

Size Does Matter – Incentives in Heterogeneous Cartels

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Introduction

Cartels cause harm to society by distorting prices and market allocation. As a remedy, Antitrust Authorities (AA) impose rules to enforce competition and programs to detect collusive acts of cartels. For an effective deterrence of cartel collusion, it is essential to understand how cartel members react to regulatory measures. This article sheds light on the incentives of cartel members to join a cartel and to stick to its agreement depending on the firms' size and on the Leniency Program (LP) the AA establishes.

To better understand the behavior of cartel members, I conducted a survey on 36 non-confidential cartel decisions published by the European Commission (EC) between January 1st, 2005 and January 1st, 2012.¹ Its pivotal data are the duration of the cartels, their estimated market share, the number of their members, the possibility of cartel entrance or exit during their lifetime and finally the relative size of the member who applied for the LP of the EC in the first place. The first applicant mostly obtains immunity from fines and is referred to as a whistle blower, since without his application the cartel might often be impossible

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¹ The detailed results of the survey are listed in Table 1 in the Appendix.

to detect. The relevant results of the survey are the following: The average cartel lasted nine years. Most of the cartels were subject to a fluctuation of cartel members, late entries occurred as well as exits prior to the cartel breakdown. They possessed an average market share of 80%, but only two of them covered the entire market.

The last but very interesting result is the fact that the whistle blower who applied at first for the LP was typically a large cartel member. The average number of cartel members was seven, the average "position" of the whistle blower was 2,53. In 15 cases the largest member was first, in five cases the second largest was first and in five cases the third largest was first to apply.

These empirical facts cast doubt on the perception of a static collusive equilibrium as developed in many economic models. Rather the collusive equilibrium occurs to be dynamic and may change over the periods. The cartel members alter with time and cartels do not last forever. The large cartel market share allows for two conclusions on the incentives of firms to join cartels depending on their size. Firms with a large market share seem to have high incentives to join a cartel. In only a few cases there were large free firms. On the other side there were almost always small firms competing besides the cartel. It seems the incentives of smaller firms to enter a cartel are rather low. Finally large firms seem to have high incentives to apply for leniency and hence to destroy the cartel, which seems to contradict their continuous participation in cartels in the beginning.

These empirical observations served as a motivation to set up a new model, which could possibly explain the observed firm behavior. Within the model, the following results turn out to be valid: There are small firms which will not join the cartel at all. The cartel will most likely consist of large firms. Given that the fines for a cartel engagement increase with the duration of the infringement, there exists a cutoff value beyond which the aggregate expected fines become too large

to be compensated by the gains from joining the cartel. If the basic fine scheme depending on the firms' size is a convex function of a firm's capacity, the cutoff value is smaller for large firms.

Related Literature

The present paper touches upon the following topics: Cartel formation, cartel stability, corporate leniency programs as well as the treatment of cartel ringleaders under those leniency programs.

The topic of cartel stability in combination with corporate leniency programs has been extensively covered in the past decade. The first to mention would be Motta and Polo (2003). Motta and Polo (2003) examine the effect of a corporate leniency program on the stability of a cartel. They describe two effects which are accompanied by the introduction of a leniency program. On the one hand, cartel participation may become more appealing since the expected fines for the cartel engagement decrease. On the other hand, it creates larger incentives to deviate from the cartel agreement once involved in a cartel. Motta and Polo (2003) show that the second effect dominates if the leniency policy is optimally chosen. In recent years several articles were published which cover the topic of corporate leniency programs quite similar to Motta and Polo (2003) were published. Additional articles on this subject include Buccirosi (2008), Aubert, Kovacic, and Rey (2006) or Harrington (2008).

The work most closely related to this text is the paper by Bos and Harrington (2010). Bos and Harrington (2010) design a model which endogenizes the formation of a cartel. They assume a finite set of firms which compete in an infinitely repeated and capacity-constrained price setting game, where firms are heterogeneous in terms of their capacities. Within this setting the authors are able to show that stable non all-inclusive cartels exist with free-riders competing besides

of it. Further, they show that the firms not participating in the cartel are the small firms, while large firms form the cartel.

Bos and Harrington (2010), however, exclude the possibility of cartel detection by an AA in their model. This topic is added in the working paper by Bos and Wandschneider (2011). Bos and Wandschneider (2011) drop the cartel entrance decision and cover only all-inclusive cartels although their paper is built on the framework of the Bos and Harrington (2010) model. Their model studies the effects of a corporate leniency program on the cartel members' incentive compatibility constraint (ICC), which governs the companies' decision to remain in the cartel or to blow the whistle. They introduce a fine scheme which depends on the firm's capacity. On this background they study the effects of ringleader discrimination, that is cartel ringleaders being not or only partially eligible for the corporate leniency program. Their model reveals that ringleader exclusion may result in a higher collusive price, depending on the form of the fine scheme and the distribution of the cartel members' capacities.

Finally, the topic of ringleader exclusion has also been covered in a working paper by Herre and Rasch (2012). They impose some asymmetries on the cartel members, they exogenously choose one firm to be the cartel ringleader. The difference between the ringleader and the other cartel members is caused by the different amounts of evidence of the conduct the firms may offer to the AA. They then analyze the effect of ringleader exclusion on the stability of collusion. They find that ringleader discrimination does not play an important role if the relative amount of the ringleader's evidence is very high. It fosters collusion if its relative amount is moderate and has a deterring effect if its relative amount is low.

Capacities and Cartel Engagement

Our model setup follows Bos and Harrington (2010). Consider an economy consisting of a finite set of firms denoted by $N = \{1, \dots, n\}$ which compete in an infinitely repeated capacity constrained Bertrand Competition with homogeneous goods. Firms have common knowledge, equal marginal costs $c > 0$ and discount future profits with equal δ . Each period they decide simultaneously on their price $p \in \{0, \epsilon, 2\epsilon, \dots, c - \epsilon, c, c + \epsilon, \dots\}$. The firms are heterogeneous with respect to their exogenously fixed capacity constraints k_i . Furthermore, denote $K = \sum_{i \in N} k_i$ as the total sum of the capacity constraints of all firms in the industry and let K_T be the sum of all capacity constraints of the cartel members. The firms face the demand function $D(p)$.² The economy is assumed to have the following structure:

$$k_i < D(p^m) \quad \text{and} \quad \sum_{j \neq i} k_j \geq D(c), \forall i$$

Here, p^m denotes the price a monopolist would charge. These assumptions require that no single firm has sufficient capacity to supply market demand at monopoly price and that any collection of firms consisting of all but one firm has sufficient capacity to supply the quantity that would be demanded at marginal costs. In addition to these assumptions an AA is introduced. The basic fine structure follows Bos and Wandschneider (2011), but the present paper considers fine schemes that are more complex. The AA detects the cartel at the end of every period t with probability $\alpha_t \in \{\underline{\alpha}, \bar{\alpha}\}$. Every firm observes the detection probability at the beginning of every period. For all future periods the firms expect the high detection probability $\bar{\alpha}$ with probability γ and the low detection probability $\underline{\alpha}$ with probability $(1 - \gamma)$. For simplicity it is assumed that $\underline{\alpha} = 0$ while $\bar{\alpha} \in (0, 1)$. As in Bos and Wandschneider (2011), it is assumed that whenever a cartel is

² All further assumptions which are necessary to support the desired outcome are as in Bos and Harrington (2010).

detected, it is also convicted. In the case of detection, the cartel members face the basic fine $F(k)$ as a function of a firm's capacity k with $F(0) = 0$, $F'(k) > 0$ and $F''(k) > 0$. This basic fine is multiplied by the factor d , which stands for the duration of the firm's cartel engagement.

It is assumed that the AA offers a corporate leniency program similar to the program of the EC. The first applicant will receive immunity from fines, all later applicants may receive a fine reduction. Since deviating firms will be the first to apply for leniency, they expect ex ante to be granted immunity. For simplicity, it is assumed that ex ante all firms expect to receive immunity if they deviate from the agreement, even if they apply simultaneously with other firms in one period. Whenever the cartel is convicted, all participants who did not deviate apply for a LP which reduces their ex ante expected fine by an equal share of $\beta \in (0, 1)$. At last the total fine $(1 - \beta)dF(k_i)$, which has to be paid in the case of conviction may not be larger than a cap value \bar{F}_i .³ Henceforth, the fine firm i expects to pay in the upcoming period after d periods of cartel engagement is:

$$E[F(k_i, d)] = \alpha_t \min\{(1 - \beta)dF(k_i), \bar{F}_i\}$$

In case of a conviction all firms pay their respective fines in the next period, the cartel will be destroyed and can never be rebuild in any future period.

Similar to Bos and Harrington (2010), it is assumed that all cartel members charge the monopoly set the price in order to maximize the cartel's profit. The cartel members share the cartel's total demand according to a proportional sharing rule, depending on the capacity constraints of the members. In addition they all play the grim trigger strategy. Whenever a cartel member deviates from the cartel

³ With $\frac{\partial \bar{F}_i}{\partial k_i} > 0$ and $\frac{\partial^2 \bar{F}_i}{\partial k_i^2} > 0$

agreement, all firms return to perfect competition.⁴ This strategy implies that while it is possible to enter the cartel in later stages an early exit results in a complete break-down of the cartel.

The static game without collusion has two possible symmetric Nash equilibria. One in which all firms price at c , the other one in which all firms price at $c + \epsilon$. Since ϵ is very small, the difference between those two equilibria is negligible. All firms earn zero profits in both equilibria. Firms are only able to increase the price successfully if they cooperate in a cartel. The larger the market share of the cartel, the more they are able to do so. Hence, the cartel has always interest in expanding. In the model, some of the firms may choose not to join the cartel. This is most likely true for small firms. Assume a cartel exists in the economy and denote K_t as the cartels market share without the participation of firm i . The condition for firm i to enter the cartel is:⁵

$$E[F_i] < \{ (p(K_t + k_i) - c) \frac{(D(p(K_t + k_i)) - K + K_t + k_i)}{K_t + k_i} - (p(K_t) - c) \} \cdot k_i \frac{1 + \delta(\gamma\bar{\alpha} - \underline{\alpha})}{1 - \delta(1 - \gamma\bar{\alpha})}$$

$E[F_i]$ are the fines firm i expects to pay in all future periods of its cartel engagement. This term is simplified since it cannot be derived explicitly without the knowledge when $dF(k_i)$ exceeds the cap value \bar{F}_i . It can be shown that if the capacity of firm i is close to zero and one ignores the expected fines, then the condition boils down to:

$$\frac{D(p(K_t)) - K + K_t}{K_t} > 1$$

⁴ Other equilibrium strategies might exist, but can be ignored within this context as the grim trigger strategy is sufficient to guarantee the desired equilibrium behavior.

⁵ The cartel entrance conditions as well as the ICC are derived explicitly in the original master thesis.

This condition is never fulfilled. It follows that if a firm's capacity is very small, it will not enter a cartel even if it expects no fines for the infringement at all. If the fine scheme is not too convex, the cartel will most likely consist of the large firms. There will exist a cutoff capacity at which each firm will be indifferent between joining the cartel or remaining a free firm. This is consistent with the observation from the survey that small firms often do not participate in cartels. Moreover, the model is able to explain why large firms have the strongest incentives to apply at first for leniency once the cartel breaks down. Once a member of a cartel, the ICC of cartel member i according to the model setup looks as follows:

$$(p(K_T) - c) \cdot k_i < (p(K_T) - c)(D(p(K_T)) - K + K_T) \cdot \frac{k_i}{K_T} \frac{1 + \delta(\gamma\bar{\alpha} - \underline{\alpha})}{1 - \delta(1 - \gamma\bar{\alpha})} - E[F_i]$$

The longer the cartel exists, the larger becomes $E[F_i]$ due to the multiplier d , the stricter become all ICCs of all cartel members. If one ignores the fines, the ICC would be the same for all cartel members. From this follows, since the fine scheme $F(k_i)$ as well as the cap value \bar{F}_i are convex, it will be the ICC of the largest cartel member which is the strictest of all cartel members. Thus, it will be the first one which is violated.

Summing up, the model offers a possible explanation why large firms have strong incentives to engage in cartels in the beginning and then again strong incentives to end the cartel and to apply for the LP. The key to this explanation is the convex fine scheme and the increasing multiplier d . Strictly speaking, the model does not explain why large firms are the first to apply for leniency. It only explains why they have the strongest incentives to do so. Due to the fact that all firms have equal knowledge about the detection probability, all firms know whether any ICC of any cartel member is satisfied or not. Hence, all cartel members will deviate

from the cartel agreement in the same period the largest cartel member does. One could solve this problem by the introduction of asymmetric information. In this article this possibility is not pursued.

Ringleader Exclusion

Cartel ringleaders are sometimes but not always excluded from the benefits of the LP. The LP of the EC, e.g., allows cartel ringleaders to apply for immunity, the LP of the German Federal Cartel Office does not.

In the following, I will discuss two countervailing effects of ringleader exclusion. Ringleaders play an important role for a cartels' structure, they often start the interaction between the firms or organize the cartel meetings. By excluding them from the LP, the role as a cartel ringleader becomes much less profitable because of the expected loss due to a possible cartel breakdown. Therefore, no firm is eager to earn the spot of the ringleader, the cartel interaction is then effectively impeded. On the other hand there exists an effect which fosters collusion. Once a firm has established itself as a ringleader, it is no longer able to apply for immunity. Hence, the effect of the LP as a whole diminishes. First, there is one firm less which may end the cartel by whistle blowing, which directly fosters the collusion. Second, the other cartel members who are still eligible to apply for the LP face a lower probability that the cartel is detected by whistle blowing, hence their ICC is less strict. Both effects may enhance the cartel duration.

In terms of the model, the deterrence as well as the fostering effect can be seen very clearly. Assume the largest firm engages as the ringleader and let it be unable to participate at the LP.⁶ The deterring effect can be seen on the cartel entrance decision of this largest firm. Since not being able to apply for immunity,

⁶ This assumption is likely to hold. Bos and Wandschneider (2011) conducted a survey on EC cartel decisions with focus on cartel ringleaders. They found 14 cases where ringleaders were explicitly named, 79% of them were the largest firms of the cartel.

its expected fines $E[F_i]$ are larger than in the non - discriminatory case. Hence the participation is less profitable. Consequently ringleader discrimination may even prevent cartel foundation under certain conditions. If the largest firm in an industry does not want to participate in the cartel, then a cartel foundation is unlikely to happen.

Nevertheless, if ringleader exclusion did not prevent the cartel foundation, then it will foster the collusion. Without the possibility of applying for leniency for the ringleader, the strictest ICC of all cartel members is now the one of the second largest firm. Thus, the cartel may endure longer than in the non-discriminatory case.⁷

Conclusion

In order to efficiently enforce cartel prosecution it is necessary to understand how cartels react to regulatory measures. The behavior of cartel members depending on their market share was described on the basis of an infinitely repeated capacity constrained Bertrand competition. It was shown that if the AA uses a fine scheme which is convex and increasing in the capacities of the cartel members and in the duration of the firm's cartel engagement, then i) there may exist a cartel consisting of the largest firms of the industry, ii) there are small firms which will not join the cartel even if they expect no fines at all for the infringement, iii) the incentive compatibility constraint of the largest cartel member will be the strictest of all cartel members, iv) as the duration of the cartel increases, the ICCs of all cartel members will become stricter, v) the ICC of the largest cartel member will be the first which will be violated.

The last part of the article covered the topic of ringleader exclusion from the corporate leniency program within the framework of the model. It was shown

⁷ The same effect may be observed if the ringleader was the smallest cartel member and the fine scheme was concave with respect to the capacity constraint of the firm.

that if the largest cartel member is the cartel ringleader and not able to apply for leniency, then ringleader exclusion may have a pro-collusive effect once a cartel is established. This effect occurs since the ICC of the ringleader may be slackened due to ringleader discrimination. Otherwise ringleader exclusion may be a good instrument to prevent cartels. If the fine scheme is convex and the largest firm expects to be the ringleader, it may prevent the largest firm from joining the cartel. Without the market share of the largest firm, the cartel may be unable to increase prices at all.

References

- (2006/C 210/02): “Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003,” Commission of the European Communities.
- AUBERT, C., W. E. KOVACIC, AND P. REY (2006): “The Impact of Leniency and Whistle Blowing Programs on Cartels,” *International Journal of Industrial Organisation*, 24, 1241–1266.
- BOS, I., AND J. E. HARRINGTON, JR. (2010): “Endogenous cartel formation with heterogeneous firms,” *Rand Journal of Economics*, 41, 92–117.
- BOS, I., AND F. WANDSCHNEIDER (2011): “Cartel Ringleaders and the Corporate Leniency Program,” *CCP Working Paper*.
- BUCCIROSSI, P. (2008): *Handbook of Antitrust Economics*. The M.I.T. Press, Spagnolo, G., "Leniency and Whistleblowers in Antitrust".
- HARRINGTON, JR., J. E. (2008): “Optimal Corporate Leniency Programs,” *The Journal of Industrial Economics*, 56, 215–264.
- HERRE, J., AND A. RASCH (2012): “Excluding Ringleaders from Leniency Programs,” *Working Paper*.
- MOTTA, M., AND M. POLO (2003): “Leniency Programs and cartel prosecution,” *International Journal of Industrial Organization*, 21, 347–379.

Appendix

Tables

Year	Case Number	Duration	Late Entries	Early Exits	Cartel Members	Cartel Market Share	Whistleblower	Position
2011	39600	3,5	No	Yes	5	n/a	Tecumseh	4
2011	39605	6	No	Yes	4	n/a	Samsung	4
2011	39579	3	No	No	3	n/a	Henkel	2
2010	39309	4,5	No	No	6	70%	Samsung	1
2010	38866	35	Yes	Yes	5	71%	Kenira	1
2010	38344	18	Yes	No	17	80%	Saarstahl	15
2010	39092	12	Yes	No	17	n/a	Masco	n/a
2010	38511	4	Yes	No	10	n/a	Micron	1
2009	38589	13	Yes	Yes	11	n/a	Chemtura	n/a
2009	39129	4	No	No	7	n/a	Siemens	1
2009	39396	3	Yes	No	7	75%	Akzo Nobel	3
2009	39401	25	No	No	2	n/a	n/a	n/a
2009	39406	19	Yes	No	6	90%	Yokohama	5
2008	39125	5	Yes	No	4	95%	Asahi	3
2008	39188	2	No	No	3	50%	Chiquita	1
2008	39181	13	Yes	Yes	10	100%	Shell	4
2008	39180	0,5	No	No	4	n/a	Boliden Odda	4
2008	38695	5	Yes	No	7	95%	Akzo Nobel	1
2008	38543	18	Yes	No	10	n/a	n/a	n/a
2008	38628	2	No	No	2	55%	Bayer	1
2007	38629	9	No	No	5	100%	Bayer	1
2007	39165	1	No	No	4	80%	Asahi	3
2007	38432	3	No	No	4	89%	Fuji	2
2007	38710	12	Yes	No	5	92%	BP	3
2007	37755	3	No	Yes	4	90%	InBev	2
2007	38823	9	Yes	Yes	5	85%	Otis	1
2007	38899	16	Yes	Yes	10	n/a	ABB	1
2006	38638	8	Yes	Yes	6	87%	Bayer	1
2006	38121	16	Yes	Yes	11	95%	Mueller	5
2006	38456	8	Yes	Yes	14	60%	BP	3
2006	38645	5	Yes	Yes	5	86%	Degussa	1
2006	38620	6	Yes	Yes	7	75%	Degussa	2
2005	38443	5	Yes	Yes	4	58%	Flexsys	1
2005	38354	20	Yes	Yes	16	77%	Combpac	1
2005	38281	7	Yes	Yes	5	n/a	Deltafina	1
2005	37773	14	Yes	Yes	5	95%	Clariant	2
Avg.	-	9,38	-	-	6,92	81,26%	-	2,53

Table 1: Statistics of the non-confidential decisions of the European Commission. All cases are available on the homepage of the European Commission, listed under their case number. "Position" describes the market share of the whistle blower in comparison to the other cartel members. All numbers are estimations. Duration in years.