Heterogeneity of Penalties and Private Information

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CRESSE, July 2015
This paper:

*What I do:*  
- What are the characteristics of the reporting firm?

*Intuition:*  
- Adequacy of fine reductions?  
- Who reports?
**Findings:**

- Firm with highest fine has a lower reporting threshold.

- In equil., firm with highest fine reports first, if the signal received is above the equilibrium threshold.

**Reporters / Immunity:**

- **US:** leader, moderate no. buyers
- **EU:** repeat offenders, number repeat offenders
Motivation

- Cartels = social cost
- Prosecution / Pre-emption effects
- US, EU Leniency Programmes - 1978, 1996

- Several repeat offenders (Akzo, Degussa, Mitsubishi, ...)
- Several repeat offenders in a given cartel
The Akzo Nobel Case

- 8 EU fines in 12 years
- Often with same partners (Arkema Fr., Degussa, EKA Chemicals, Elf Aquitane and Peroxid Chemie)
Harrington, 2013, Corporate LPs when Firms have Private Information: The Push of Prosecution and the Pull of Pre-emption, JIE

- homogeneous firms
- public / private signals
- static model
- symmetric equilibria
- Firm with highest signal reports
Empirical Literature

- Data analysis: Connor 07, Wils 07, Mihai 08, Veljanovski 09, Asker 09;
- Borrell and Jimenez 07: drivers of antitrust effectiveness, found to be increased by the LP;
- Miller 09: no. cartels discovered > in periods around introduction of LP and decreases to pre-LP levels after;
- Arlman 05: 1990-2004, LP= dummy for max reduction → < investigation duration, > gravity, > reduced fine.
- Brenner 09: 1990-2003, LP dummy → < investigation duration, > gravity, > reduced fine.
Harrington, 2011 - homogeneous firms
Ideal model - continuous time

Private signal

Firm 1  Firm 2
Firm 3  ...
...
...  Firm N

EU Comp. Commission

Fine + A - M

Len. Reduction

Signal 1  Signal 2
Signal 3  ...
...
...  Signal N

Firm 1  Firm 2
Firm 3  ...
...
...  Firm N

EU Comp. Commission

Fine + A - M

Len. Reduction
This paper - discrete time


Signal 1, Signal 2, Signal 3, ..., Signal N

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Policy Background

- Article 81 EU Treaty, 1992 (101 of the TFEU, 2009)

- Sherman Act, 1890 + Federal Trade Commission Act, 1914
- Antitrust Procedures and Penalties Act, Title 15
  - individual fine $\leq$ US$100K
  - corporate fine $\leq$ US$1M
  - plea negotiations (black box)
- Antitrust Criminal Penalty Enhancement + Reform Act of 2004: $\leq 10$ years
- Amnesty Plus Program 1978, 1993
Game stages

- **Stage 1**: 2-firm cartel collapses for internal reasons.
  - firms are risk-neutral and
  - heterogeneous in terms of fines \((F_k, \text{ where } k = (i, j))\)

- **Stage 2**: firms receive signals and decide whether or not to report.
  - \(s_k = E(\rho) = E[\text{prob(detection and conviction)}]\)
  - \(s_k \in [s, \overline{s}]\)
  - signals are private information but correlated
  - \(F_t = Y_{t-1}[a\%CD + b\% + Aggr.C. - Mitig.C.]\)
Firms’ strategy pair

\[ \phi(s_i, s_j) = \begin{cases} 
(R, R) & \text{iff } s_i \in (x_i, s) \text{ and } s_j \in (x_j, s) \\
(R, NR) & \text{iff } s_i \in (x_i, s) \text{ and } s_j \in [s, x_j] \\
(NR, R) & \text{iff } s_i \in [s, x_i] \text{ and } s_j \in (x_j, s) \\
(NR, NR) & \text{iff } s_i \in [s, x_i] \text{ and } s_j \in [s, x_j] 
\end{cases} \]

\[ H(s_j|s_i) \text{ = firm } i \text{'s CDF on firm } j \text{'s signal conditional on its own signal.} \]

**Firm i reports if:** \( \Delta(s_j, x_i) = V_i^R - V_i^{NR} \)

\[ V_i^R = -H(x_j|s_i)(\theta F_i + G_i) + [1 - H(x_j|s_i)]\left(\frac{1+\theta}{2} F_i + G_i\right) \]

\[ V_i^{NR} = -H(x_j|s_i)E[\rho|s_i, s_j \leq x_i](F_i + G_i) + [1 - H(x_j|s_i)](F_i + G_i) \]
Equilibrium

Firms choose the strategy which min. $E(\text{Fine})$. New ICCs:

**Firm $i$:** $\Delta(s_j, x_i) = 0$

**At the cut-off point** ($s_j = x_j$): $\Delta(x_j, x_i) = 0$

**Firm $i$’s *strategy:*** report when $s_i > x_i$ iff $\Delta(x_j, x_i) \geq 0$, as then $\Delta(s_i, x_i) > 0$, $\forall s_i > x_i$; and v.v.

**THEOREM:** An equilibrium exists in which firms choose to report or not, given their own signal and the expectation on the other firm’s signal. If $(x_i, x_j) \in (\underline{s}, \bar{s})$ and $\Delta(x_i, x_j) = 0$ or $\Delta(x_j, x_i) = 0$ then $\phi(s_i, s_j)$ is the set of Bayesian-Nash Equilibria.
Equilibrium strategy pairs:

(1) (R,R):
- \((s_i, s_j)\)
- \((s'_i, s'_j)\) and \(\Delta(x_i, x_j) \geq 0\) OR \((s_i, s'_j)\) and \(\Delta(x_j, x_i) \geq 0\)
- \((s'_i, s'_j)\) and \(\Delta(x_i, x_j) \geq 0, \Delta(x_j, x_i) \geq 0\)

(2) (NR,NR):
- \((s_i, s_j)\)
- \((s'_i, s'_j)\) and \(\Delta(x_i, x_j) \leq 0\) OR \((s_i, s'_j)\) and \(\Delta(x_j, x_i) \leq 0\)
- \((s'_i, s'_j)\) and \(\Delta(x_i, x_j) \leq 0, \Delta(x_j, x_i) \leq 0\)

(3) (R,NR) or (NR,R):
- \((s'_i, s_j)\) and \(\Delta(x_i, x_j) \leq 0\) OR \((s_i, s'_j)\) and \(\Delta(x_j, x_i) \leq 0\)
- \((s'_i, s_j)\) and \(\Delta(x_i, x_j) \geq 0\) OR \((s_i, s'_j)\) and \(\Delta(x_j, x_i) \geq 0\)
- \((s'_i, s'_j)\) and different signals for \(\Delta(x_i, x_j)\) and \(\Delta(x_j, x_i)\)
Relationship between the thresholds

Assume:

- $F_{t,i} > F_{t,j}$
- $G = G_i = G_j$
- $E[\rho|x_j^*, x_i^*] = E[\rho|x_i^*, x_j^*] = E[\rho]$

Then: $x_j^* > x_i^*$
Perfect Equilibria Properties

1. If $s_j \in [x_j, \bar{s}]$, a firm reports, provided that $\Delta(x_i, x_j) \geq 0$, as then $\Delta(s_j, x_i) > 0$, for all $s_j > x_j$. Inversely, if $s_j \in [s, x_j]$, the firm doesn’t report if $\Delta(x_i, x_j) \leq 0$, as then $\Delta(s_i, x_i) < 0$, for all $s_j < x_j$; here

2. If $F_i > F_j$, then $x_i^* < x_j^*$

Discontinuity Issue
Possible Extensions:

- larger N,
- include pre-cartel environment,
- **continuous time** (work in progress),
- elimination of the risk-neutrality assumption.
Data

  - 1984-2009
  - 799 cartels
  - 2310 firms

- EU: Marvao (2011)
  - self-collected data
  - 1998-2011
  - 81 cartels
  - 385 firms

- Repeat Offenders: 351/2310 US (11%), 63/385 EU (16%)

- Sample Selection Bias

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Method - Probit Estimator

\[ I._EU_{ijts} = \beta_0 + \beta_1 N_{jts} + \beta_2 RO_{ijts} + \beta_3 RO1_{ijts} + \beta_4 NRO_{jts} + \beta_5 Def.Turnover_{ijts} + \beta_6 oth.red_{ijts} + \beta_7 fine.increase_{ijts} + \beta_8 Firm1post_{ijts} + \beta_9 eea_{jts} + \beta_{10} LP_1996_{jts} + \beta_{11} LP_2002_{jts} + \beta_{12} inv.dur_{jts} + \beta_{13} invdur2_{jts} + \gamma T_t + \delta S_s + \epsilon_{ijts} \]

\[ I._US_{ijts} = \beta_0 + \beta_1 N_{jts} + \beta_2 RO_{ijts} + \beta_3 NRO_{jts} + \beta_4 S_US_cartel_{jts} + \beta_5 S EU_cartel_{jts} + \beta_6 Prison US_{ijts} + \beta_7 leader_{ijts} + \beta_8 Many_buyers_{jts} + \beta_9 Mod_buyers_{jts} + \gamma T_t + \delta S_s + \epsilon_{ijts} \]
## Regression Results - EU Data - Probit model

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<tr>
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<th>immunity_EU (1)</th>
<th>immunity_EU (2)</th>
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***, **, * correspond to 1, 5 and 10% significance level, respectively. Standard errors are clustered at the cartel level and reported in parenthesis.

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Regression Results - US Data - Probit model

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Results

- Fine (Sales, A, M) \(\Rightarrow\) < Equil. threshold for reporting (T, E)

- 1st reporter US \(\Rightarrow\) leader, moderate sized market
  \(\Rightarrow\) sectors rubber and plastic (6%), paper and printing (4%)

- 1st reporter EU \(\Rightarrow\) RO, RO1, NRO, (-) LP1996, (-) N
  \(\Rightarrow\) sectors fine art auctions (1%)
Conclusion

- Prosecution effect
- Pre-emption effect

Policy implications: identifying the most likely reporter in a cartel is key to designing a successful Leniency Programme.

Close monitoring: stronger prosecution effect, lower threshold for reporting, thus more discovered cartels.

make the Programme more successful in terms of convictions, increase the prior probability of conviction, stronger deterrence effect
Thank you.

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