ON THE DESIGN OF LENIENCY PROGRAMS

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Journal of Law and Economics, Vol. 56, No. 4 (November 2013), pp. 917-957

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1. INTRODUCTION

- First adopted in 1978 in the United States. In 1993, the U.S. amnesty program was revised
- adopted by the European Union Commission in 1996 and revised in 2002;
- many European countries have also adopted leniency programs.
- South Korea adopted a program that goes further and grants monetary rewards to individual informants.

2. THE MODEL

We use an infinitely repeated game. The firms will form a cartel and benefit from collusion or deviate and report collusion to benefit from the reduction of fines.

2.1. THE COLLUSION GAME

1. In each industry, n identical firms ($n \geq 2$) play an infinitely repeated game
2. firms use the same discount rate $\delta \in (0, 1)$
3. maximize the expected discounted sum of their profits
4. in each period, choose whether to collude or compete a ` la Bertrand
5. the gross profit of a firm is 0 if all firms compete, B if all firms collude, and nB for a firm that deviates from the collusive market scheme when the others collude, in which case the other firms get 0.
6. in the absence of any antitrust policy,

$$B(1+\delta+\delta^2+\ldots) = \frac{B}{1-\delta} \geq nB + \delta \times 0(1+\delta+\ldots) = nB,$$

$$\delta > \underline{\delta} \equiv \frac{n-1}{n}.$$

2.2. ANTITRUST ENFORCEMENT

(1) in the absence of any report, the antitrust authority launches an investigation with probability a, α

where $0 < \alpha < 1$

(2) when an investigation is launched, which is assumed to be publicly observed by the firms, in the absence of any report it succeeds in uncovering cartels with probability,

where p

$0 < p < 1$

2.2.1. LENIENCY PROGRAM

We now introduce a leniency program, which allows the first informant (and only the first one) to benefit from a reduced fine

$$(1 - q)F \qquad q_b \quad q_a$$

or even from a positive reward, if

$$q > 1$$

THE TIMING OF THE GAME BECOMES:

Stage 0: Cartel Agreements.

Stage 1: Product Market Competition and Pre investigation Reporting.

(i) whether to respect the agreement and collude or deviate and compete on the market and

(ii) whether to report the evidence to the antitrust agency.

Stage 2: Random Investigations.

Stage 3: Post investigation Reporting.

Remark: Detection and Punishment: We assume that a firm’s deviation in the product market is not detected by rivals until the end of the period. Otherwise, firms could try to punish such deviations by denouncing the cartel (this is self-sustainable, as each firm is willing to expose the cartel if it expects rivals to do so anyway).

2.2.2. BENCHMARK: NO LENIENCY

In the absence of any leniency program,

$$V_N \equiv \frac{B - \alpha pF}{1 - \delta},$$

$$V_N \geq nB - \alpha pF$$

$$B \geq \underline{B} \equiv \frac{\delta \alpha pF}{1 - n(1 - \delta)}. \quad (1)$$

The threshold thus characterizes the effectiveness of antitrust enforcement

3. OPTIMAL LENIENCY PROGRAM

3.1.1. Normal Collusion (N)

3.1.2. Collude and Report Systematically (R)

3.1.3. Collude and Report in Case of Investigation (I)

3.1.1. NORMAL COLLUSION (N)

There are three kind of deviation:

$$B \geq B_N^r(q_b) \equiv \frac{\alpha p - (1-\delta)(1-q_b)}{1-n(1-\delta)} F, \qquad q_b > \underline{q}_b \equiv 1 - \alpha p > 0.$$

where the threshold B_N^r increases with the amnesty rate q_b and exceeds $\underline{B}$ when $q_b > \underline{q}_b$.

$$B \geq B_N^i(q_a) \equiv \frac{\alpha p - \alpha(1-\delta)(1-q_a)}{1-n(1-\delta)} F, \qquad q_a > 1 - p.$$

where the threshold $B_N^i(q_a)$ increases with the postinvestigation leniency rate q_a and exceeds $\underline{B}$ when $q_a > 1 - p$.

$$B \geq B_N^c(q_a) \equiv \frac{p(1-\delta+\alpha\delta) - (1-\delta)(1-q_a)}{\delta} F. \qquad -pF + \delta V_N \geq -(1-q_a)F$$

To be sustainable, normal collusion must be robust to all deviations; the stake from collusion must therefore be large enough that

$$B \geq B_N(q_b, q_a) \equiv \max\{B_N^i(q_a), B_N^r(q_b), B_N^c(q_a), \underline{B}\}. \tag{2}$$

3.1.2. COLLUDE AND REPORT SYSTEMATICALLY (R)

The threshold decreases as the amnesty rate increases

$$B \geq B_R(q_b) \equiv \frac{\delta[1-(q_b/n)F]}{1-n(1-\delta)}. \qquad q_b > \bar{q}_b \equiv n(1-\alpha p),$$

3.1.3. COLLUDE AND REPORT IN CASE OF INVESTIGATION (I)

There are two kind of deviation:

$$B \geq B_{\mathrm{I}}^{\mathrm{r}}(q_{\mathrm{b}}, q_{\mathrm{a}}) \equiv \frac{\alpha[1 - (q_{\mathrm{a}}/n)] - (1 - \delta)(1 - q_{\mathrm{b}})}{1 - n(1 - \delta)} F.$$

$$B \geq B_{\mathrm{I}}^{\mathrm{i}}(q_{\mathrm{a}}) \equiv \frac{\delta\alpha[1 - (q_{\mathrm{a}}/n)]}{1 - n(1 - \delta)} F,$$

$$B \geq B_{\mathrm{I}}(q_{\mathrm{b}}, q_{\mathrm{a}}) \equiv \max\{B_{\mathrm{I}}^{\mathrm{i}}(q_{\mathrm{a}}), B_{\mathrm{I}}^{\mathrm{r}}(q_{\mathrm{b}}, q_{\mathrm{a}})\}.$$

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Conversely, it can be checked that no other form of collusion is sustainable if these are not. To deter collusion in as many industries as possible, the amnesty rates qb and qa should maximize the deterrence threshold:

$$B(q_b, q_a) \equiv \max\{B_N(q_b, q_a), B_I(q_b, q_a), B_R(q_b)\}.$$

3.2. NO LENIENCY DURING INVESTIGATION

$$B \geq B_N(q_b, 0) = \max\{B_N^r(q_b), \underline{B}\},$$

$$B(q_b) \equiv \min\{B_N(q_b), B_R(q_b)\},$$

$$q_b = \hat{q}_b \equiv \frac{1 - \alpha p}{1 - [(n-1)\delta/n]}. \quad (4)$$

$$\hat{B} \equiv \frac{\delta[(n-1)(1-\delta) + \alpha p]}{\delta - n(n-1)(1-\delta)^2} F \quad (5)$$

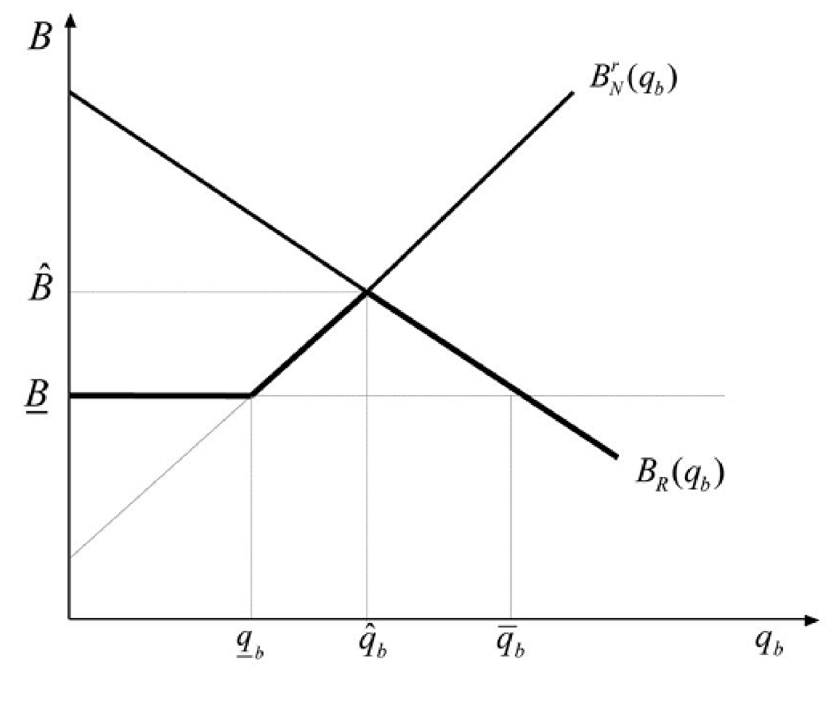


Figure 1. Optimal preinvestigation leniency rate

Proposition 1. It is always desirable to offer some leniency. If leniency is available only before investigation, then the optimal leniency rate lies between $\underline{q}_b = 1 - \alpha p > 0$ and $\bar{q}_b = n\underline{q}_b$; it is given by equation (4) and increases as the probability of prosecution, αp, decreases.

3.3. LENIENCY BOTH BEFORE AND DURING INVESTIGATIONS

Under the leniency policy $(\hat{q}_b, 0)$, cartel members in a marginal industry

$$V_N = V_N^r(\hat{q}_b) = nB - (1 - \hat{q}_b)F. \quad (6)$$

$$\alpha(1 - q_a) < 1 - \hat{q}_b; \quad (7)$$

This ensures that:

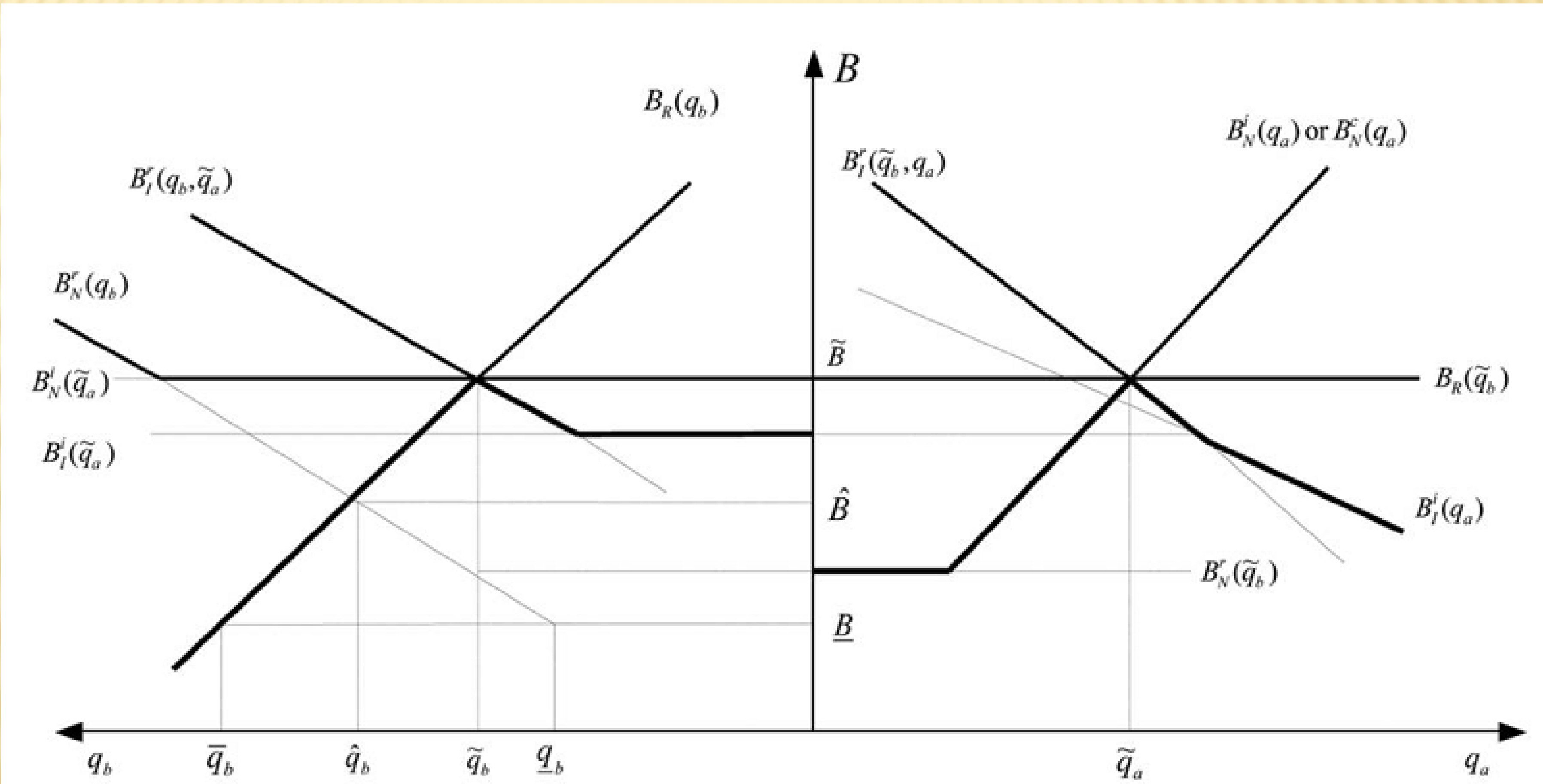
$$p < 1 - \frac{q_a}{n}. \quad (8)$$

$$V_N \leq V_N^i(q_a) \Leftrightarrow B \leq B_N^i(q_a) = \frac{\alpha p - \alpha(1 - \delta)(1 - q_a)}{1 - n(1 - \delta)} F,$$

$$V_I(q_a) \leq V_I^r(q_b) \Leftrightarrow B \leq B_I^r(q_b, q_a) = \frac{\alpha[1 - (q_a/n)] - (1 - \delta)(1 - q_b)}{1 - n(1 - \delta)} F,$$

$$V_R(q_b) \leq V_R^r(q_b) \Leftrightarrow B \leq B_R(q_b) = \frac{\delta[1 - (q_b - n)]F}{1 - n(1 - \delta)}.$$

3.3. LENIENCY BOTH BEFORE AND DURING INVESTIGATIONS



In Figure 2, the threshold $B(q_b, q_a) = \min\{B_N^i(q_a), B_I^r(q_b, q_a), B_R(q_b)\}$ appears in bold.

3.3. LENIENCY BOTH BEFORE AND DURING INVESTIGATIONS

Combining conditions (7) and (8) leads to

$$p < \tilde{p}_1(\alpha) \equiv \frac{\alpha[\delta + n(1-\delta)] - \delta}{n\alpha(1-\delta)}. \quad (9)$$

cartel members to report in case of investigation undercutting each other in the product market and when random investigations are unlikely to succeed (that is, when $p < \tilde{p}_1(\alpha)$)

Alternatively, cartel members to report in case of investigation without undercutting each other in the product market and when random investigations are unlikely to succeed (that is, when $p < \tilde{p}_1(\alpha)$

3.3. LENIENCY BOTH BEFORE AND DURING INVESTIGATIONS

The candidate optimal leniency policy $(\tilde{q}^1_{\mathrm{b}}, \tilde{q}^1_{\mathrm{a}})$ is thus characterized by

$$\tilde{B}_1 = B^{\mathrm{i}}_{\mathrm{N}}(\tilde{q}^1_{\mathrm{a}}) = B^{\mathrm{r}}_{\mathrm{I}}(\tilde{q}^1_{\mathrm{b}}, \tilde{q}^1_{\mathrm{a}}) = B_{\mathrm{R}}(\tilde{q}^1_{\mathrm{b}}),$$

which yields

$$\tilde{q}^1_{\mathrm{b}} \equiv \frac{n[\delta + n(1-\delta)](1-\alpha) + n\alpha(1-p)}{\delta + \delta n(1-\delta) + n^2(1-\delta)^2},$$

$$\tilde{q}^1_{\mathrm{a}} \equiv \frac{n(n-1)\delta(1-\alpha)(1-\delta) + n\alpha(1-p)[\delta + n(1-\delta)]}{[\delta + \delta n(1-\delta) + n^2(1-\delta)^2]\alpha}. \tag{10}$$

The resulting deterrence threshold is

$$\tilde{B}_1 \equiv \frac{n(n-1)(1-\delta)^2 + \alpha[(n-1)(1-\delta) + p]}{[\delta + \delta n(1-\delta) + n^2(1-\delta)^2]} \frac{\delta F}{[1 - n(1-\delta)]}, \tag{11}$$

where indeed $\tilde{B}_1 \geq \hat{B}$ if and only if $p \leq \tilde{p}_1(\alpha)$.

3.3. LENIENCY BOTH BEFORE AND DURING INVESTIGATIONS

The candidate optimal leniency policy $(\tilde{q}_b^2, \tilde{q}_a^2)$ is therefore such that

$$\tilde{B}_2 = B_N^c(\tilde{q}_a^2) = B_I^r(\tilde{q}_b^2, \tilde{q}_a^2) = B_R(\tilde{q}_b^2)$$

and is thus given by

$$\tilde{q}_b^2 \equiv \frac{n(\alpha\delta^2 + [1 - n(1 - \delta)]\{[n(1 - \alpha) + \alpha](1 - \delta) - \alpha p(1 - \delta + \alpha\delta)\})}{n(1 - \delta)[\delta - n(n - 1)(1 - \delta)^2] + \alpha\delta^2} \qquad (14)$$

and

$$\tilde{q}_a^2 \equiv \frac{n\{\alpha\delta^2 + (n - 1)(1 - \delta)\delta^2 + [\delta - n(n - 1)(1 - \delta)^2][(1 - \delta)(1 - p) - p\alpha\delta]\}}{n(1 - \delta)[\delta - n(n - 1)(1 - \delta)^2] + \alpha\delta^2}. \qquad (15)$$

The resulting deterrence threshold is

$$\tilde{B}_2 \equiv \frac{(1 - \delta)(n - 1)[n(1 - \delta) + \alpha] + \alpha p(1 - \delta + \alpha\delta)}{n(1 - \delta)[\delta - n(n - 1)(1 - \delta)^2] + \alpha\delta^2}\delta F, \qquad (16)$$

where $\tilde{B}_2 \geq \hat{B}$ if and only if $p \leq \tilde{p}_2(\alpha)$.

Case 1: $\delta > \hat{\delta}$.

When firms are sufficiently patient

$\tilde{B}_1 = \hat{B}$

$\tilde{B}_2 = \hat{B}$

$\tilde{B}_1 = \tilde{B}_2$

$\tilde{B}_1 = \tilde{B}_2 = \hat{B}$

$(q_{1b}^* = \hat{q}_{1b}, q_{1a}^* = 0)$.

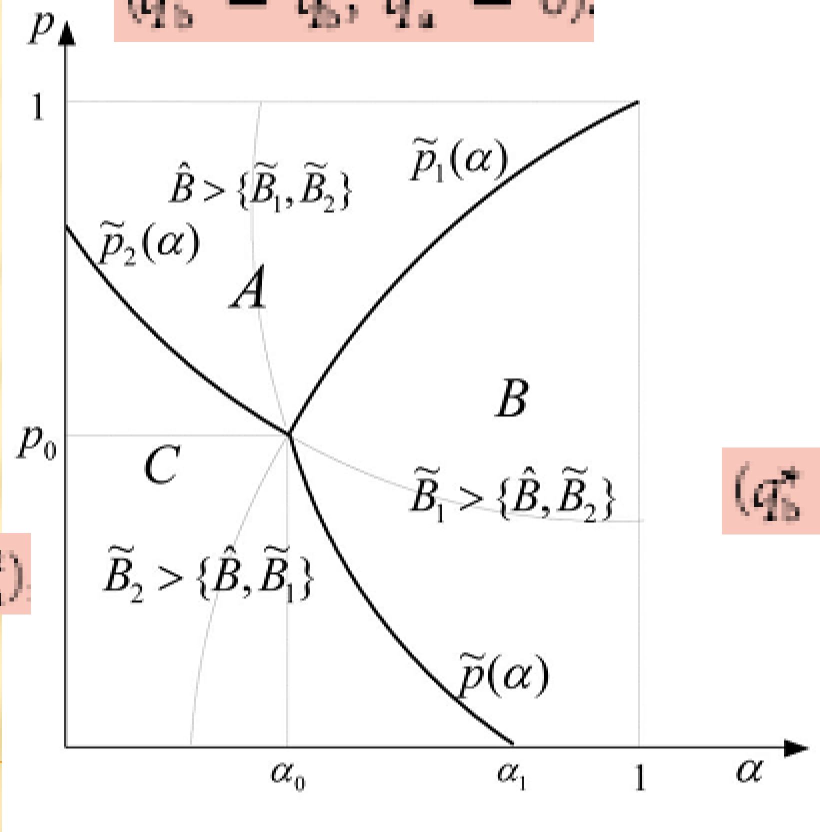


Figure 3. Optimal leniency policies, $\delta > \hat{\delta}$

$(q_{1b}^* = \tilde{q}_{1b}^1, q_{1a}^* = \tilde{q}_{1a}^1)$,

$(q_{1b}^* = \tilde{q}_{1b}^2, q_{1a}^* = \tilde{q}_{1a}^2)$

Case 2: $\underline{\delta} < \delta \le \hat{\delta}$.

When firms are less patient,

$\tilde{p}_2(\alpha) \le 0$,

$(\tilde{q}_b^2, \tilde{q}_a^2)$ is thus always dominated by $(\hat{q}_b, 0)$ for any p and α.

it is optimal to deny leniency once an investigation

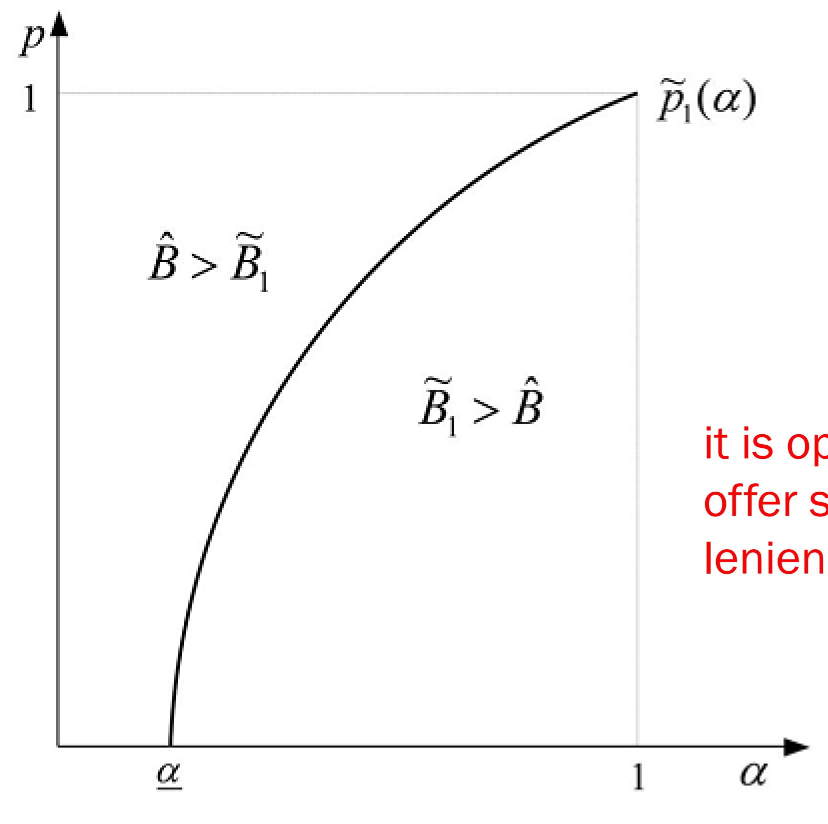


Figure 4. Optimal leniency policies, $\delta \le \hat{\delta}$

it is optimal to offer some leniency even

3.3. LENIENCY BOTH BEFORE AND DURING INVESTIGATIONS

Proposition 2. It is always optimal to offer leniency before investigations. Moreover,

1) when firms are patient ($\delta > \hat{\delta}$), it is optimal to keep offering some leniency in case of investigation if and only if $p \leq \max\{\tilde{p}_1(\alpha), \tilde{p}_2(\alpha)\}$; the optimal policy is then $(q_b^*, q_a^*) = (\tilde{q}_b^1, \tilde{q}_a^1)$ if $p \geq \tilde{p}(\alpha)$ and $(q_b^*, q_a^*) = (\tilde{q}_b^2, \tilde{q}_a^2)$ if $p \leq \tilde{p}(\alpha)$;

2) when instead firms are impatient ($\delta \leq \hat{\delta}$), it is optimal to keep offering some leniency in case of investigation if only if $\alpha \geq \underline{\alpha}$ and $p \leq \tilde{p}_1(\alpha)$, in which case the optimal policy is $(q_b^*, q_a^*) = (\tilde{q}_b^1, \tilde{q}_a^1)$.

Proposition 3. Restricting leniency to first-time offenders makes it ineffective in deterring collusion.

3.5. COMPARATIVE STATICS

Proposition 4. Increasing p or α makes the leniency program more effective. Moreover,

1) increasing p leads to offering less leniency, both before and during investigation;

2) increasing α leads to offering less leniency preinvestigation; the postinvestigation rate $\tilde{q}_a^1$ also decreases as α increases but $\tilde{q}_a^2$ instead increases with α.

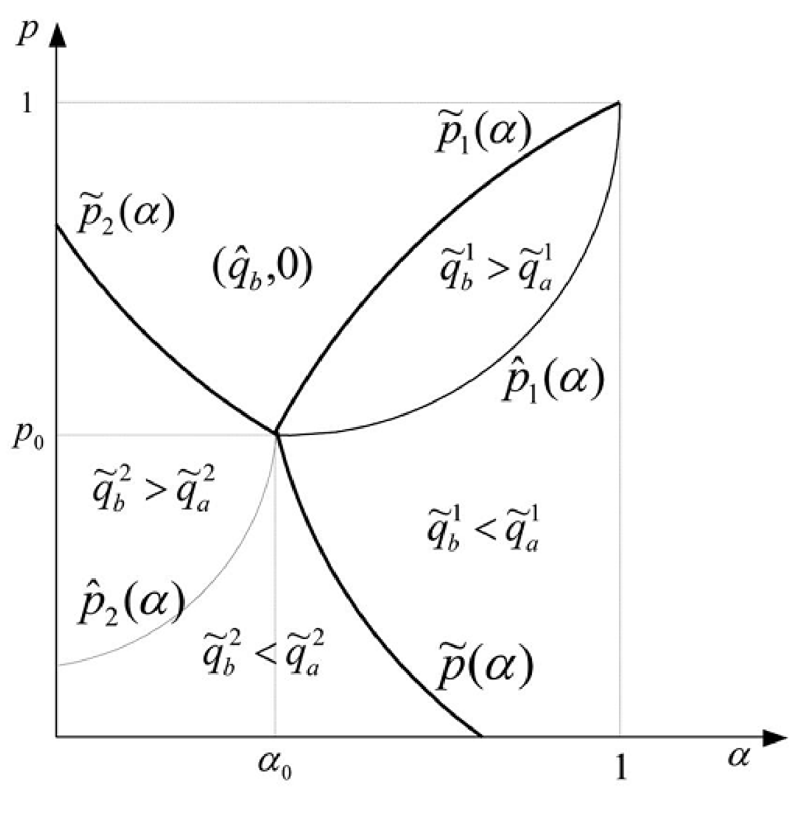


Figure 5. Comparative statics for $\delta > \hat{\delta}$

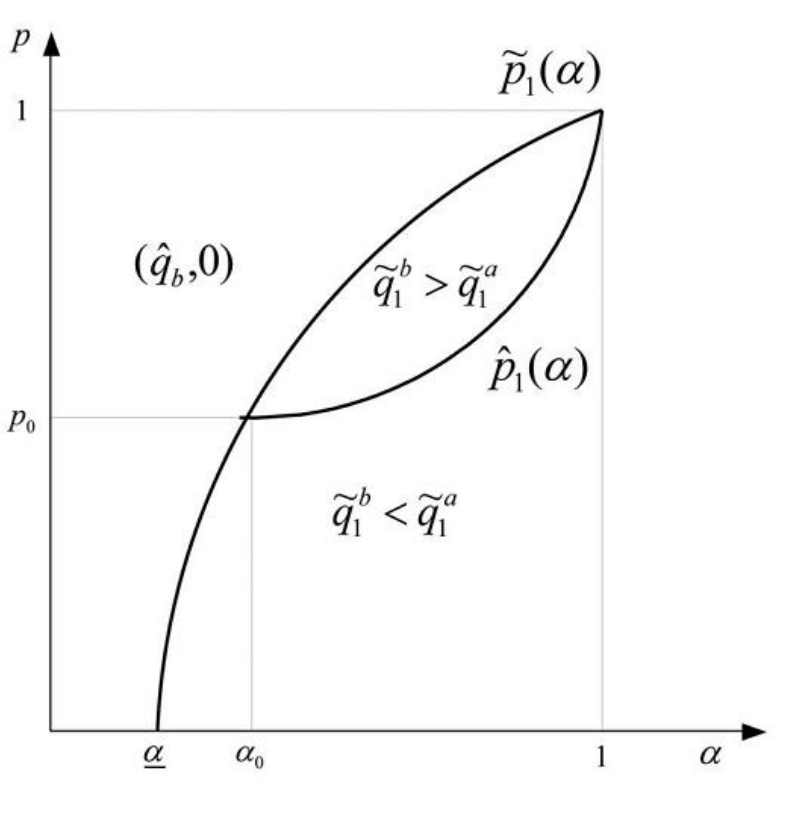


Figure 6. Comparative statics for $\delta \leq \hat{\delta}$

4. CONCLUDING REMARKS

1. We show that offering leniency can indeed help fight collusion.
2. Our simple framework allows us to relate the optimal leniency policy to the frequency and effectiveness of investigations.
3. Our analysis also confirms the usefulness of restricting leniency to the first informant only
4. In contrast, it does not support prohibiting leniency for repeat offenders.