

# The Impact of Antitrust Policy on Collusion with Imperfect Monitoring

Jesko Herre

University of Cologne

(joint work with Achim Wambach)

# Outline

1. Introduction
2. The Model
3. Benchmark (Green-Porter Solution)
4. Information Policy
5. Leniency Policy
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# 1. Introduction

- more cartel cases via leniency/whistleblowing

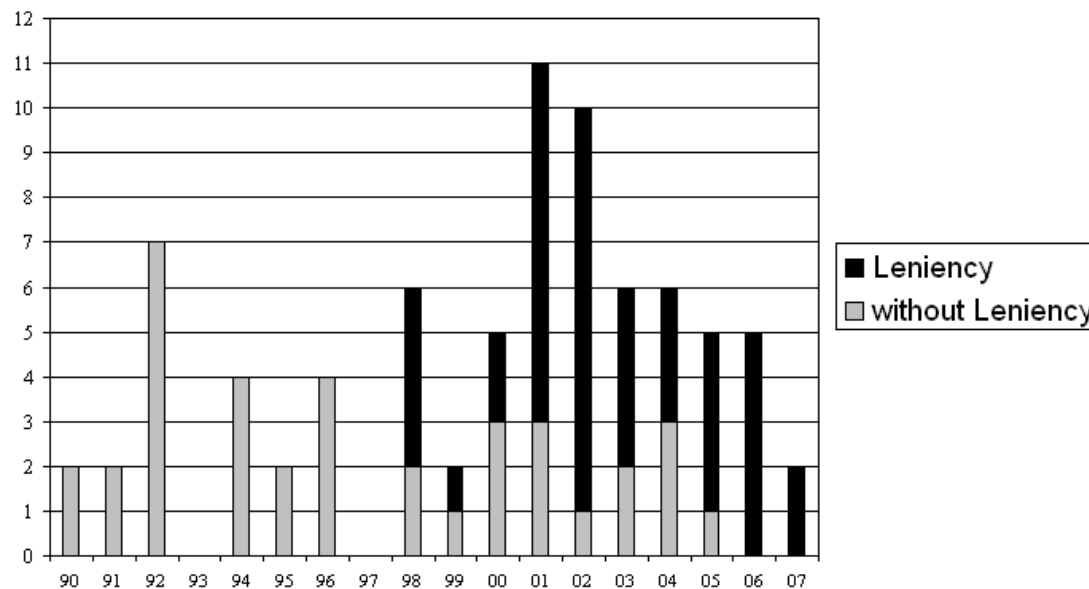


Figure 1: Decision on cartels in Europe since 1990.

- increasing average fine per case

## Our work

- Focus on the effects of increasing fines and information spillovers from the antitrust authority to collusive firms.
- Embed fines, information policy, and leniency program in a Green-Porter (1984) style model.

## Our results

- Fines and information spillovers make collusion more stable.
- Antitrust policies (may) reduce welfare.
- Leniency programs reduce (increase) sustainability of collusion in industries with relatively low probability (high probability) of demand shocks.
- Leniency programs increase the frequency of whistleblowing

## 2. Model

### Players

- **Nature**
  - chooses unobservable market demand  $D \in \{0, D(p)\}$   
 $prob\{D = 0\} = \alpha$ ;  $prob\{D = D(p)\} = 1 - \alpha$ , with  $\alpha \in (0, 1)$
  - chooses an observable signal  $s \in \{0, 1\}$
- **Firms**
  - industry of two firms:  $i$ , with  $i \in \{1, 2\}$
  - Bertrand competition for  $t$  periods, with  $t \in \{0, 1, 2, \dots, \infty\}$
  - homogenous products and constant marginal costs  $c > 0$
  - discount factor:  $\delta \in [0, 1)$
  - **Imperfect information:** Firms can observe (directly) their own demand  $D_i^t$ , but neither rivals demand  $D_j^t$  nor price  $p_j^t$ .

- **Antitrust authority**

- sets lump-sum fine for collusive behavior:  $F \in (0, \infty)$
- budget constraint: never investigates an industry in absence of whistleblowing of at least on firm
- learns the prices of both firms  $p_i^t$  during the investigation
- convicts firms of collusion if it observes  $p_i^t > c$  in period  $t$

- **Policies:**

- ⇒ **Information policy:**

- $nd$  : leave the price of each firm private (**non disclosure**)

- $d$  : **disclose**  $p_i^t$  to firm  $j$

- ⇒ **Leniency policy:**

- $nl$  : colluding firms must pay  $F$  (**no leniency**)

- $l$  : reduced fines  $R$  for the whistleblowing firm, with  $R = (1 - r)F$  and  $r > 0$  (**leniency**)

## The Game

**Period  $t=0$ :** (ex-ante)

Antitrust authority commits to  $F$  and policies.

**Every period  $t \geq 1$  has the following structure:**

**Stage 1:** Firms choose prices  $p_i^t \in [c, p^M(c)]$ .

**Stage 2:** Nature chooses market demand  $D^t$  and signal  $s^t$ .

**Stage 3:** Firms observe their own demand, the signal  $s^t$ , and decide whether to blow the whistle or not.

*If no firm has blown the whistle, the game restarts in Stage 1. Otherwise the game enters Stage 4.*

**Stage 4:** Antitrust authority investigates the industry and follows the procedure as committed ex-ante.

## Firms' strategies

**GPP (Collusion and Green Porter Punishment):** Firms collude as long as  $D = D(p)$ . If in period  $t$  the demand of at least one firm is zero, firms start in  $t + 1$  a price war of  $T$  periods. In  $t + 1 + T$ , they revert to collusion.

## **GFPF (Collusion and Green Porter and Fine Punishment)**

Firms collude as long as  $D = D(p)$ . If in period  $t$  the demand of at least one firm is zero, firms blow the whistle with probability  $\gamma$  and reveal information to the antitrust authority. Furthermore, firms start in  $t + 1$  a price war for  $T^\gamma$  periods. In  $t + 1 + T^\gamma$ , they go back to collusion. With probability  $1 - \gamma$  no firm does whistleblowing, but a price war of  $T'$  periods is started in the next period. In  $t + 1 + T'$  firms revert to collusion. If a deviation from the equilibrium strategy occurs, firms choose  $p_i^t = c$  in every following period.



### 3. Benchmark (Green-Porter Solution)

- Firm value from collusion:

$$V^+ = (1 - \alpha) \left( \frac{1}{2} \Pi^M + \delta V^+ \right) + \alpha (0 + \delta^{T+1} V^+)$$

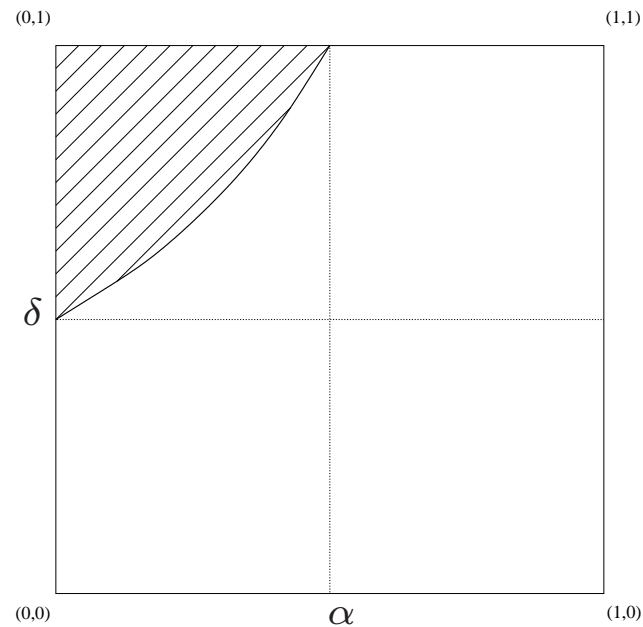
- Firm value from deviation:

$$V^D = (1 - \alpha) (\Pi^M + \delta^{T+1} V^+) + \alpha (0 + \delta^{T+1} V^+)$$

- Collusion is sustainable if  $V^+ \geq V^D$ :

$$(\delta - \delta^{T+1}) V^+ \geq \frac{1}{2} \Pi^M$$

## Result: GPP Equilibria



**Optimization:** Maximization of the collusive firm value.

$\implies$  minimize  $T$  such that  $V^+ \geq V^D$  is satisfied

## 4. Information Policy

### 4.1 *Non-disclosing* antitrust authority (fines only)

**new:** if demand = 0  $\implies$  whistleblowing with probability  $\gamma$ .

$$V^+ = (1 - \alpha) \left( \frac{1}{2} \Pi^M + \delta V^+ \right) + \alpha \left( \gamma \left[ -F + \delta^{T^\gamma+1} V^+ \right] + (1 - \gamma) \delta^{T'+1} V^+ \right)$$

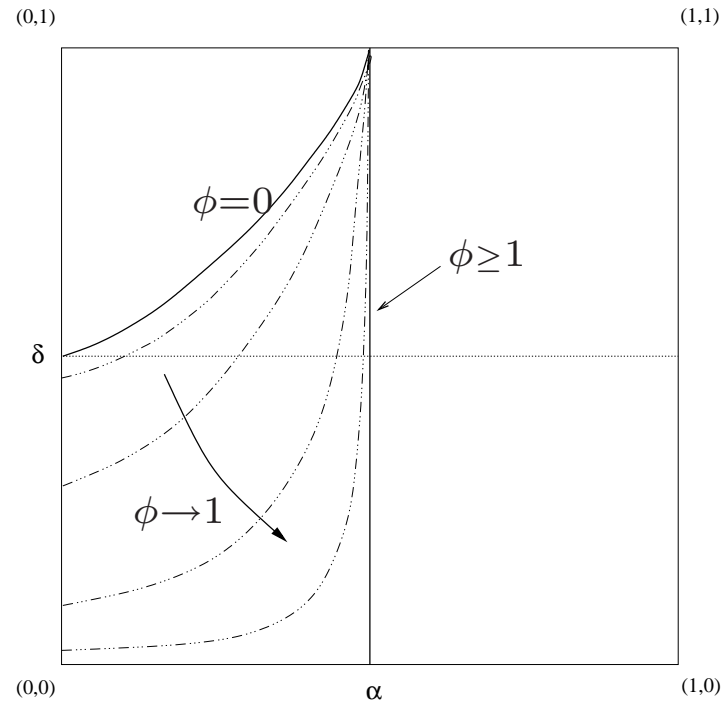
$$V^D = (1 - \alpha) \left( \Pi^M + \gamma \left[ -F + \delta^{T^\gamma+1} V^+ \right] + (1 - \gamma) \delta^{T'+1} V^+ \right) + \\ + \alpha \left( \gamma \left[ -F + \delta^{T^\gamma+1} V^+ \right] + (1 - \gamma) \delta^{T'+1} V^+ \right).$$

[Define:  $\phi \equiv \frac{2F}{\Pi^M}$ ;  $\delta^{eff} \equiv \gamma \delta^{T^\gamma+1} + (1 - \gamma) \delta^{T'+1}$ ]

$\implies$  Collusion is sustainable if  $V^+ \geq V^D$  (and  $V^+ \geq 0$ ):

$$(\delta - \delta^{eff}) V^+ \geq \frac{1}{2} \Pi^M - \gamma F = \frac{1}{2} \Pi^M (1 - \gamma \phi)$$

**Result:** sustainable collusion for  $F$ ,  $\{nd\}$ , and  $\{nl\}$



**Remark:** - if collusion sustainable, instruments are substitutes  
 $\implies$  no optimization of  $V^+$

## 4.2 *Disclosing* antitrust authority

**new:** (1) if the antitrust authority does not find cheating

⇒ revert to collusion immediately

(2) if the antitrust authority discloses cheating

⇒  $p_i^t = c$  forever

$$V^+ = (1 - \alpha) \left( \frac{1}{2} \Pi^M + \delta V^+ \right) + \alpha \left( \gamma [-F + \delta V^+] + (1 - \gamma) \delta^{T'+1} V^+ \right)$$

$$V^D = (1 - \alpha) \left( \Pi^M + \gamma [-F] + (1 - \gamma) \delta^{T'+1} V^+ \right) + \\ + \alpha \left( \gamma [-F] + (1 - \gamma) \delta^{T'+1} V^+ \right)$$

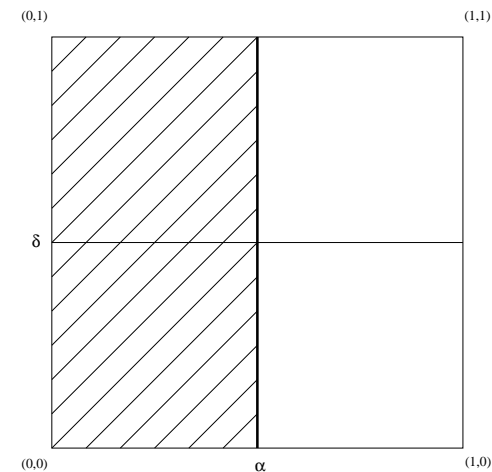
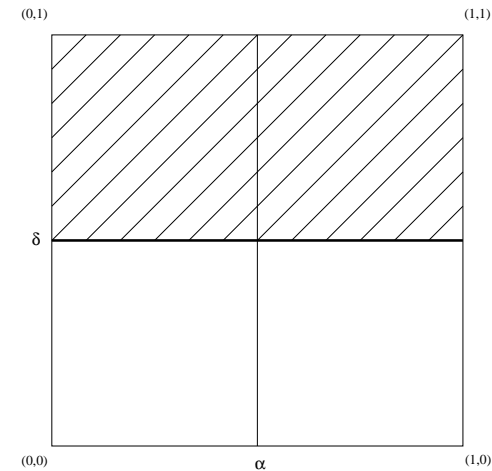
[Define:  $\delta^{eff} \equiv \gamma \delta^\infty + (1 - \gamma) \delta^{T'+1} = (1 - \gamma) \delta^{T'+1}$ ]

⇒ Collusion is sustainable if  $V^+ \geq V^D$  (and  $V^+ \geq 0$ ):

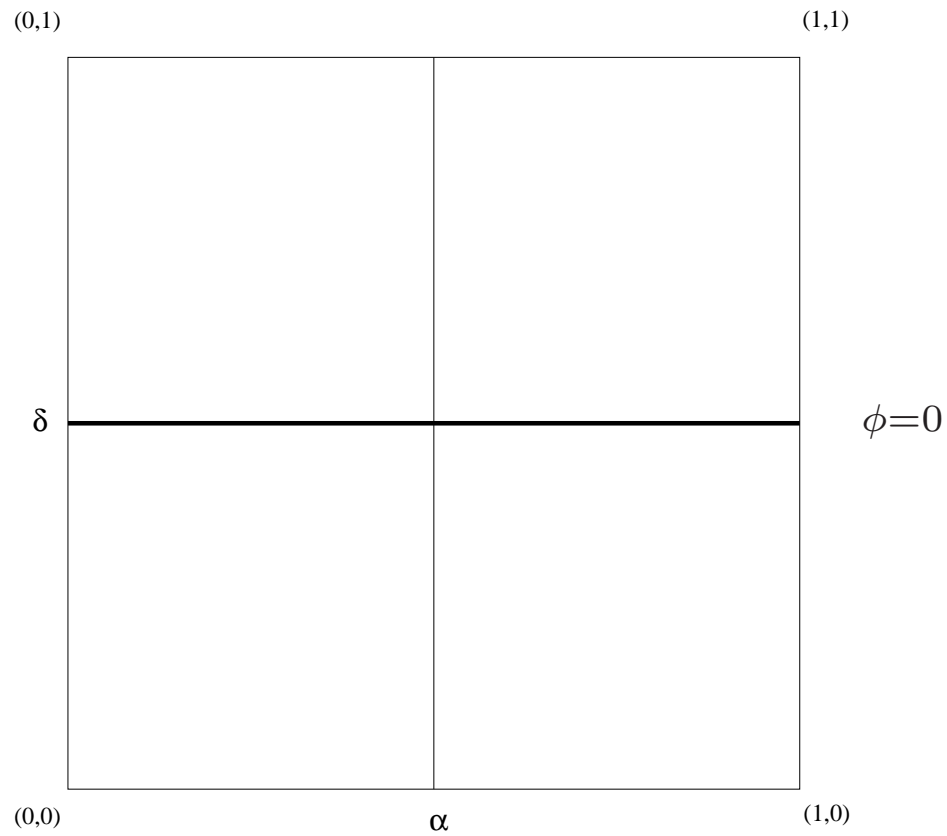
$$(\delta - \delta^{eff}) V^+ + \frac{\alpha}{(1 - \alpha)} \gamma \delta V^+ \geq \frac{1}{2} \Pi^M - \gamma F$$

## Extreme cases:

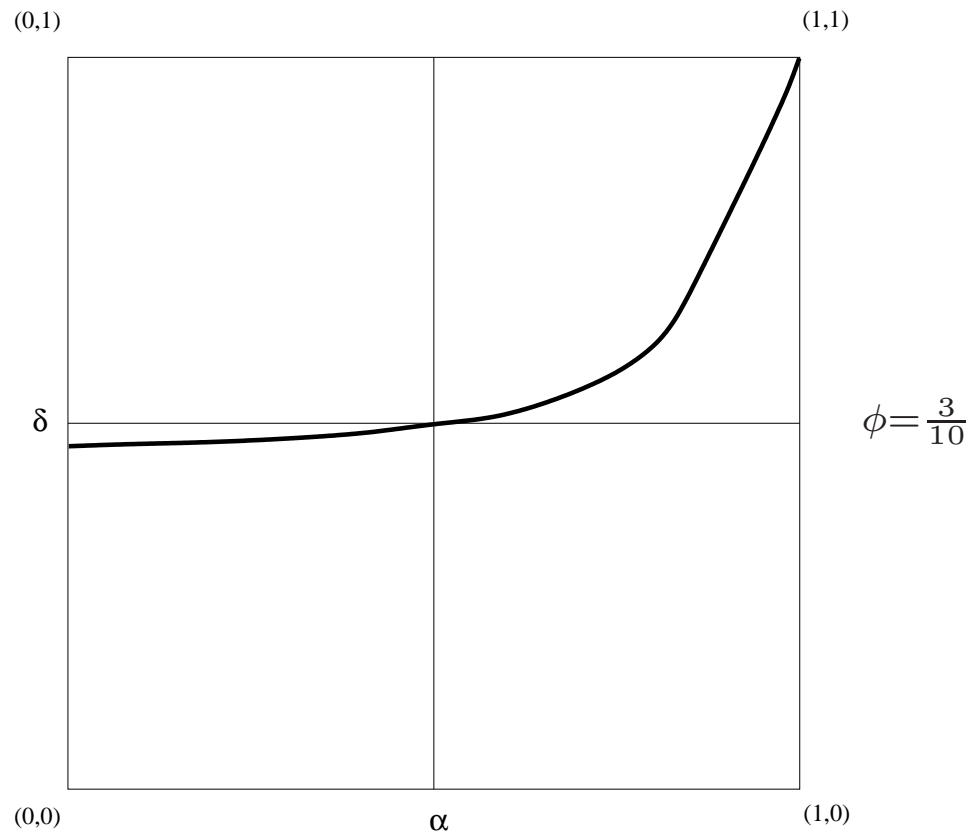
- $\phi \rightarrow 0$  (costless information):
  - firms can always observe reason for zero demand  $\Rightarrow \gamma \rightarrow 1$
  - perfect monitoring  $\Rightarrow \delta \geq \frac{1}{2}$  for all  $\alpha$  (Folk Theorem)
  
- $\phi \rightarrow \infty$ :
  - price for information  $\rightarrow \infty$   
 $\Rightarrow \gamma \rightarrow 0$ : no information
  - result identical to the case of a non-disclosing antitrust authority  
 $\Rightarrow \delta \geq 0, \alpha \leq \frac{1}{2}$



**Result: sustainable collusion for  $F$ ,  $\{d\}$ , and  $\{nl\}$**

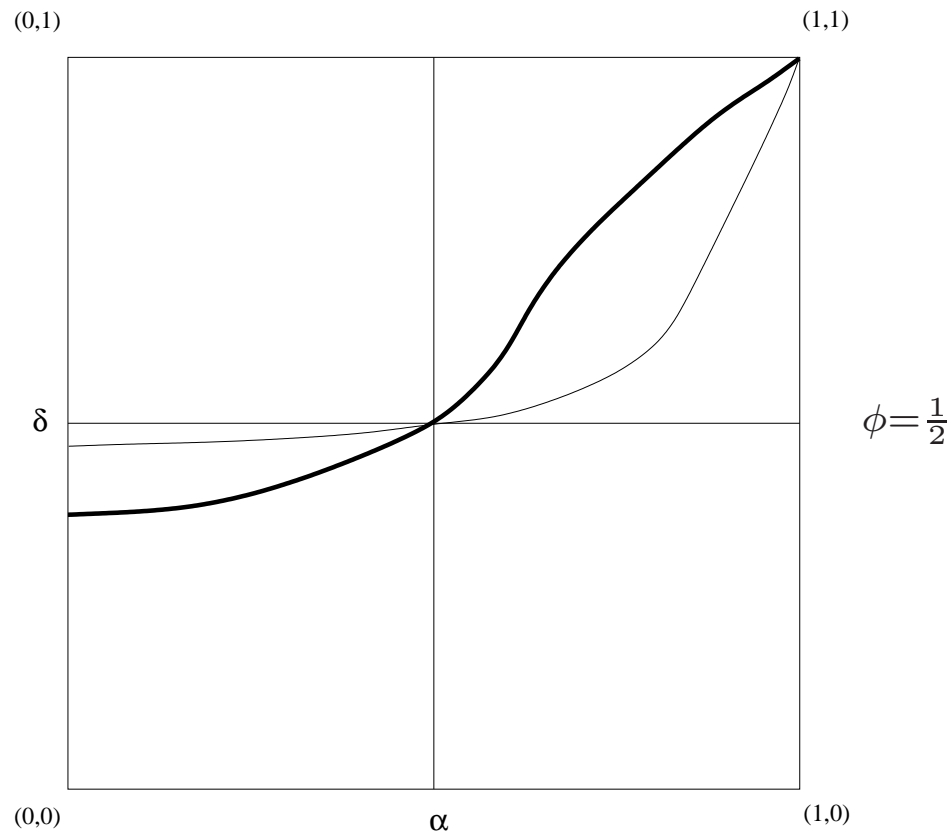


**Result: sustainable collusion for  $F$ ,  $\{d\}$ , and  $\{nl\}$**

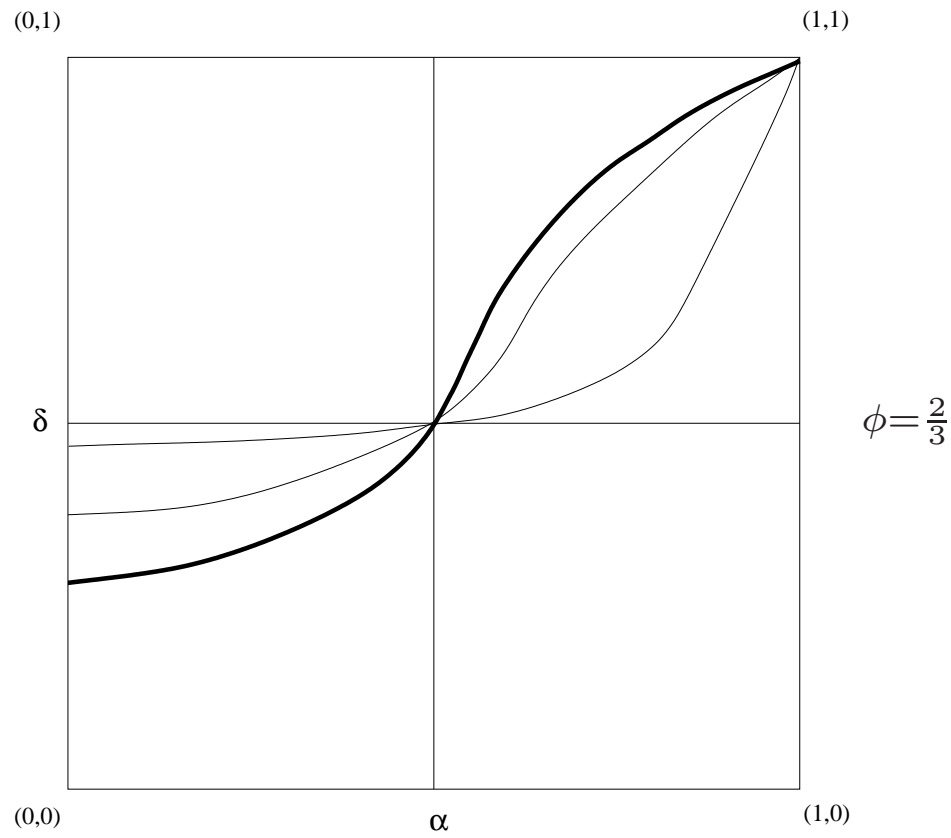




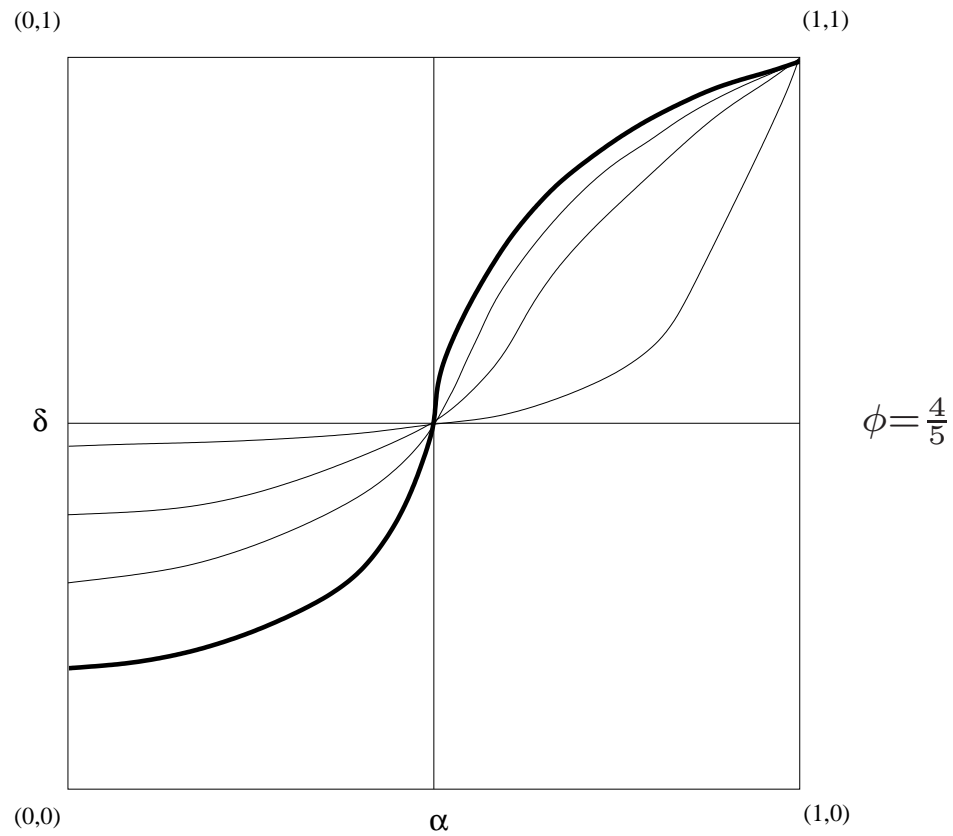
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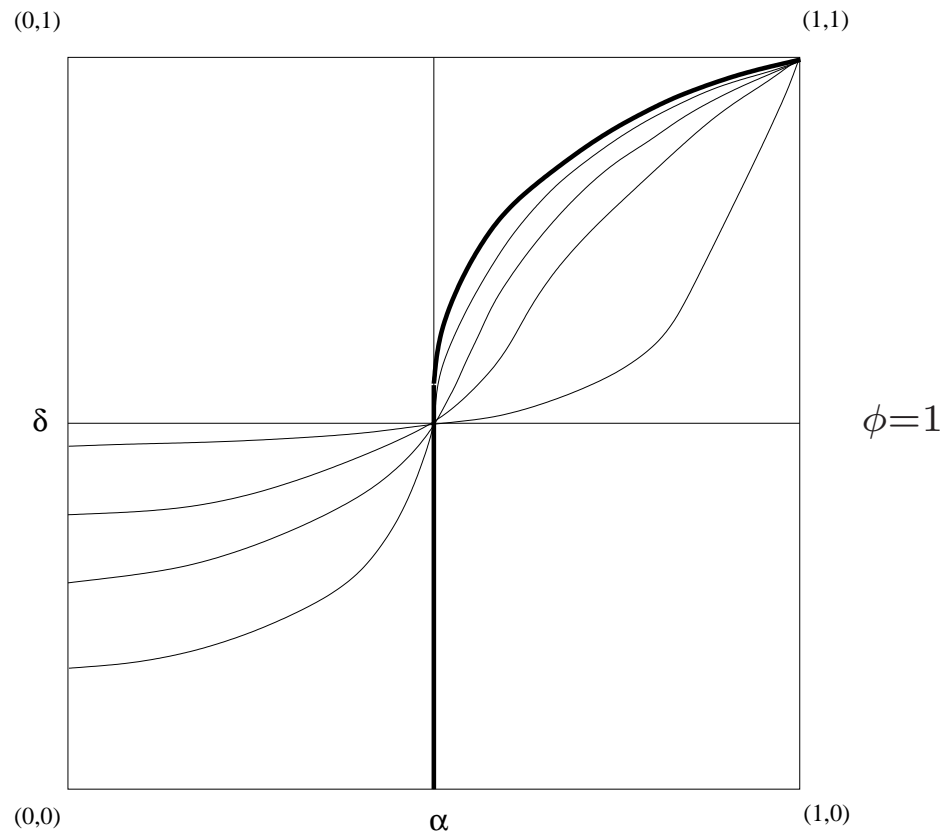
**Result: sustainable collusion for  $F$ ,  $\{d\}$ , and  $\{nl\}$**



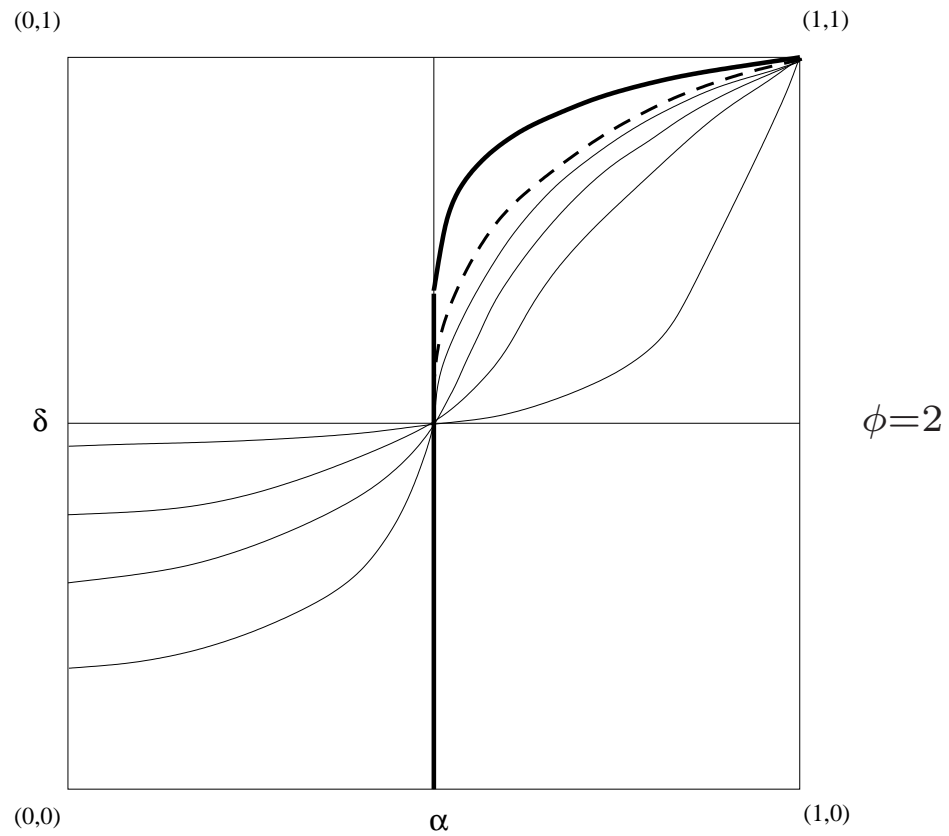
**Result: sustainable collusion for  $F$ ,  $\{d\}$ , and  $\{nl\}$**



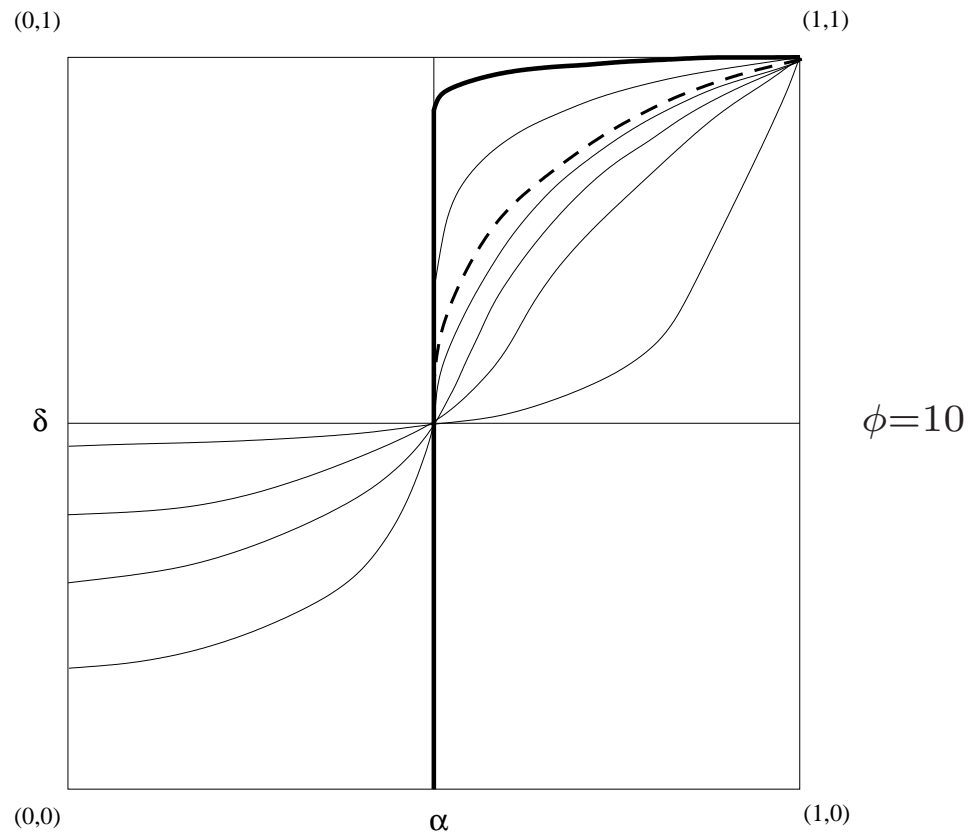
**Result: sustainable collusion for  $F$ ,  $\{d\}$ , and  $\{nl\}$**



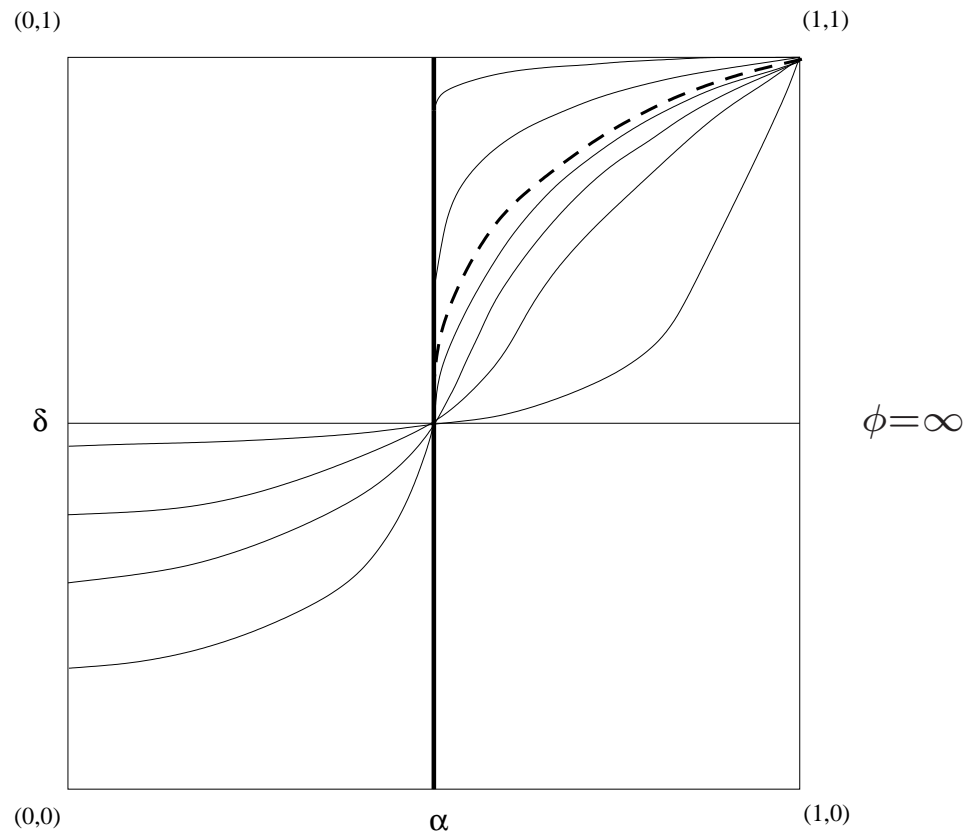
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**Result: sustainable collusion for  $F$ ,  $\{d\}$ , and  $\{nl\}$**



**Optimization:** Maximization of the collusive firm value.

$\implies$  minimize  $\gamma$  such that  $V^+ \geq V^D$  (and  $V^+ \geq 0$ ) is satisfied

**Remark:**

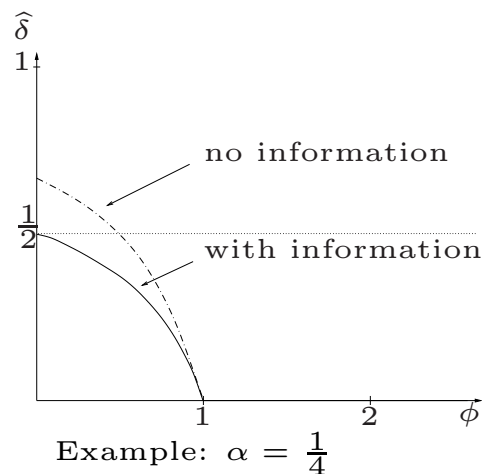
-  $\gamma, T'$  are no longer substitutes

(i.e. choose  $\gamma$  as large as necessary but as small as possible  
and  $T' = 0$ )  $\implies$  **no price wars**



## Welfare effects:

- Fines reduce total welfare by increasing the number of colluding industries.
- Information disclosure enhance the effect of fines:
  - $\hat{\delta}$  lower for  $\alpha \leq \frac{1}{2}$ ,
  - cartels even if  $\alpha > \frac{1}{2}$ .



- Even if collusion is sustainable without antitrust policies (Benchmark), introducing fines decrease welfare by reducing the number of price war periods.
- If paying fines has a positive effect on welfare (e.g. for consumers), introducing a disclosing antitrust authority reduces welfare, as firms pay less fines on average.

## 5. Leniency Policy

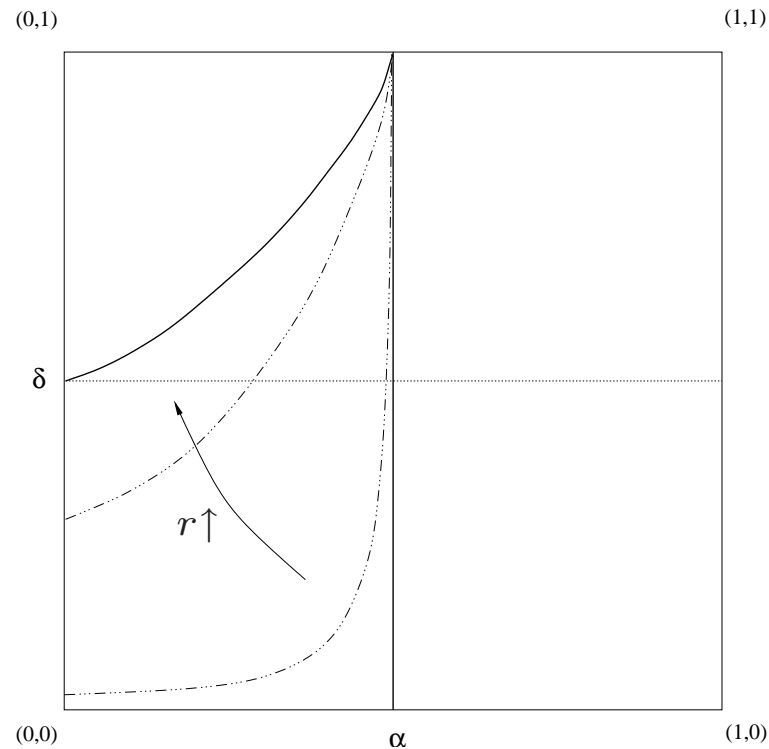
- **Definition of Leniency program:**

- The whistleblowing firm has to pay a reduced fine  $R = (1 - r)F$ , the other firm pays  $F$ .
- $r \in (0, 1]$  (no rewards)
- If both firms blow the whistle in the same period  $t$  each firm gets the reduced fine with  $prob = \frac{1}{2}$ .

$$\Rightarrow E[F] = \left(1 - \frac{1}{2}r\right) F$$

## 5.1 *Non-disclosing* antitrust authority

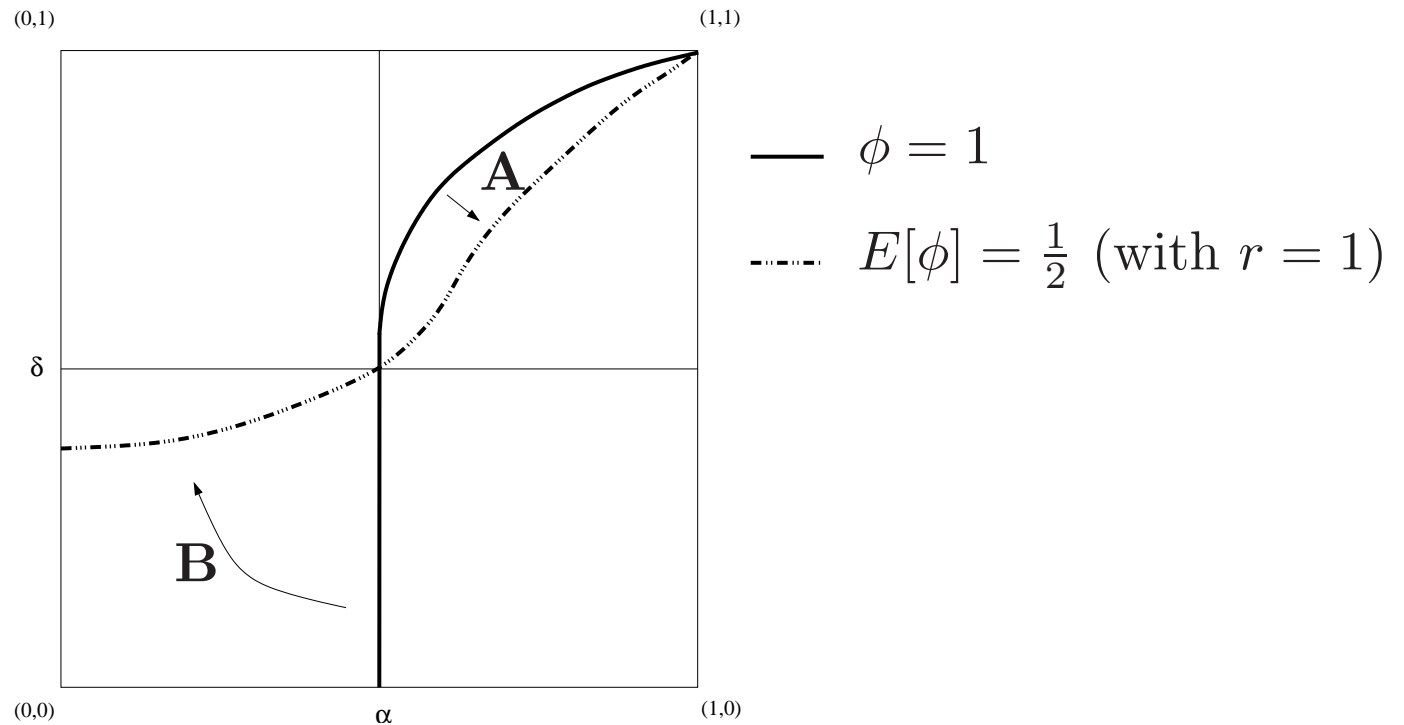
- for  $\phi < 2$ :



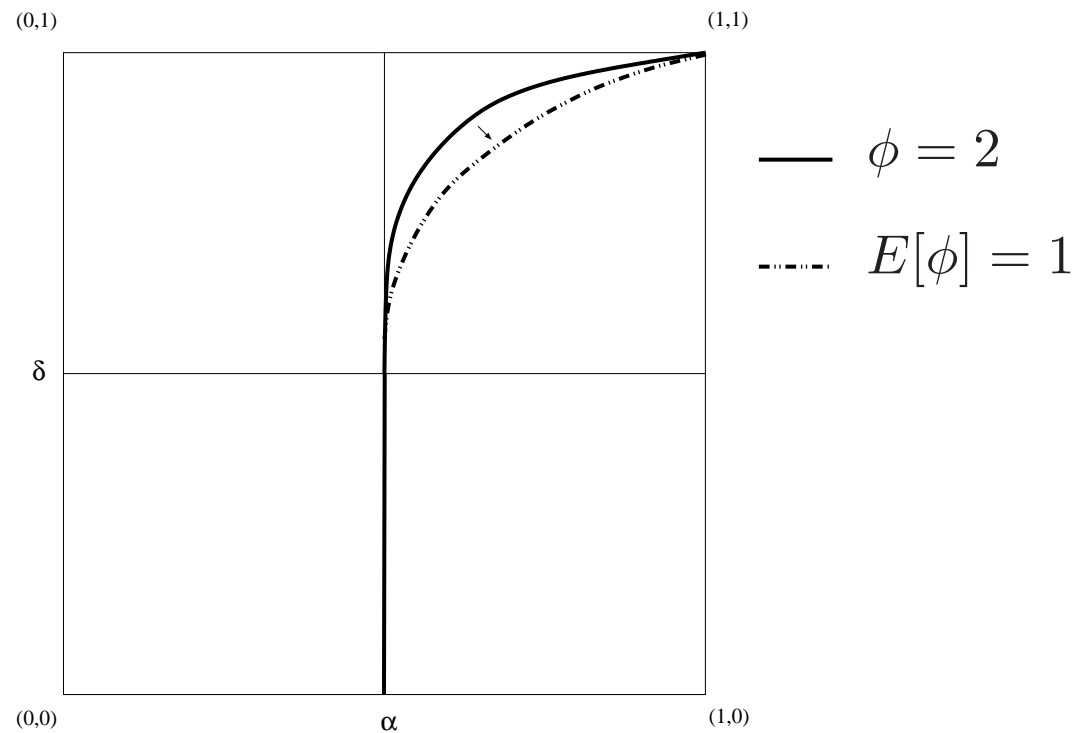
- for  $\phi \geq 2$ : even for  $r = 1$ , full range ( $\alpha \leq \frac{1}{2}$ ) possible  
 $(r \nearrow \implies \gamma \nearrow)$

## 5.2 *Disclosing* antitrust authority

Trade-off:



## Welfare-reducing leniency possible:



**High fines:**  $\Rightarrow$  more collusive industries in region  $\alpha > \frac{1}{2}$ , no effect for industries in region  $\alpha \leq \frac{1}{2}$

## 6. Summary and Discussion

- **Effects of fines:**
  - allows industries with small  $\delta$  (and small  $\alpha$ ) to collude
  - loss in welfare even if industry had colluded anyway
- **Effect of disclosure:**
  - more information allows an industry to collude even if the demand is very uncertain
- **Effects of leniency:**
  - "reduced fine effect" with ambiguous consequences for sustainability of collusion in general  
(for high fines: leniency leads to more collusion)
  - leniency increases the frequency of whistleblowing