>a</sub>* classifies final goods and services as heterogeneous, while classifying intermediate ones as homogenous. Second, *criterion<sub>b</sub>* is based on the KFTC's identification strategy. Goods and services are considered homogeneous if the KFTC classifies the related goods and services as homogeneous. However, in cases the proportion of raw materials in cost structure is substantially higher, or only price rather than quality or brand is important factor to determine demand, the relevant products are considered homogeneous. Interestingly, in both criteria, a ringleader is not involved in about 70% of homogeneous product cartel cases.

Table 2.7 Incidence &amp; roles of industry associations across RL types

Monitoring mechanisms	No RL	Ringleader involved			Total
		Organ.-only	Aggres.	Subtotal	
Industry association	68	2	10	12	80
- administrative role	32	1	8	9	41
- aggressive role	36	1	2	3	39

Table 2.7 shows how often industry associations as alternative monitoring mechanisms appear in cartel structures across ringleader types. In 80 out of the 327 cartel cases, industry associations play important roles in organizing or controlling cartels. Only 12 out of these 80 cases (15%) are ringleader-involved. It is easily observable that an organizing-only ringleader is less likely to appear when an industry association is pre-involved with the cartel.

## 2.4 Empirical Results

### 2.4.1 Empirical Frameworks

First, the linear probability model (LPM) is first estimated using OLS, where the binary response  $y$  is specified as

$$pr(RL_i) = \beta_1 + \beta_2 N_i + \beta_3 Asym_i + \beta_4 Homo_i + \beta_5 Asso_i + \mathbf{Z}_i \beta + \varepsilon_i \quad (2.1)$$

where  $pr(RL_i)$  is the probability that cartel case  $i$  has a ringleader(s), measured using a binary variable with one denoting existence of a ringleader. Variable  $N$  is an maximum number of cartel firms over its duration. Variable  $Asym$  is the proxy for asymmetry in cartel size, which is measured by the normalized HHI.<sup>19</sup> Variable  $Homo$  is a dummy for products homogeneity where it equals one, if products and services related to cartel cases are considered to be homogeneous. Variable  $Asso$  is a dummy indicating the presence of an industry association, which operates as an alternative monitoring mechanism.  $Z$  includes the variables  $post-2005$  and  $IND$ .  $Post-2005$  is a dummy variable with one, if the case is subject to the new leniency program revised in 2005. The new program allowed a ringleader to be eligible for leniency benefits.  $IND$  is an industry fixed effect.<sup>20</sup> The error term,  $\varepsilon_i$  follows a normal distribution. Positive  $\beta_2$  and  $\beta_3$ , and the negative  $\beta_4$  and  $\beta_5$ , are expected.

Second, the equation will be estimated with index models of probit and logit forms to consider changing the marginal effects of the explanatory variables on the probability of ringleader existence.

$$pr(RL_i) = f(N_i, Asym_i, Homo_i, Asso_i, Z_i) \quad (2.2)$$

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<sup>19</sup>Unlike Davies and De's (2013) study on EC data where they use a 'range' of firm size in a cartel, a different proxy for market asymmetry in size is used here. However, for robustness, a 'range'—the difference of market shares between largest and smallest firm in a cartel—is also used. The results are almost similar.

<sup>20</sup>The industry dummy is based on the Korea Standard Industry Classification (KSIC).

where the function  $f$  is the CDF of the standard normal distribution for the probit model while it is the CDF of standard logistic distribution for the logit model. The positive coefficients for  $N$  and  $Asym$ , and the negative coefficients for  $Homo$  and  $Asso$  are predicted.

Also, the equation will be re-estimated as a multinomial logit to test how the effects of those cartel determinants on ringleader incidences differ across ringleader types. The cartel chooses one of the three alternatives, no ringleader, an organizational only ringleader, or an aggressive ringleader:

$$pr(k_i) = pr\{U(k) > U(l)\} \quad (2.3)$$

for all other  $l \neq k$  where  $U(k) = f(N_i, Asym_i, Homo_i, Asso_i, Z_i)$ .

## 2.4.2 Empirical Results

In Table 2.8, full samples are included for analysis, making no distinctions across cartel types or ringleader types. Specifications, (1), (3), and (5) include only main explanatory variables, while (2), (4), and (6) contain additional anti-cartel policy change effects and industry effects. The results are significantly consistent. Both variables  $N$  and  $Asym$  are positively significant at conventional levels. This finding implies that a cartel structure is more likely to choose ringleader-based structure in a situation where a cartel problem is prevalent. Conventional theory predicts that features of “more firms” and “greater asymmetry” make collusion unstable by leading cartel firms to deviate from collusion, all other things being equal. However, the empirical results show that it might be possible for cartel firms to overcome or at least alleviate these situations by choosing a ringleader structure. This sort of ringleader-based structure can make the IC constraint less binding by increasing trust or decreasing coordination cost among firms.

First, Specification (2) shows that one unit increase in a participating firm enhances the probability of ringleader-based cartel structure by 0.028. As the number of firms increases, a cartel chooses ringleader-based structure to sustain collusion. In order to consider the changing marginal effects, probit and logit models are also estimated. By using the rough rule of thumb, we can divide

Table 2.8 LPM, Probit, and Logit Estimates of Ringleader-based Cartel

(Full samples)

Dependent Variable: <i>Ringleader involved</i>						
Variables	LPM (OLS)		Probit (MLE)		Logit (MLE)	
	(1) <sup>short</sup>	(2) <sup>long</sup>	(3) <sup>short</sup>	(4) <sup>long</sup>	(5) <sup>short</sup>	(6) <sup>long</sup>
<i>Number of firms</i>	.03*** (.007)	.028*** (.007)	.09*** (.021)	.095*** (.024)	.15*** (.036)	.16*** (.04)
<i>Asymmetry</i>	.35*** (.148)	.34*** (.147)	1.015*** (.431)	1.129*** (.468)	1.66*** (.709)	1.924*** (.786)
<i>Homogeneity</i>	-.089 (.055)	-.085 (.059)	-.271* (.163)	-.317* (.189)	-.45* (.27)	-.568* (.322)
<i>Industry Association</i>	-.337*** (.066)	-.276*** (.067)	-1.065*** (.222)	-1.008*** (.243)	-1.87*** (.412)	-1.718*** (.433)
<i>Post-2005</i>		.27*** (.068)		.888*** (.216)		1.49*** (.374)
<i>Industry effect</i>	No	Yes	No	Yes	No	Yes
<i>Cons.</i>	.243*** (.069)	.134 (.102)	-.73 (.204)	-1.138 (.339)	-1.2 (.338)	-1.868 (.58)
<i>Obs.</i>	290	289	290	287	290	287
<i>LR chi<sup>2</sup></i>	-	-	38.9	68.76	39.51	68.89
<i>Correct Predictions(%)</i>	-	-	69.7	73.5	70.0	73.2
<i>ll</i>	-	-	-169.22	-152.96	-168.92	-152.9
<i>Pseudo R<sup>2</sup>†</i>	.124	.214	.103	.184	.105	.184

Remark: Standard errors in parentheses. Significance levels: \*&lt;10%, \*\*&lt;5%, \*\*\*&lt;1%.

†The usual R-squared is reported for LPM.

the probit estimates by 2.5 and the logit estimates by 4, so that these estimates can be compared to the LPM estimates. The scaled estimate on the variable  $N$  is 0.038 for probit and 0.04 for logit. The values of the conditional marginal effects at means for the variable  $N$  are 0.034 for both probit and logit.<sup>21</sup> Observably, there is not much difference in the scaled estimates. Interestingly, when the squared term of the variable  $N$  is added in the OLS regression, the probability of ringleader incidence peaks at  $N=16$ , and then decreases.<sup>22</sup> A possible reason for this finding is that too many firms in a cartel—even in the case of an explicit collusion—exposes the cartel to being detected by an anti-trust agency authority. That is, as the number of firms in a cartel increases, that cartel, to some extent, can alleviate issues of cheating by choosing a ringleader structure. However, above

<sup>21</sup>The results are not displayed.<sup>22</sup>The results with the squared term of the variable  $N$  are not displayed here. However, the estimation results are qualitatively not much different from those shown in Table 2.7.

the critical point, the high risk of detection or heavier penalty to a ringleader increase the expected cost of the collusive behavior. Thus, the probability of ringleader incidence begins to decrease.

The positively significant estimates are obtained for the proxy for asymmetry, *Asym*. Here, the normalized HHI is used.<sup>23</sup> As the asymmetry in size increases, the odds of the ringleader-based cartel structure increases. A cartel needs to have a ringleader to respond to the difficulties of coordination problems. In other words, the cartel shows willingness to choose a ringleader-based structure with more asymmetries in the industry in order to maximize joint profit, instead of no ringleader. All three models consistently show the same directions. These results are consistent with the findings of Davies and De (2013), where the EU data set is used.

Product homogeneity could be an important factor in analyzing ringleader presence in cartels. According to theoretical predictions, it is generally recognized that product homogeneity facilitates collusion.<sup>24</sup> Therefore, it can be argued that a cartel with a homogeneous product, compared to the case with heterogeneous products, would be unwillingly to delegate the ringleader's role to any firm. However, the estimates are significant at only 10% in both index models, even though the directions of the coefficients are all consistently negative.<sup>25</sup>

The coefficient for the industry association dummy *Asso* is regarded as the impact of an alternative monitoring mechanism on ringleader incidence in a cartel. As expected, the results consistently show significantly negative directions for the three models. The existence of a ringleader in a cartel is less likely if an alternative monitoring mechanisms is involved. This result confirms that a cartel uses a ringleader as an organizational response. Being a ringleader can increase profits by coordinating collusions, while it is also risky and costly because many anti-trust agencies impose heavier fines on ringleaders detected for collusion. Thus, if other mechanism plays a ringleader-like role in a cartel, a firm would be less willing to take the role of a ringleader in the cartel. Compared to a case without involvement of an industry association, when an industry association is involved in a

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<sup>23</sup>When an alternative proxy for asymmetry—the range of cartel share between the largest and the smallest firms—is used, the results are similar at the conventional level of significance.

<sup>24</sup>Product homogeneity feature also has a destabilizing effect on a cartel. Homogeneity makes it possible for a firm to capture larger market shares when undercutting.

<sup>25</sup>Here, the *criterion<sub>a</sub>* is applied. When *criterion<sub>b</sub>* is used, the estimate results are qualitatively similar. The results are not displayed here.

cartel, the probability of a ringleader-based cartel decreases by 0.276 in Specification (2).

Also, as predicted, the generously revised leniency program in 2005 increases the probability of a ringleader cartel by 0.335 in Specification (2). Because the KFTC grants ringleaders leniency benefits such as fine reduction or immunity in return for submitting incriminating evidence, the cost of being a ringleader may decrease. However, it should be noted that this policy change can also destabilize a cartel because of the higher detection rate by anti-trust agencies. When we restrict the analysis to ringleader frequency, this policy modification empirically increases the probability of the ringleader-involved cartels. The overall percent correctly predicted is moderately high.

Davies and De (2013) argue that the likelihood of a ringleader varies with the nature of an agreement. They discuss that the need for a ringleader is less pronounced where collusion can be merely forborne by members. (i.e., the agreement is self-enforced.) In such situations, each firm respects its rivals' previous market shares, where cheating is easier to detect and there is no necessity to agree on a common price. Davies and De (2013) finds that a ringleader does not exist in the market allocation cartels of their EC samples.

Table 2.9 shows the results with a sub-sample set of having only price-fixing or bid-rigging cartel cases. It is possible that price-fixing and bid-rigging cartels, compared to others, such as market allocation cartels, are unstable. Among the 39 cartels in the current sample, which were neither price-fixing nor bid-rigging cartels, only three cases were leniency-filed.<sup>26</sup> If that is the case, the magnitudes of the main estimates with those partial samples would be greater than those of the coefficients obtained by using a full sample set.

Here, Specifications (1), (3), and (5) are associated with price-fixing cartel samples, and (2), (4), and (6), with bid-rigging cartels. The estimation results are mixed, with conflicting consequences depending on agreement types. In the case of bid-rigging cartels, compared to the results from full sample regressions in Table 2.8, the value of the estimates as to *Number of firms* is greater than the relevant coefficient of full sample results. Considering a bid-rigging cartel is often related to only a one-time project, there is also a larger incentive to deviate as the number of firms increases

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<sup>26</sup>Out of 288 price-fixing or bid-rigging cartels, the 70 cases were leniency-filed.

Table 2.9 LPM, Probit, and Logit Estimates of Ringleader-based Cartel

*(Price-fixing or bid-rigging samples only)*

Dependent Variable: <i>Ringleader involved</i>						
Variables	LPM (OLS)		Probit (MLE)		Logit(MLE)	
	(1) <i>pricing</i>	(2) <i>bidding</i>	(3) <i>pricing</i>	(4) <i>bidding</i>	(5) <i>pricing</i>	(6) <i>bidding</i>
<i>Number of firms</i>	.024*** (.007)	.032*** (.012)	.089*** (.027)	.135*** (.047)	.147*** (.046)	.222*** (.08)
<i>Asymmetry</i>	.347** (.164)	.231 (.228)	1.184** (.533)	.688 (.727)	1.934** (.89)	1.17 (1.251)
<i>Homogeneity</i>	-.095 (.074)	-.202** (.101)	-.297 (.238)	-.704** (.359)	-.509 (.402)	-1.212* (.628)
<i>Industry Association</i>	-.296*** (.076)	-.47*** (.164)	-1.11*** (.286)	-2.072*** (.689)	-1.861*** (.512)	-3.499*** (1.243)
<i>Post-2005</i>	.22*** (.072)	.387*** (.123)	.781*** (.234)	1.417*** (.461)	1.262*** (.401)	2.458*** (.912)
<i>Industry effect</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Cons.</i>	.149 (.104)	-.001 (.202)	-1.131** (.348)	-1.772** (.726)	-1.848 (.598)	-3.255 (1.477)
<i>Obs.</i>	238	105	231	101	231	101
<i>LR chi<sup>2</sup></i>	-	-	55.5	40.33	54.67	40.24
<i>Correct Predictions(%)</i>	-	-	71.9	80.2	72.7	79.2
<i>ll</i>	-	-	-123.67	-48.72	-124.03	-49.763
<i>Pseudo R<sup>2†</sup></i>	.221	.346	.183	.289	.181	.288

Remark: Standard errors in parentheses. Significance levels: \*&lt;10%, \*\*&lt;5%, \*\*\*&lt;1%.

†The usual R-squared is reported for LPM.

in a cartel. In those situations where cartel problems are prevalent, the necessities of ringleaders grow to avoid the break-down of a cartel. However, this is not the case with other coefficients on *Asymmetry*, *Homogeneity* and *Industry Association* in both sub-samples. The magnitudes of relevant coefficients are not significantly greater than those of the full samples, or on the contrary, they display exactly opposite consequences. These seemingly contradictory results possibly can be attributed to the measurement issue, which results from ambiguous typology when the KFTC classifies cartel types.<sup>27</sup>

<sup>27</sup>For example, out of 263 price-fixing cartels classified by the KFTC's application, 62 cases are also combined



Table 2.10 Multinomial Logit Estimates with 3 ringleader choices

Dependent Var: <i>Ringleader type</i>	Base: No ringleader	
Variables	Organizing-only	Aggressive RL
<i>Number of firms</i>	.093 <sup>†</sup> (.061)	.183*** (.045)
<i>Asymmetry</i>	.833 (1.243)	2.379*** (.884)
<i>Homogeneity</i>	.513 (.75)	-.468 (.406)
<i>Administrative role of Industry Association</i>	-2.262** (1.105)	-1.17** (.532)
<i>Active role of Industry Association</i>	-2.131* (1.128)	-2.33** (.83)
<i>Post-2005</i>	.717 (.651)	1.546*** (.395)
<i>Industry effect</i>	Yes	Yes
<i>Cons.</i>	-18.234 (1448.503)	-2.302 (.602)
<i>Obs.</i>	289	
<i>LR chi2</i>	103.92	
<i>Correct Predictions(%)</i>	70.9	
<i>ll</i>	-194.46	
<i>Pseudo R<sup>2</sup></i>	.211	

Remark: Standard errors in parentheses. Significance levels: \*<10%, \*\*<5%, \*\*\*<1%.

<sup>†</sup>The p-value is .128.

Table 2.10 shows what kinds of ringleader types can be chosen by a cartel when it confronts an unfavorable situation, where a deviation could possibly be attractive. The multinomial logit model is estimated to distinguish aggressive ringleaders from organizing-only ringleaders, as opposed to no ringleader cartels. Compared to Specification (6)<sup>long</sup> in Table 2.8, the magnitudes of the first two main coefficients—related to variables *Number of firm* and *Asymmetry*—for aggressive ringleader types are greater, while those for organizing-only ringleader types are less. This finding implies that a cartel structure prefers to choose an aggressive ringleader, rather than an organizing-only with other types such as a market allocation cartel.

ringleader in order to maximize the joint profit as those adverse environments become aggravated.

As the number of firms increases, an aggressive ringleader is preferred to an organizing-only ringleader. However, the estimation results for an organizing-only ringleader are insignificant at conventional level, where the p-value is 0.128. There are only 28 cases of an organizing-only ringleader. It is probable that organizational ringleader cartels, due to the fragility features, can either develop to more stabilized cartels with an aggressive ringleader, or collapse in the middle of collusion without detection. Actually, the average cartel duration in the current data set is 12.4 months for organizing-only cartels, but 17.1 months for aggressive cartels.

Here, the role of an industry associations is classified into two types in order to determine how the role of an industry association affects the presence of a cartel ringleader. When an industry association is involved in a cartel, its role falls into either an administrative, such as providing a meeting place, distributing determined cartel plans to firms, etc., or an active role, such as presiding over cartel meetings, suggesting cartel plans, etc. The empirical results consistently confirm that an industry association plays a substitutive role for a cartel ringleader. When an industry association is involved in a cartel, the probability of a ringleader-based cartel decreases irrespective of the role of the industry associations. That is, no ringleader in a cartel is preferred when an industry association is already involved with a cartel. More specifically, when an industry association already plays an administrative role in a cartel, an organizing-only ringleader is less likely to be chosen, compared to an aggressive ringleader. This finding implies that if an industry association plays an administrative role in a cartel and the cartel needs a ringleader, it delegates an aggressive role to a ringleader in order to additionally enforce or monitor the cartel. This result is the same when the role of industry associations is active. That is, when an industry association already plays an active role in a cartel, an aggressive ringleader is less likely to be chosen. A ringleader does not have to take the risk of harsher penalty by an anti-trust agency. These estimates are significantly negative at a conventional level. The Small and Hsiao (SH) test for the independence of irrelevant alternatives (IIA) confirms that the assumption can be accepted, while the cross equation test fails.

## 2.5 Conclusions

Many previous empirical papers on cartels focus on the overall determinants of cartels. It is generally acknowledged that unfavorable market features against collusion destabilize cartels. However, these factors can be endogenously determined following the organizational responses of cartel firms. This endogeneity can be a potential reason for the divergence between conventional wisdom and empirical estimation results. This research delves deeper into a ringleader's role in a cartel in order to find an adequate answer to the empirical puzzle. It finds that a cartel structure develops more efficient and enforcing mechanism as an organizational response. It identifies the features of ringleaders' behaviors and their strategic responses across their roles and agreement types.

The current paper humbly contributes to the literature by concentrating on a ringleader's role in organizing a cartel structure using Korea's cartel cases. It confirms previous findings by using richer samples and adding meaningful variables that can cause cartel problems. Also, it distills more extensive and stylized facts about a ringleader. The empirical results show consistent and significant evidence on a ringleader's significant role in overcoming or at least alleviating cartel problems. A cartel willingly or sometimes reluctantly delegates its primary role into a ringleader under unfriendly environments against the cartel. That is, a ringleader is more likely to instigate a cartel or even to actively participate in determining cartel plans as the number of firms or the asymmetry in size grows, but product homogeneity becomes less. These sorts of behaviors, in spite of the seemingly mixed results, are more pronounced in bid-rigging cartels, where it is more difficult to coordinate and to agree on a focal point for collusion. Moreover, firms prefer aggressive ringleader choices rather than organizing-only ringleaders to maximize their joint profits, as opposed to no ringleader structure with more firms and greater asymmetries.

Last, but not least, this paper finds that an industry association is almost perfectly substitutive for a ringleader in collusion. When an industry association is already involved in a cartel, no ringleader structure is preferred. And, when an industry association plays an administrative role in organizing a cartel, but if the cartel still needs a ringleader, an aggressive ringleader is preferred in

order to strengthen the management of the cartel.

These findings should be interpreted cautiously because there is the potential issue of sample selection, which is unavoidable in an empirical study of cartels. We only observe cartels detected and finalized by anti-trust agencies. More secretive and stronger cartels tend to hide underground, undetected. The evidence also confirms that the leniency program granting the leniency benefits to a ringleader increases the incidence of a ringleader in a cartel. Note that this effect is different from the impact of the policy on cartel stability.

This study can be extended by empirically estimating the impact of cartel ringleaders or industry associations on cartel stability. Existence of those monitoring mechanisms could increase or decrease cartel stability. Thus, it can be an empirical issue. With regard to public policy, even though this research has some limitations, the findings can aid in fine-tuning or enforcing anti-trust policies. For example, an anti-trust agency should focus more on the role of an industry association because it frequently takes a ringleader-like role in a cartel. And, when the agency treats a ringleader in penalizing or granting a leniency in order to desist or deter collusion, it could be more effective to differentiate them by their types and roles. Also, when the agency determines a merger, it should be noted that apparently pro-competitive features post-merger, such as more firms or asymmetries can support collusion by making a stronger ringleader more prevailing.

## REFERENCES

## REFERENCES

- Athey, S., and Bagwell, K.** (2008). Collusion with persistent cost shocks. *Econometrica*, 76 (3), 493–540
- Davies and De** (2013). Ringleaders in larger number asymmetric cartels. *The Economic Journal*, 123
- Dick, Andrew R.** (1996a). When are cartels stable contracts? *Journal of Law and Economics*, 39(1), 241–83
- European Commission** (1996). Notice on the non-imposition or reduction of fines in cartel cases. *Official Journal of the European Commission C*, 207, 4–6
- European Commission** (2002). Commission notice on immunity from fines and reduction of fines in cartel cases. *Official Journal of the European Commission C*, 45, 3–5
- Ganslandt, M. Persson, L. and Vasconcelos, H.** (2012). Endogenous mergers and collusion in asymmetric market structures. *Economica*, 79(316), 766–91
- Grout, P and Sonderegger, S.** (2005). Predicting cartels. *Economic Discussion Paper: Office of Fair Trading*, 773
- Ganslandt, M. Persson, L. and Vasconcelos, H.** (2012). Endogenous mergers and collusion in asymmetric market structures. *Economica*, 79(316), 766–91
- Harrington, J.E., Jr.** (2006). How do cartels operate? *Foundations and Trends in Microeconomics*, 2(1), 1–105
- Ishibashi, L.** (2008). Collusive price leadership with capacity constraints. *International Journal of Industrial Organization*, 26 (3), 347–79
- Ivaldi, M. et al.** (2003). The economics of tacit collusion. *Final report for DG Competition, European Commission*,
- Jacquemin, A et al.** (1981). A dynamic analysis of export cartels: the Japanese case. *The Economic Journal*, 91 (363), 685–96
- Korea Fair Trade Commission** (2014). Statistical Yearbook. <http://eng.ftc.go.kr/bbs.do>
- Levenstein, M.C. and Suslow, V. Y.** (2006). What determines cartel success? *Journal of Economic Literature*, 44(1), 43–95
- Markham, Jesse W.** (1952). Competition in the Rayon Industry. *Cambridge: Harvard University Press*,
- Motta, M. and M. Polo** (2003). Leniency Programs and Cartel Prosecution. *International Journal of Industrial Organization*, 21, 347–79

- Mouraviev, I. and Rey, P.** (2011). Collusion and leadership. *International Journal of Industrial Organization*, 29(4), 721–41
- Osborne, Dale K.** (1976). Cartel problems. *American Economic Review*, 66(5), 837–44
- Posner, Richard A.** (1970). A statistical study of antitrust enforcement. *Journal of Law and Economics*, 13(2), 365–419
- Rotemberg, J.J. and Saloner, G.** (1990). Collusive price leadership. *Journal of Industrial Economics*, 39(1), 93–111
- Stigler, George** (1964). A theory of oligopoly. *Journal of Political Economics*, 72 (1), 44–61
- Tirole, Jean** (1988). The theory of industrial organization. *Cambridge: MIT Press*

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## CHAPTER 3

# What Governs Cartels?: Evidence from Korea

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### 3.1 Introduction

According to traditional theories, a cartel is inherently unsustainable due to the temptation of cutting a collusive price among firms, unless firms are sufficiently patient. However, as Green and Porter (1984) indicate, imperfect information can facilitate collusion under certain circumstances. They discuss that a price war is an important mechanism to maintain on-and-off collusion. Many empirical studies show that in reality, some cartels collapse without intervention of an anti-trust agency, while others are detected by the agency for various reasons. However, a strong cartel can survive in the industry without collapsing and being detected.

Irrespective of causes of death, however, it is observed that many cartels frequently operate a special monitoring mechanism in order to survive. Cartel governance can be strategically chosen based on an agreement among cartel members. Firms put more effort and funds into a cartel in order to maintain collusion by reducing uncertainty and preventing firms from cheating. Levenstein and Suslow (2006) argue that an industry association can be used as an important organization to avoid reducing profits and undermining trust among cartel firms. For example, assume an industry association collects price or sales information of each firm and helps cartel firms share it. Then, it is easier for a cartel firm to distinguish “demand shock” from “cheating by rivals” when the firm observes less sales or profits. Thus, a firm is less likely to mistakenly punish a rival firm even when it suffers from a negative demand shock. Thus, it is important to understand what cartel structure looks like, how it operates in a cartel, and how it affects cartel stability, as well as gaining an understanding of the behavior of each individual cartel firm.

What actually operates a cartel inside it? There might exist various types of the monitoring



mechanism in a cartel. This study focuses on three types of cartel governance: an industry association, a body of regular meetings, and a hierarchical structure in a cartel. It is generally accepted that these sorts of monitoring mechanisms support cartel stability by reducing distrust among firms and facilitating communication. However, Levenstein and Suslow (2010) find that the impact of an industry association on cartel stability can be different depending on the causes of cartel death.

This paper confirms that developing a monitoring mechanism significantly increases cartel stability. However, different types of cartel governance have different degrees of impact on stability. When a cartel operates a body of regular meetings in which cartel firms participate, the likelihood of cartel death is smaller than when an industry association is involved in a cartel. Interestingly, the impact of various types of governance on cartel stability can go in opposite directions depending on the causes of cartel death. Specifically, involvement of an industry association with a cartel increases cartel stability more in cases of “natural death” cartels than in cases of “death by anti-trust” cartels. This finding is consistent with Levenstein and Suslow (2010).<sup>1</sup>

This paper also investigates the impact of other monitoring mechanism, a body of regular meetings, which is not explored in the previous literature. This mechanism displays opposite results from an industry association. A body of regular meetings in a cartel decreases the likelihood of death more in “anti-trust death” cartel cases than in “natural death” cases. It is possible that both types of cartel governance respond differently when detected, even though they commonly play a role of facilitator in a cartel. Another finding of the paper is that a higher hierarchical structure stabilizes “natural death” cartels while it destabilizes “anti-trust death” cartels even though the point estimates are insignificant at a conventional level. Also, with regard to the role of industry association in cartel stability, this paper finds that an industry association with administrative roles decreases the stability of “anti-trust death” cartels, while one with an aggressive role does not. However, the results are insignificant.

Survival models are used to identify the impact on cartel stability. The data set includes 327 cartel cases finalized between January 1, 2000 and December 31, 2010 by the Korea Fair Trade

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<sup>1</sup>They find that involvement of an industry association increases the stability of “natural death” cartel while it decreases the stability of “anti-trust death” cartel.

Commission (KFTC). The remainder of the paper is organized as follows. The next section describes the data. In Section 3, empirical frameworks are explained. Section 4 displays the impact of cartel governance on cartel stability. Section 5 explores how the role of an industry association affect cartel stability and Section 6 concludes the paper.

## 3.2 Data and Descriptive Statistics

The sample set covers finalized 327 cartel cases filed between January 1, 2000 and December 31, 2010 for violations of Article 19 (1) of the MRFTA.<sup>2</sup> Following Levenstein and Suslow (2010), the data set is divided into two sub-samples across reasons of cartel death: “death by anti-trust” and “natural death” in order to distinguish the effects of cartel governance on cartel stability. “Natural death” might be caused by cheating, applying for leniency to an anti-trust agency, new entry, etc. “Death by anti-trust” may be initiated by the investigation of an anti-trust agency that obtains a lead from other sources such as consumer complaints, reports from up- or down-stream markets, a press release, requests from a legislative branch, etc. The previous literature identify the cause of cartel breakup based on a specific reason in each case document.<sup>3</sup> However, here two sub-samples are separated not by specific reasons of collapsing, but by the time-line of each case. In detail, if a cartel ends before the KFTC begins its investigation, it would fall under the category of a “natural death” cartel. In contrast, if the investigation start date of a case comes before the collapse date of the cartel, this is included in the sub-group of “death by anti-trust.” The magnitudes of the relevant coefficients in both sub-samples are compared with each other.

As shown in Table 3.1, the proportion of “anti-trust death” in Korea is about 34%, which is lower by 26% than Levenstein and Suslow’s (2010) findings.<sup>4</sup> There might be the possibility of weaker detection or conviction capability by the KFTC. However, the proportion of leniency-filed cases is very close, 22.3% in the current research and 20.98% in previous research. Also, the average cartel duration is statistically longer in natural death cartels than in anti-trust death cartels, as Levenstein and Suslow (2010) find. Also, natural death cartels, on average, have a smaller number of firms and higher concentration ratio than anti-trust death cartels. It seems to be consistent with comparison of the cartel duration. Natural death cartels are more likely stable.

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<sup>2</sup>Some English-version documents filed during the periods are available for download from the Commission website, [www.eng.ftc.go.kr](http://www.eng.ftc.go.kr).

<sup>3</sup>According to Levenstein and Suslow (2010), if a cartel case dies due to amnesty application, cheating, or growing fringe, it falls into the category of “natural death.” On the contrary, it dissolves due to follow-on investigation, customer complaint, or whistle-blowers, it goes into the group of “anti-trust death.”

<sup>4</sup>There are 49 anti-trust death out of total 81 cases.

Table 3.1 Descriptive statistics on Korea cartel by death reasons (2000 - 2010)

	Natural Death	Death by Anti-trust
Number of total cases [leniency-filed]	216 [73]	111
Average cartel duration (month)*	29.48 (36.57)	19.21 (20.51)
Average number of firms	5.80 (4.52)	6.80 (4.50)
Concentration ratio <sup>†</sup>	4,195 (2,030)	3,258 (1,779)
Product Homogeneity <sup>‡</sup>	.40 (.49)	.33 (.47)
Industry Association	.23 (.42)	.27 (.45)
Regular Meeting	.10 (.30)	.07 (.26)
Hierarchy (frequency)		
- executive or higher	126	68
- general manager	28	20
- working manager or lower	19	6
- unknown	43	17

Remark: Standard deviations in parentheses

\*Cartel duration is averaged over no-bidding cases.

<sup>†</sup> Concentration ratio is measured by the method calculating HHI (Herfindahl-Hirschman index). But, here the cartel share of each firm is used instead of its market share.

<sup>‡</sup> When a cartel product is an intermediate rather than a final one, it is considered homogeneous.

In this data set, cartel products are classified into two categories, intermediate and final. Also, following Jacquemin, A. et al. (1981) intermediate goods and services are considered homogeneous, while final ones are not. When a cartel agreed upon intermediate goods and services rather than final ones, there can be two conflicting effects on cartel stability. Considering price information as to intermediate products is relatively private, the cartel is likely more unstable.<sup>5</sup> Also, buyers of the intermediate products tend to have bigger gaining power, or are more organized/concentrated than unorganized many average consumers who purchase final goods and ser-

<sup>5</sup>Refer to Harrington and Skrzypacz (2007) for discussions of private prices and collusion.

vices.<sup>6</sup> This feature also can hurt cartel stability. In contrast, if intermediate products are relatively more homogenous than final ones, cartel firms can find an agreeable focal point more easily than when a cartel product is a final product. This supports cartel stability. It seems that the latter effects apparently dominate the former effects.

Moving onto the main predictors of the current paper, there are three variables that influence on cartel activity: involvement of industry association in a cartel, existence of regular meeting among cartel firms, and a hierarchical structure of personnel involved with the cartel. These variables play important roles in forming/managing a cartel inside either the cartel itself or even each cartel firm. There is no significant difference between two sub-samples as to the frequency of an industry association or a regular meeting. Also, note that a top level position such as an executive or a CEO is more likely to be involved in cartels in both sub-samples. More rigorous analyses are needed to draw significant results controlling for other covariates.

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<sup>6</sup>Dick (1996) finds that Webb-Pomerene cartels with more concentrated consuming markets are less stable.

### 3.3 Empirical Frameworks

Survival analysis is employed to estimate the impact of organizational characteristics inside a cartel on cartel stability. First, the Cox semi-parametric hazard model is used following much previous literature (De, 2010; Zhou, 2012; Choi and Hahn, 2016). Also, a parametric survival model with Weibull distribution is applied in order to investigate the robustness of the results. These models specify the probability of cartel collapse as a function of the main features that affect organizing and maintaining a cartel inside it. In Cox regression, a hazard rate for a cartel  $i$  at time  $t$ ,  $h_i(t; \mathbf{x})$  is basically the relative ratio of the probability density function  $f(x)$  to the survival function  $S(x)$ . It refers to the instantaneous probability with which a cartel breaks down, conditional on its survival to time  $t-1$ . The hazard function can be expressed as follows.

$$h_i(t; \mathbf{X}) = h_0(t) \times \exp(\mathbf{X}_i \boldsymbol{\beta}) \quad (3.1)$$

where  $t$  is the elapsed time since the formation of a cartel,  $\mathbf{X}$  is a vector of observed explanatory variables that influence cartel durations, and  $\boldsymbol{\beta}$  is a vector of parameters to be estimated via a maximum likelihood approach. These parameters measure the impact of the observed characteristics.

The hazard function consists of two terms: the first term,  $h_0(t)$ , is the baseline hazard that depends only on time and is common to all subjects in the population; the second term,  $\exp(\mathbf{X}_i \boldsymbol{\beta})$ , depends only on the explanatory variables rather than on time. This term shifts the baseline hazard. For the explanatory variables, cartel level information is collected from the sample data set. The main predictors are the variables as to cartel governance that influence operating a collusive agreement inside either a cartel itself or cartel firms. They include the dummy for the involvement of an industry association in a cartel, the dummy for the existence of regular meetings in a cartel, and the highest hierarchical position of those involved in a cartel. Other determinants are also included, such as the number of cartel firms, the concentration ratio measured by the cartel shares of the firms, the dummy for the innovative anti-cartel policy change in Korea in 2005,<sup>7</sup> and industry

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<sup>7</sup>The KFTC innovated anti-cartel policies around 2005. Most of all, it developed an old leniency program in more

effects. When the ratio of hazard rates is calculated, the baseline hazard rates are canceled out, implying that the ratio does not depend on time, but only depends on covariates.

For example, if the main determinant of cartel stability, say  $x_1$ , increases by one, while holding other covariates fixed, the relative hazard rate ratio will be the following.

$$\frac{h_i(t; x_1 + 1, x_2)}{h_i(t; x_1, x_2)} = \frac{h_0(t) \times \exp\{\beta_1(x_1 + 1) + \beta_2 x_2\}}{h_0(t) \times (\beta_1 x_1 + \beta_2 x_2)} = \exp(\beta_1) \quad (3.2)$$

where the positive coefficient - an estimated hazard rate ratio greater than one - implies that the observed variable increases a dissolution hazard rate and reduces cartel duration controlling for other variables, while a negative coefficient - an estimated hazard rate ratio less than one - reflects that the relevant characteristic increases cartel stability, given other variables are fixed.

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transparent and predictable ways following the US DOJ in 1993 and the EC in 2002.

Table 3.2 Hazard rate estimation results

Variables	Cox Models		Parametric Models	
	Natural Death	Death by Anti-trust	Natural Death	Death by Anti-trust
	(1) Hazard Ratio (z-statistic)	(2) Hazard Ratio (z-statistic)	(3) Hazard Ratio (z-statistic)	(4) Hazard Ratio (z-statistic)
<i>Asso</i>	.637** (-2.00)	.849 (-.55)	.644** (-1.98)	.918 (-.29)
<i>Reg_Mtng</i>	.405*** (-3.48)	.319** (-2.30)	.431*** (-3.27)	.349** (-2.20)
<i>Hierarchy</i>	.899 (-.85)	1.23 (1.02)	.911 (-.75)	1.232 (1.04)
<i>NF</i>	1.004 (.12)	.989 (-.28)	1.001 (.02)	.987 (-.33)
<i>Concent</i>	1.001 (.50)	1.001 (.44)	1.001 (.37)	1.001 (.44)
<i>Intermed_Prodct</i>	.954 (-.21)	4.376*** (3.53)	.937 (-.30)	4.407*** (3.79)
<i>post_2005</i>	.510*** (-3.17)	.360*** (-3.29)	.540*** (-2.96)	.366*** (-3.35)
<i>IND</i>	Yes	Yes	Yes	Yes
<i>Cons.</i>			.031*** (-6.15)	.001*** (-8.26)
<i>Obs.</i>	154	77	154	77
<i>Chi<sup>2</sup></i>	38.03	41.80	35.49	44.86

Remark: Z-statistics in parentheses. Significance levels: \* < 10 percent, \*\* < 5 percent, \*\*\* < 1 percent.

## 3.4 Empirical Results

In this section, the regression analyses for the equation 3.1 are performed. Table 3.2 displays the estimation results. The regression turns first to the Cox model [Specifications (1) and (2) in Table 3.2] with two sub-samples, “natural death cartels” and “death by anti-trust cartels.” Then, parametric models assuming Weibull distribution [Specifications (3) and (4) in Table 3.2] are estimated.

### 3.4.1 Involvement of Industry Association

As expected, involvement of an industry association (*Asso*) in a cartel increases cartel stability overall for all specifications, irrespective of the reasons of cartel death. In detail, for cartels that



collapse without being detected by an anti-trust agency (natural death), an industry association involved in the cartel significantly decreases the likelihood of the cartel death. [Specification (1)] Involvement of an industry association is also more likely to obstruct the breakdown of the cartel by an anti-trust agency (death by anti-trust). [Specification (2)] However, the magnitudes of the hazard ratio as to the industry association variable are different.

The hazard ratio for the sub-sample of “death by anti-trust” is greater than the magnitude for “natural death.” It implies that the impact of involvement of an industry association on cartel stability is less in the case of “death by anti-trust” than in the case of “natural death.” The result is similarly consistent with the findings of Levenstein and Suslow (2010). Assuming the same base line hazard, the difference of the coefficient on *Asso* between “natural death” and “death by anti-trust” is marginally significant at 10% significance level.<sup>8</sup> Even though involvement of an industry association facilitates a cartel, some other effect can reduce cartel stability for “anti-trust death” cartels. It might be possible that operation of an industry association leaves a trail of incriminating evidence, which supports prosecution by anti-trust agency.<sup>9</sup> As a result, a cartel in which an industry association is involved becomes unstable when it is detected by an anti-trust agency. However, the point estimate is insignificant.

### 3.4.2 Existence of Regular Meetings

The estimation results as to the variable, existence of regular meetings in a cartel (*Reg\_Mtng*) are all significant at a conventional level. Expectedly, the existence of a regular meeting in a cartel also stabilizes a cartel by facilitating better communication and sharing updated information on the cartel. The relevant hazard rate ratios are less than one for all specifications. Also, the stabilizing effects of a regular meeting are greater than those of an industry association for both sub-samples. However, the sizes of the magnitudes in “natural death” and “death by anti-trust” are completely opposite, when compared with those of the previous variable, *Asso*. That is, if a cartel has a regular

<sup>8</sup>Using robust standard errors, p-value is 0.096 with logarithm value of cartel durations.

<sup>9</sup>Levenstein and Suslow (2010) write that “Cartels appear to face a tradeoff: the involvement of a trade association helps to stabilize the cartel, providing a mechanism for communication and mediation; but it also increases the cartel’s visibility and the written record of its conspiratorial activities, making it more vulnerable to prosecution.”

meeting among cartel firms, the meeting increases cartel stability more when the death is caused by an anti-trust agency's intervention than in the case of "natural death."

What makes a regular meeting yield different results than an industry association? It is probably because an industry association and a body of regular meetings behave differently during collusion and respond differently to an anti-trust agency's investigation. A body of regular meetings usually consists of cartel firms, while an industry association is a legally independent entity of cartel firms. When an anti-trust agency discovers a cartel, it tends to focus more on cartel firms rather than an industry association and charges them a heavier penalty. When detected, cartel members in a body of regular meetings are more careful in concealing hard evidence as to their illegal behaviors in order to avoid heavy penalties. Those behaviors can happen during collusion, but they are more pronounced when the cartel is detected by an anti-trust agency. However, in the case of a cartel in which an industry association is involved, an industry association invests less effort and care into hiding incriminating evidence, unless it is actively involved with the cartel. Thus, a cartel with a body of regular meetings, when an investigation is initiated by an anti-trust agency, likely has lower probability of being convicted, compared to a cartel in which an industry association is involved - that is, the former seems to be likely stronger and more stable than the latter. However, the difference test between two sub-samples are not significant at a conventional level.

### **3.4.3 Hierarchical Structure**

A cartel is composed of firms in the industry. However, a collusive decision is made by personnel in the firms. Interestingly, a hierarchical structure shows different impact on cartel stability across the reasons of cartel death, even though the results are insignificant. It is possible that a cartel becomes stable, as higher levels of positions are involved in the cartel. As expected, when higher positions are involved in cartels, cartel stability increases in "natural death" cartels. [The coefficient is less than one in Specification (1).] It is likely that a cartel agreed on by a CEO or executive of firms is stronger and more stable than one by a working manager or one in a lower position. In contrast, stability decreases in "death by anti-trust" cartels. [The coefficient is greater than one in

Specification (2).] Probably, there is a conflicting effect on cartel stability. A higher level of people is more likely to cooperate with the investigation of the anti-trust agency in order to avoid personal liability when a cartel is detected by the agency.

### 3.4.4 Other Determinants

Even though it is not a main predictor, the variable, intermediate products (*Intermed\_Product*), also shows conflicting results in “natural death” and “death by anti-trust” sub-samples. As noted before, when a cartel agrees upon intermediate goods and services rather than final goods, two conflicting effects on cartel stability exist. This feature, on the one hand, decreases cartel stability due to private price information, or greater bargaining power of more organized/concentrated buyer than unorganized average consumers who purchase final goods and services. However, in contrast, this can support cartel stability if intermediate products are relatively more homogenous than final ones.<sup>10</sup> In that case, cartel firms can find an agreeable focal point more easily than when a cartel product is a final product. The results indicate that the latter slightly dominates the former for the “natural death” cartels [Specification (1)], while the former strongly dominates the latter for the “death by anti-trust” cartels [Specification (2)] It is likely that when a cartel with an intermediate product is detected, it can face organized complaints or lawsuits on the buyers’ side.<sup>11</sup> And an investigating agency can collect stronger evidence from concentrated buyers. These conditions can hinder cartel stability more when the cartel with intermediate products is detected by an anti-trust agency.

However, no significant evidence regarding the negative relationship between the number of firms (*NF*) and cartel stability is found. A greater concentration ratio (*Concent*) measured by cartel shares does not increase cartel stability, either. Unlike conventional theoretical predictions, many previous empirical results do not confirm these. Endogeneity issues may be the reason behind this. The cartels discovered post 2005 - when anti-cartel policies were innovated - have longer cartel

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<sup>10</sup>Homogeneity feature also can destabilize cartel because a firm can capture greater market share when undercutting.

<sup>11</sup>Unlike the USA, South Korea does not have a treble damage system in civil suits. A class action lawsuit following indictment against illegal cartels is not institutionalized as well as a civil lawsuit filed by consumers is not prevalent.

durations for both sub-samples. According to Harrington and Chang (2009) and Brenner (2009), a longer duration following policy change means destabilizing effects on collusion in the short run, because breakdown of the “marginal cartels” increases the average duration of population cartels. Expectedly, policy change has a greater impact on “death by anti-trust” cartels.

## 3.5 Different Roles of an Industry Association

### 3.5.1 Roles of Industry Association

The same regression is conducted except for the distinguishing roles of an industry association. Here, the roles of industry associations are grouped into two categories, administrative and active. In cases of administrative roles, an industry association is used as a simple instrument in order to support collusive decisions made by cartel firms. Here, an industry association provides a meeting place or distributes information to cartel firms. However, if an industry association actively has cartel firms form to join a collusive agreement, or determines a specific condition of the agreement, this case falls into an active role. An industry association might respond differently depending on its role. As a result, the impact of an industry associations on cartel stability also can vary.

### 3.5.2 Results

Table 1.3 shows the results. When an industry association with administrative roles is involved in a “natural death” cartel, its involvement increases cartel stability. However, if the cartel dies due to an anti-trust agency’s intervention, its involvement hurts cartel stability, and even decreases cartel durations. Because the penalty related to the cartel case is focused on cartel firms, the industry association is more likely to comply with an anti-trust agency’s investigation. Or, it at least is less likely to try to conceal incriminating evidence about the cartel. Generally, an industry association playing an administrative role is less likely to be heavily punished by an anti-trust agency unless it forced firms to join a cartel even when a cartel has been detected. This makes the cartel unstable. Note that the hazard ratio of the variable, *Admin\_Aссо* is greater than one even though it is insignificant. However, assuming the same base line hazard, the difference of the coefficient on *Admin\_Aссо* between “natural death” and “death by anti-trust” is significant only at 10% significance level.<sup>12</sup>

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<sup>12</sup>Using robust standard errors, p-value is 0.078.

Table 3.3 Hazard rate estimation results by Roles of Industry Association

Variables	Cox Models		Parametric Models	
	Natural Death	Death by Anti-trust	Natural Death	Death by Anti-trust
	(1) Hazard Ratio (z-statistic)	(2) Hazard Ratio (z-statistic)	(3) Hazard Ratio (z-statistic)	(4) Hazard Ratio (z-statistic)
<i>Admin_Aссо</i>	.560** (-1.96)	1.331 (.69)	.594* (-1.79)	1.469 (.96)
<i>Active_Aссо</i>	.731 (-1.07)	.604 (-1.28)	.702 (-1.22)	.625 (-1.19)
<i>Reg_Mtng</i>	.411*** (-3.41)	.319** (-2.36)	.437*** (-3.19)	.336** (-2.27)
<i>Hierarchy</i>	.891 (-.92)	1.247 (1.07)	.905 (-.80)	1.244 (1.08)
<i>NF</i>	1.004 (.13)	.982 (-.44)	1.001 (.02)	.979 (-.50)
<i>Concent</i>	1.001 (.40)	1.001 (.25)	1.001 (.30)	1.001 (.22)
<i>Intermed_Prodct</i>	.943 (-.26)	4.968*** (3.73)	.929 (-.34)	5.118*** (4.01)
<i>post_2005</i>	.534*** (-2.82)	.354*** (-3.31)	.556*** (-2.67)	.358*** (-3.37)
<i>IND</i>	Yes	Yes	Yes	Yes
<i>Cons.</i>			.031*** (-6.15)	.001*** (-8.24)
<i>Obs.</i>	154	77	154	77
<i>Chi<sup>2</sup></i>	38.53	43.86	35.69	47.38

Remark: Z-statistics in parentheses. in parentheses. Significance levels: \*<10 percent, \*\*<5 percent, \*\*\*<1 percent.

However, if an industry association plays an active role in a cartel detected by an anti-trust agency, the industry association - as well as firms - possibly confront a high chance of being charged or penalized for the wrongdoing. This behavior is likely to lead the industry association to non-cooperation or hiding cartel evidence especially when detected by an anti-trust agency. This type of industry association acts like a body of regular meetings before. The hazard ratio related to the variable, *Active\_Aссо* decreases in Specification (2) than in (1). However, the result of the difference test is insignificant at a conventional level. Other outcomes are very similar to those in Table 3.2.

### 3.6 Conclusions

This research explores what takes place inside a cartel. A cartel is composed of multiple cartel firms. If it fails in aligning the incentives of each individual firm to collusive profits, the cartel is vulnerable to collapse. To maintain collusive profits and avoid undermining uncertainty, the cartel develops organizational governance within. And, even though a cartel is an agreement among firms, the cartel or the firms are run by personnel who work for them. The current study focuses on what actually operates a cartel. More specifically, it studies the impact of three cartel governances on cartel stability: involvement of an industry association in a cartel, existence of a regular meeting in a cartel, and hierarchical positions of those involved in a cartel. To identify these effects, survival analyses are employed for the data set of 327 cartel cases between 2000 and 2010 in Korea.

While the results are marginally significant, involvement of the industry association increases cartel stability, irrespective of the causes of cartel death. This finding implies that an industry association helps cartel firms communicate with each other and reduce uncertainty/distrust. However, when the samples are divided into two sub-samples based on causes of death, the increasing effect in stability is greater for “natural death” cartels than “death by anti-trust” cartels. This result confirms Levenstein and Suslow’s (2010) finding in their data set of international cartels finalized by the US DOJ and the EC. It is possible that operation of an industry association in a cartel enhances the risk of detecting “anti-trust death” cartels due to the trail of incriminating evidence. This effect undermines the stabilizing effect in those cartels.

Next, existence of a regular meeting in a cartel significantly increases cartel stability for both sub-samples. However, here the sizes of the magnitudes are opposite to those of the previous variable, *Asso*. Possibly, cartel firms in a body of regular meetings put more effort into and are more careful about concealing incriminating hard evidence than an industry association does. These behaviors can be pronounced for “death by anti-trust” cartels. Thus, this stronger cartel, when detected by an anti-trust agency, likely has lower probability of failure.

Third, involvement of a higher level of personnel in each firm with a cartel can increase or

decrease cartel stability depending on causes of cartel death. For “natural death” cartels, top executives or CEOs possibly increase cartel stability. In contrast, they can decrease stability for “death by anti-trust” cartels. The KFTC, like what many competition authorities in other jurisdictions do, charges harsher penalty and personal liability when top-ranking positions are involved with a cartel. Thus, this progressive penalty mechanism possibly makes a cartel detected by anti-trust agency less stable as higher-ranking positions are involved with a cartel.

Last, even though it is not a main predictor, an intermediate product show opposite effects on cartel stability depending on types of cartel death. The characteristic of intermediate goods and services, a priori, can stabilize or destabilize a cartel. While stabilizing effects dominate destabilizing ones for “natural death” cartels, the latter dominates the former for “death by anti-trust” cartels.

This research confirms the finding of the prior literature, which argues a cartel endogenously develops organizational governance to avoid collapsing. This study contributes to the literature by not only with its methodology, but also its focus. It uses a variety of variables related to structural features inside a cartel, while it focuses on hierarchical characteristics in a cartel. This might be one of the first research studies on cartel governance using rich cartel samples. It can be replicated by using cartel case samples of other anti-trust agencies. Also it can be extended to analyze the impact of demographical characteristics - such as age, gender, and career of people who are involved in a cartel - on cartel stability. This study is further extended to an in-depth analysis of an individual cartel case.



## REFERENCES

## REFERENCES

- Brenner, S.** (2009). An Empirical Study of the European Corporate Leniency Program. *International Journal of Industrial Organization*, 27(6), 639–45
- Choi, Y.J. & Hahn, K.S.** (2014). How does a Corporate Leniency Program Affect Cartel Stability? Empirical Evidence from Korea. *Journal of Competition Law and Economics*, 10(4), 883–907
- Cox, D.R.** (1972). Regression Models and Life-Tables (with Discussions). *Journal of Royal Statistical Society Series, B*(34), 187–220
- De, Oindrila** (2010). Analysis of cartel duration: Evidence from EC prosecuted cartels. *International Journal of the Economics of Business*, 17(1), 33–65
- Dick, Andrew R.** (1996). When are cartels stable contracts? *Journal of Law and Economics*, 39, 241–83
- Green, E.J. and R.H. Porter** (1984). Noncooperative Collusion under Imperfect Price Information. *Econometrica*, 52(1), 87–100
- Harrington, J.E. and M.H. Chang** (2009). Modeling the birth and death of cartels with an application to evaluating antitrust policy *Journal of the European Economic Association*, 7(6), 1400–35
- Harrington, J.E. and Andrzej Skrzypacz** (2007). Collusion under monitoring of sales. *Rand Journal of Economics*, 38, 314–31
- Jacquemin et al.** (1981). A dynamic analysis of export cartels: The Japanese case. *Economic Journal*, 91(363), 685–96
- Levenstein, M. C. and V. Y. Suslow** (2006). What Determines Cartel Success? *Journal of Economic Literature*, XLIV, 43–95
- Levenstein, M. C. and V. Y. Suslow** (2010). Breaking up is hard to do: Determinants of cartel duration. *Ross School of Business working paper*,
- Stigler, George** (1964). A Theory of Oligopoly. *Journal of Political Economy*, 72(1), 44–61
- Zhou, Jun** (2012). Evaluating Leniency and Modeling Cartel Durations: Time-Varing Policy Impacts and Sample Selection. *Bonn University*,
- Zimmerman, J.E. and J.M. Connor** (2005). Determinants of Cartel Duration: A Cross-Sectional Study of Modern Private International Cartels. *Working paper* , <http://ssrn.com/abstract=1158577>