Antitrust Enforcement and Corporate Leniency Programs

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Introduction

Challenges to Deterring Collusion

1. Challenge of ideas
2. Challenge of measurement
3. Challenge of implementation

Introduction

Challenges to Deterring Collusion: Ideas

- Challenge: Developing new policies.
- With an upper bound on penalties, it is critical to increase the probability that penalties are levied.
- Examples
  - Leniency programs
  - Whistleblowers
  - Screening

Introduction

Challenges to Deterring Collusion: Measurement

- Challenge: Determining when a policy works.
- Policy objective is to impact the population of cartels, including
  - number of cartels
  - average duration of cartels
  - average overcharge
- Population of cartels is not observed, only the population of *discovered* cartels.

Introduction

Challenges to Deterring Collusion: Measurement

- Number of discovered cartels may not be a good proxy for number of cartels.
- In response to a new policy, the number of discovered cartels could fall because
  - the policy is **effective** and there are fewer cartels
  - the policy is **ineffective** and thus fewer cartels are caught and convicted.
- The population of discovered cartels may not be a random sample of the population of cartels.
  - Unstable cartels may collapse before being caught $\Rightarrow$ over-sampling more stable cartels.
  - Stable cartels may avoid detection$\Rightarrow$ over-sampling less stable cartels.

Introduction

Challenges to Deterring Collusion: Implementation

- Challenge: Having the competition authority properly implement a policy.
- Proper implementation includes
  - effective execution of the program itself (e.g., leniency program)
  - proper selection of complementary instruments (e.g., prosecution of non-leniency cases)

Introduction

Challenges to Deterring Collusion: Implementation

- Example: leniency program
- An abundance of leniency applications may cause the EC to reduce how many non-leniency cases it pursues.
- This could weaken the deterrence of relatively stable cartels.
- Would not an optimizing EC choose enforcement to minimize the cartel rate?
- *Why should the EC try to minimize the cartel rate?*

Introduction

Objective of the Competition Authority

- Taking a career concerns perspective,
  - the CA can only be rewarded based on *observable* measures of performance
  - the cartel rate is not observable
  - therefore, the CA will not be concerned with the cartel rate
- Will the CA undervalue deterrence?
- Vitamins: US DOJ and Hoffman La Roche.
  - Guidelines: Fine between \$1.3B and \$2.6B.
  - Actual fine: \$0.5B.
- Proper design of a policy should take into account the incentives of the CA.

Introduction
Overview of Research

- Competition authority faces a resource constraint
  - Firms use the leniency program if they think it is sufficiently likely they'll be penalized.
  - Likelihood of being penalized depends on the CA's caseload which includes both leniency and non-leniency cases.
- Competition authority influences its caseload.
- Main findings
  - Holding the CA's enforcement policy fixed, a leniency program lowers the cartel rate.
  - Allowing the CA to adjust its enforcement policy, a leniency program can either raise or lower the cartel rate.

Model

Firm Environment

- In each market, n firms interact in a Prisoners' Dilemma - *collude* or *compete*.
  - All collude: each firm earns $\pi > 0$.
  - All compete: each firm earns $\alpha\pi$, $\alpha \in [0, 1)$.
  - A firm competes and all others collude: deviator earns $\eta\pi$, $\eta > 1$.
- Stochastic market conditions
  - π is *iid* with cdf $H : [\underline{\pi}, \overline{\pi}] \rightarrow [0, 1]$.
  - $\mu \equiv \int \pi H'(\pi)\, d\pi$.
  - π is observed prior to firms deciding between *collude* and *compete*

Model

Firm Environment

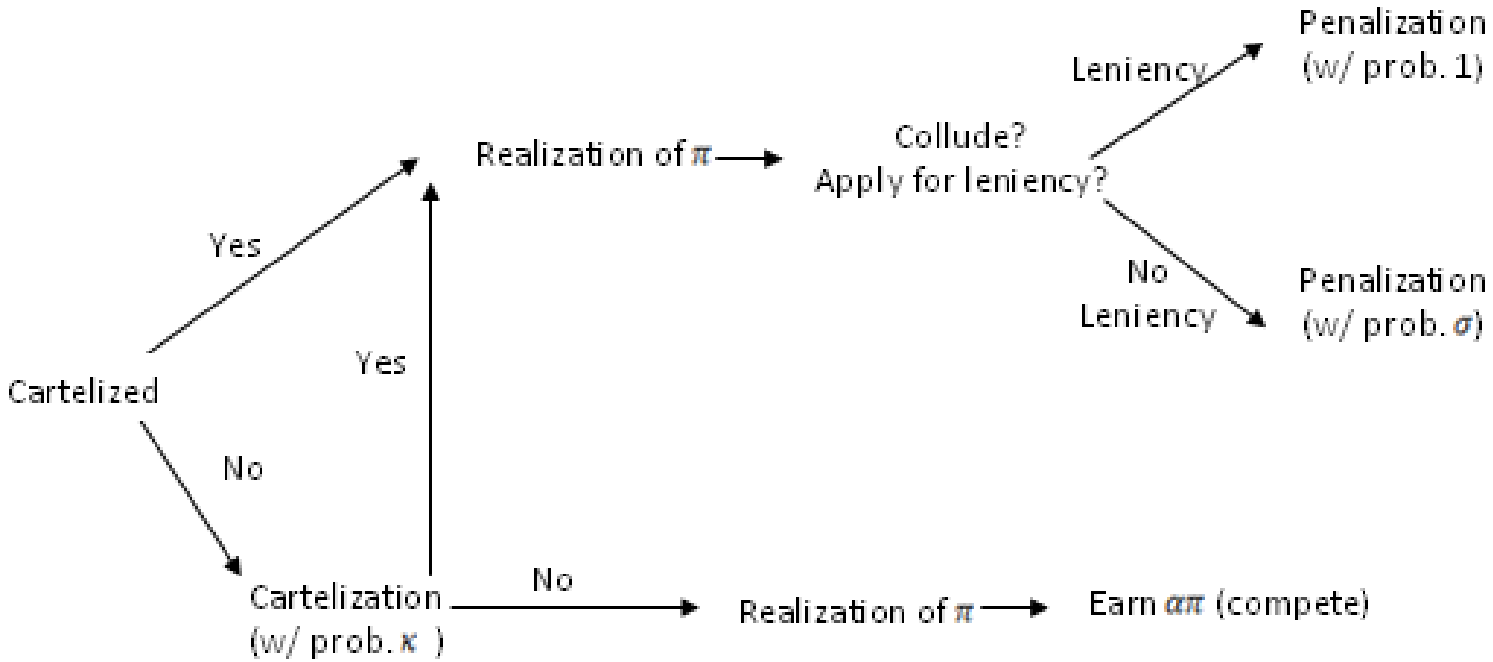
- State of an industry: *cartel* or *non-cartel*.
- If firms are not cartelized then each firm earns $\alpha\pi$.
- If firms are cartelized then each firm decides
  - to *collude* or *compete* and
  - whether to apply for leniency.
- Penalization - leniency program is not used.
  - Cartel is discovered, prosecuted, and convicted with probability $\sigma \in [0, 1)$.
  - If convicted, each firm pays a (per period) penalty of F.
- Penalization - leniency program is used.
  - First firm "in the door" receives a penalty of θF, $\theta \in [0, 1]$.
  - All other firms pay F.

Model

Evolution of Cartel Status

- If an industry enters the period as a cartel then it exits the period as a cartel iff
  - all firms chose *collude*
  - no firm applied for leniency
  - the CA did not discover, prosecute, and convict.
- If an industry enters the period not as a cartel then
  - with probability κ it becomes a cartel
  - with probability $1-\kappa$ it remains a competitive industry
- Industry heterogeneity
  - Industry type: η controls the propensity to cheat.
  - Distribution of industries, cdf $G : \left[\underline{\eta}, \overline{\eta}\right] \rightarrow [0,1]$.

Model
Sequence of Events



Model

Antitrust Enforcement Technology

- $\sigma = q \times r \times s$ is the probability that a cartel pays penalties (when no firm used the leniency program).
  - q is the probability the cartel is discovered
  - r is the probability the CA prosecutes a discovered cartel
  - s is the probability that the CA is successful in a prosecution
- Probability of a conviction:

$$s = p\left(\lambda L + R\right) = \frac{\tau}{\xi + v\left(\lambda L + R\right)^{\rho}}$$

  - L is the number (or mass) of leniency cases
  - R is the number of non-leniency cases
  - $\lambda \in [0,1]$, $v > 0$, $\rho \geq 1$, $\tau \in (0,1]$, $\xi \geq \tau$

Equilibrium
Collusion

- Y is firm value when firms are in the cartel state.
- W is firm value when firms are not in the cartel state.
- Incentive compatibility constraint:

$$\begin{aligned}(1-\delta)\,\pi+\delta\left[(1-\sigma)\,Y+\sigma\,(W-F)\right] \quad &\geq \\ (1-\delta)\,\eta\pi+\delta\left[W-\min\left\{\sigma F,\theta F\right\}\right]\end{aligned}$$

- Endogenizing penalty: $F=\gamma\,(Y-\alpha\mu)\,,\ \gamma>0.$

$$\begin{aligned}\pi &\leq \frac{(Y-W)-\delta\left[\sigma-\min\left\{\sigma,\theta\right\}\right]\gamma\,(Y-\alpha\mu)}{(1-\delta)\,(\eta-1)} \\ \pi &\leq \phi\,(Y,W,\eta)\end{aligned}$$

Equilibrium
Collusion

- (Y, W) are equilibrium values iff:

$$W = (1-\kappa)\left[(1-\delta)\,\alpha\mu + \delta W\right] + \kappa Y \tag{1}$$

$$\begin{aligned} Y \;=\; & \int_{\underline{\pi}}^{\phi(Y,\sigma,\eta)} \left\{(1-\delta)\,\pi + \delta\left[(1-\sigma)\,Y + \sigma\,(W-F)\right]\right\} \\ & \times H'(\pi)\,d\pi \\ & + \int_{\phi(Y,\sigma,\eta)}^{\overline{\pi}} \left[(1-\delta)\,\alpha\pi + \delta W - \delta\beta\,(\sigma,\theta)\,F\right] H'(\pi)\,d\pi \end{aligned} \tag{2}$$

- Y^* is the maximal solution:

$$Y^*(\sigma,\eta) \equiv \max\left\{Y \in [\alpha\mu, \mu] : (Y, W) \text{ solve (1)-(2)}\right\}.$$

Equilibrium

Markov Process on Cartel Birth and Death

- Incentive compatibility constraint:

$$\pi \leq \phi\left(Y^*\left(\sigma,\eta\right),W^*\left(\sigma,\eta\right),\eta\right) \equiv \phi^*\left(\sigma,\eta\right)$$

- $C\left(\sigma,\eta\right)$ is the proportion of cartels among type-η industries.
- Stationary proportion of type-η industries which are not cartelized:

$$\begin{aligned} 1-C\left(\sigma,\eta\right) &= \left[1-C\left(\sigma,\eta\right)\right]\times \\ &\quad \left[\left(1-\kappa\right)+\kappa\left(1-H\left(\phi^*\right)\right)+\kappa H\left(\phi^*\right)\sigma\right] \\ &\quad +C\left(\sigma,\eta\right)\left[\left(1-H\left(\phi^*\right)\right)+H\left(\phi^*\right)\sigma\right] \end{aligned}$$

  - κ is the probability a competitive industry cartelizes.
  - $H\left(\phi^*\right)$ is the probability that a cartel internally collapses.
  - σ is the probability that a cartel collapses because it is convicted.

Equilibrium

Stationary Distribution on Cartels

- Solve for $C(\sigma, \eta)$:

$$C(\sigma, \eta) = \frac{\kappa H(\phi^*(\sigma, \eta))}{1 - (1 - \sigma - \kappa) H(\phi^*(\sigma, \eta))}$$

- Rate of cartelized industries:

$$\begin{aligned} C(\sigma) &= \int_{\underline{\eta}}^{\overline{\eta}} C(\sigma, \eta) G'(\eta) d\eta \\ &= \int_{\underline{\eta}}^{\overline{\eta}} \left[\frac{\kappa H(\phi^*(\sigma, \eta))}{1 - (1 - \sigma - \kappa) H(\phi^*(\sigma, \eta))} \right] G'(\eta) d\eta \end{aligned}$$

Equilibrium

Probability of Conviction

- $\sigma = q \times r \times s$ is the probability that a cartel is discovered (q), prosecuted (r), and convicted (s).
- Leniency cases:

$$L(qrs) = \int_{\underline{\eta}}^{\overline{\eta}} \left[1 - H\left(\phi^*\left(qrs, \eta\right)\right)\right] C\left(qrs, \eta\right) G'\left(\eta\right) d\eta.$$

- Non-leniency cases:

$$R(qrs) = qrC(qrs).$$

Equilibrium

Conviction and Enforcement Rate

- Equilibrium conviction rate, $s^*(r)$:

$$s^* = p\left(\lambda L\left(qrs^*\right) + R\left(qrs^*\right)\right).$$

- Optimal enforcement (or prosecution) rate:

$$r^* = \arg\max L\left(qrs^*(r)\right) + qrs^*(r)\, C\left(qrs^*(r)\right).$$

Numerical Analysis

Parameterization

- Leniency policy
  - A firm with leniency pays θF.
  - A firm without leniency pays F.
- Policy comparison
  - No leniency: $\theta = 1$.
  - Full leniency: $\theta = 0$.
- Parameters
  - Probability a cartel is discovered: $q = .2$
  - Probability a competitive industry cartelizes: $\kappa = .05$
  - Market conditions: $H(\pi) : [1, \infty) \rightarrow [0, 1]$ is a log-normal distribution.
  - Industry types: $G(\eta) : [1.1, \infty) \rightarrow [0, 1]$ is a log-normal distribution.

Numerical Analysis
Method

1. Given $\sigma\left(=q\times r\times s\right)$, solve for equilibrium collusive behavior, $\phi^{*}\left(\sigma,\eta\right)$, for each industry type η. Collude iff $\pi\leq\phi^{*}\left(\sigma,\eta\right)$.
2. Given $\phi^{*}\left(\sigma,\eta\right)$, define the Markov process on cartel birth and death. Solve for the stationary distribution on cartels for each industry type η and aggregate over types to derive the stationary cartel rate, $C\left(\sigma\right)$.
3. Given $C\left(\sigma\right)$, solve for the equilibrium conviction rate, s^{*}:

$$s^{*}=p\left(\lambda L\left(qrs^{*}\right)+R\left(qrs^{*}\right)\right)$$

4. Given $s^{*}\left(r\right)$, solve for the value for r which maximizes the antitrust authority's objective:

$$r^{*}=\arg\max L\left(qrs^{*}\left(r\right)\right)+qrs^{*}\left(r\right)C\left(qrs^{*}\left(r\right)\right)$$

Preliminary Results

Table 1: Case of No Leniency Program ($\theta = 1$)

r	prob. of conviction	prob. of penalties	cartel rate	cartel duration
0%	.801	.000	.326	155.57
10%	.691	.014	.230	42.54
20%	.613	.025	.180	26.92
30%	.562	.034	.149	20.49
40%	.530	.042	.127	16.78
50%	.512	.051	.108	14.17
60%	.508	.061	.091	12.10
70%	.520	.073	.075	10.27
80%	.547	.088	.059	8.68
90%	.578	.104	.047	7.37
100%	.615	.123	.036	6.28

Preliminary Results

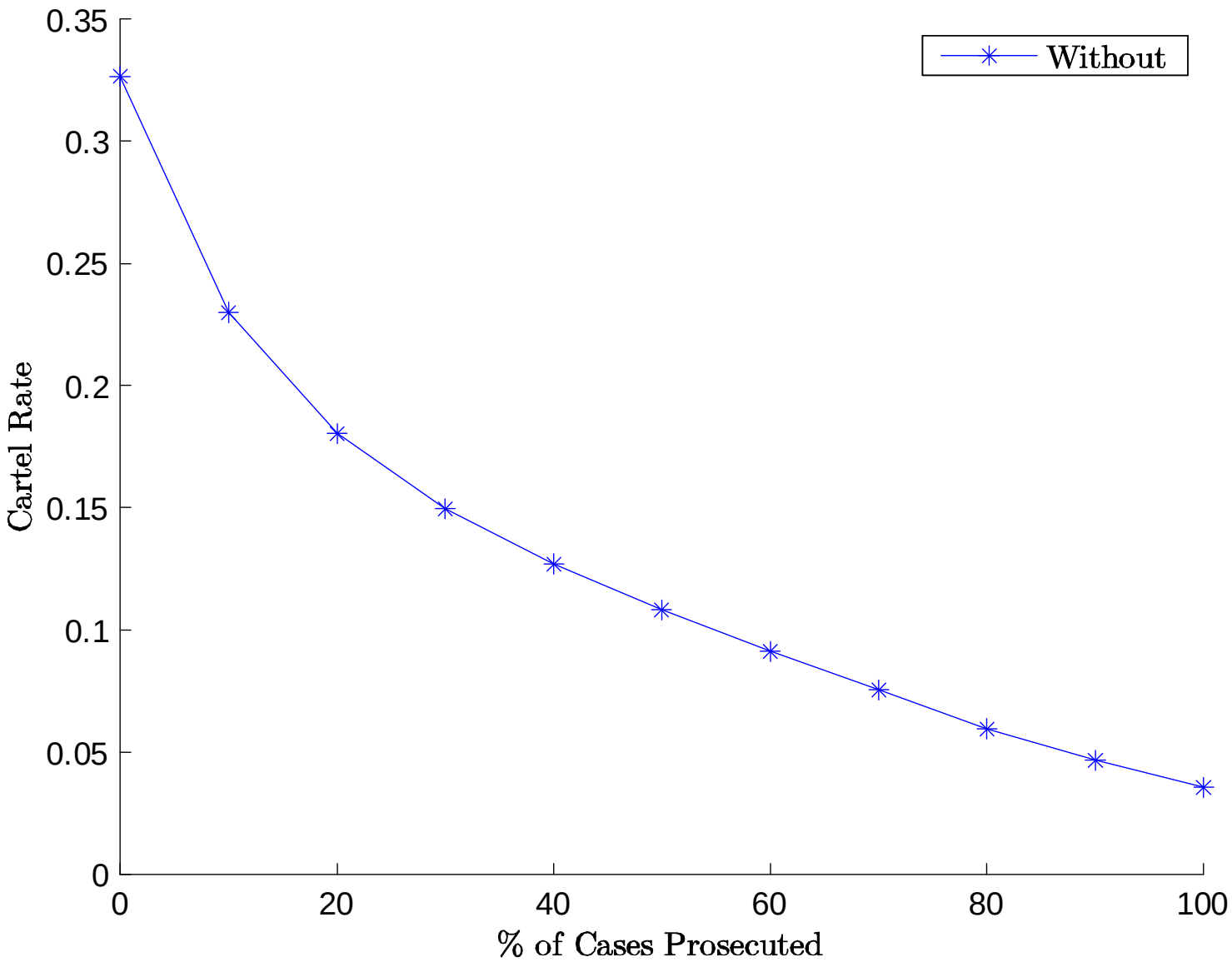
Table 2: Case of Full Leniency Program ($\theta = 0$)

r	prob. of conviction	prob. of penalties*	cartel rate	cartel duration
0%	.801	.000	.326	155.57
10%	.707	.024	.163	46.27
20%	.674	.040	.113	26.97
30%	.666	.056	.081	18.82
40%	.682	.074	.056	14.01
50%	.711	.095	.036	10.82
60%	.748	.119	.020	8.59
70%	.775	.145	.011	7.01
80%	.789	.174	.005	5.82
90%	.799	.204	.001	4.92
100%	.801	.277	.0001	3.62

*Includes both leniency and non-leniency cases.

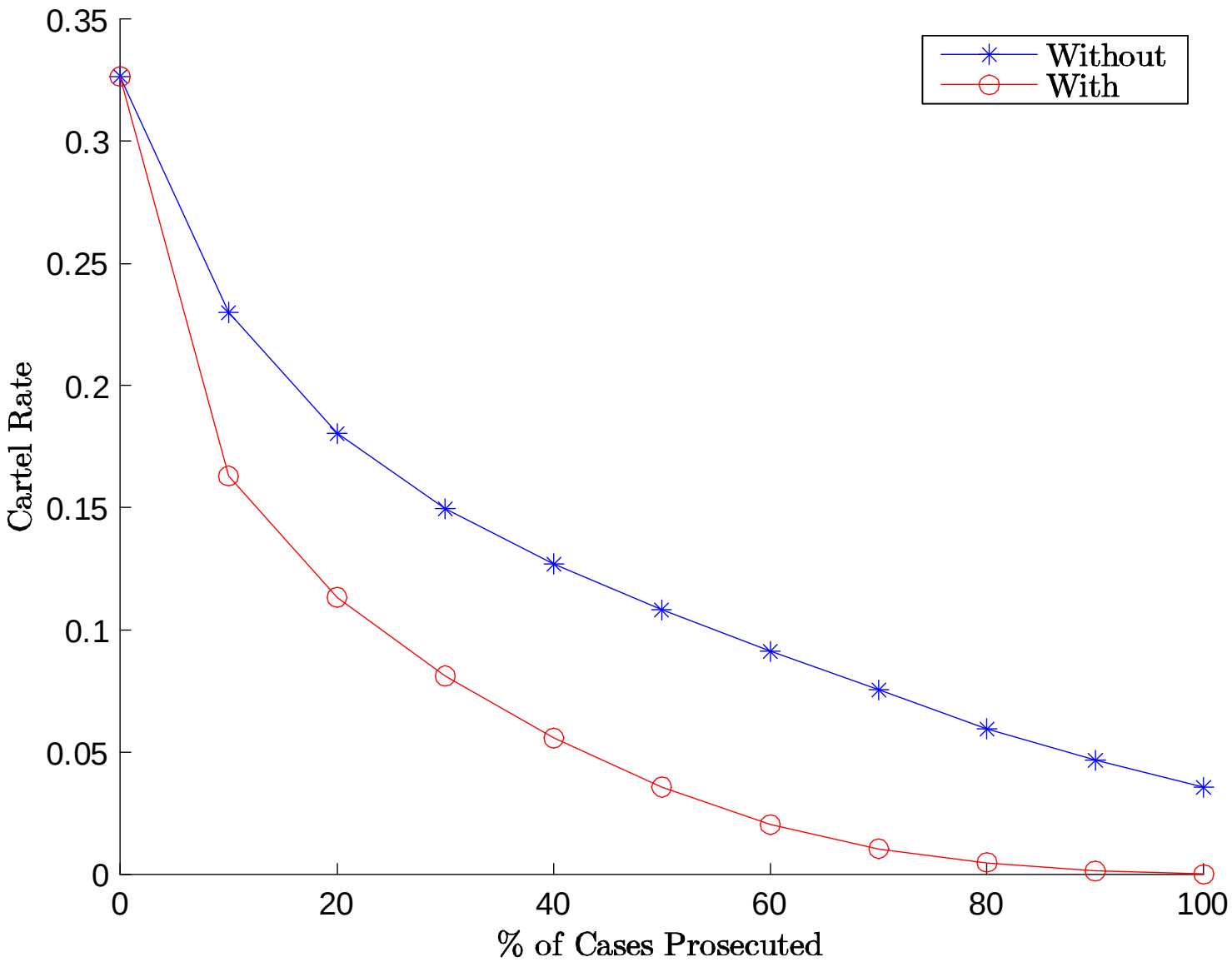
Preliminary Results

Figure 1: Effects of Prosecution Policy on the Cartel Rate ($\rho = 1.5$)



Preliminary Results

Figure 1: Effects of Prosecution Policy on the Cartel Rate ($\rho = 1.5$)

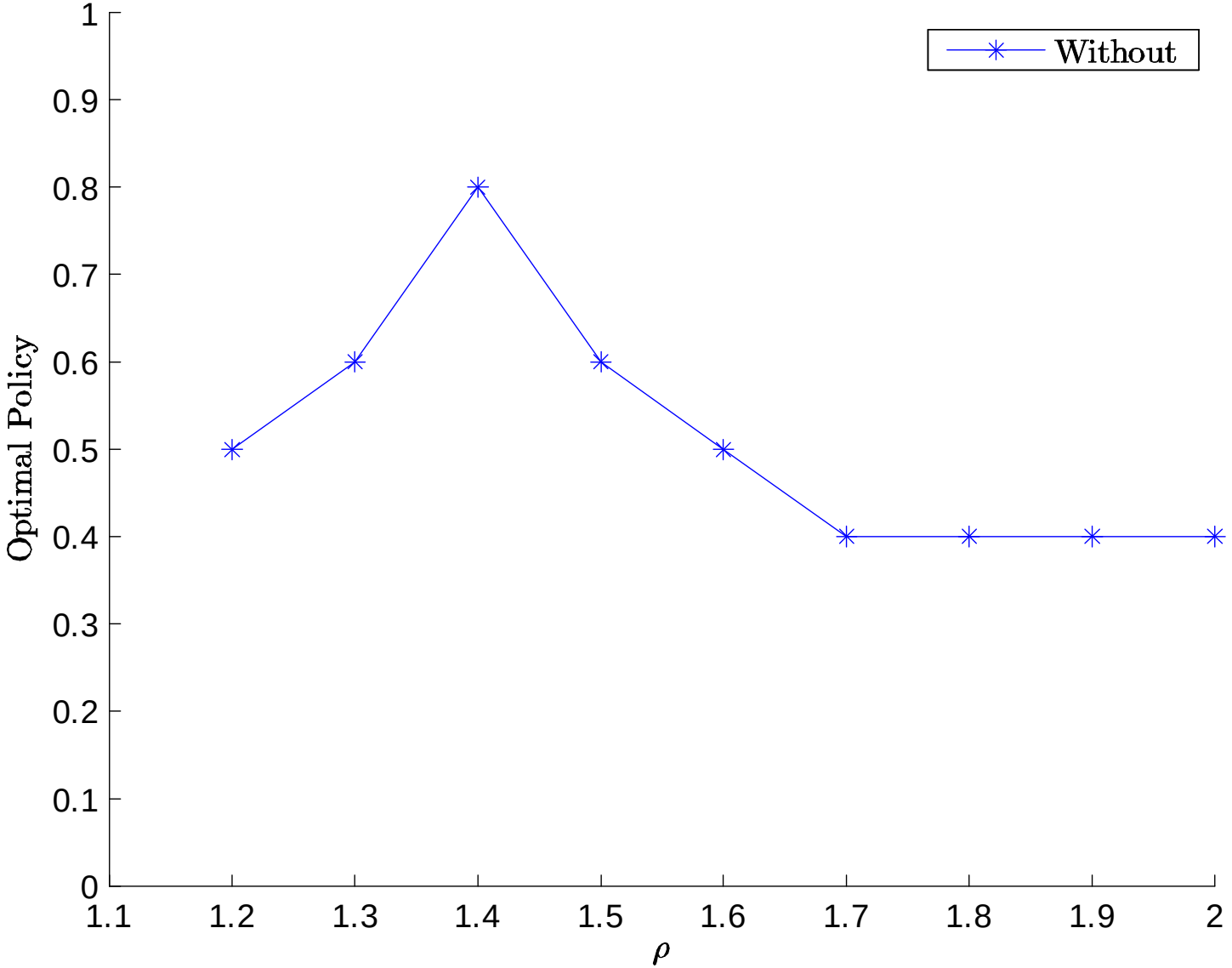


Preliminary Results

Property 1 *Given the competition authority's enforcement policy (i.e., r is fixed), the introduction of a leniency program reduces the cartel rate.*

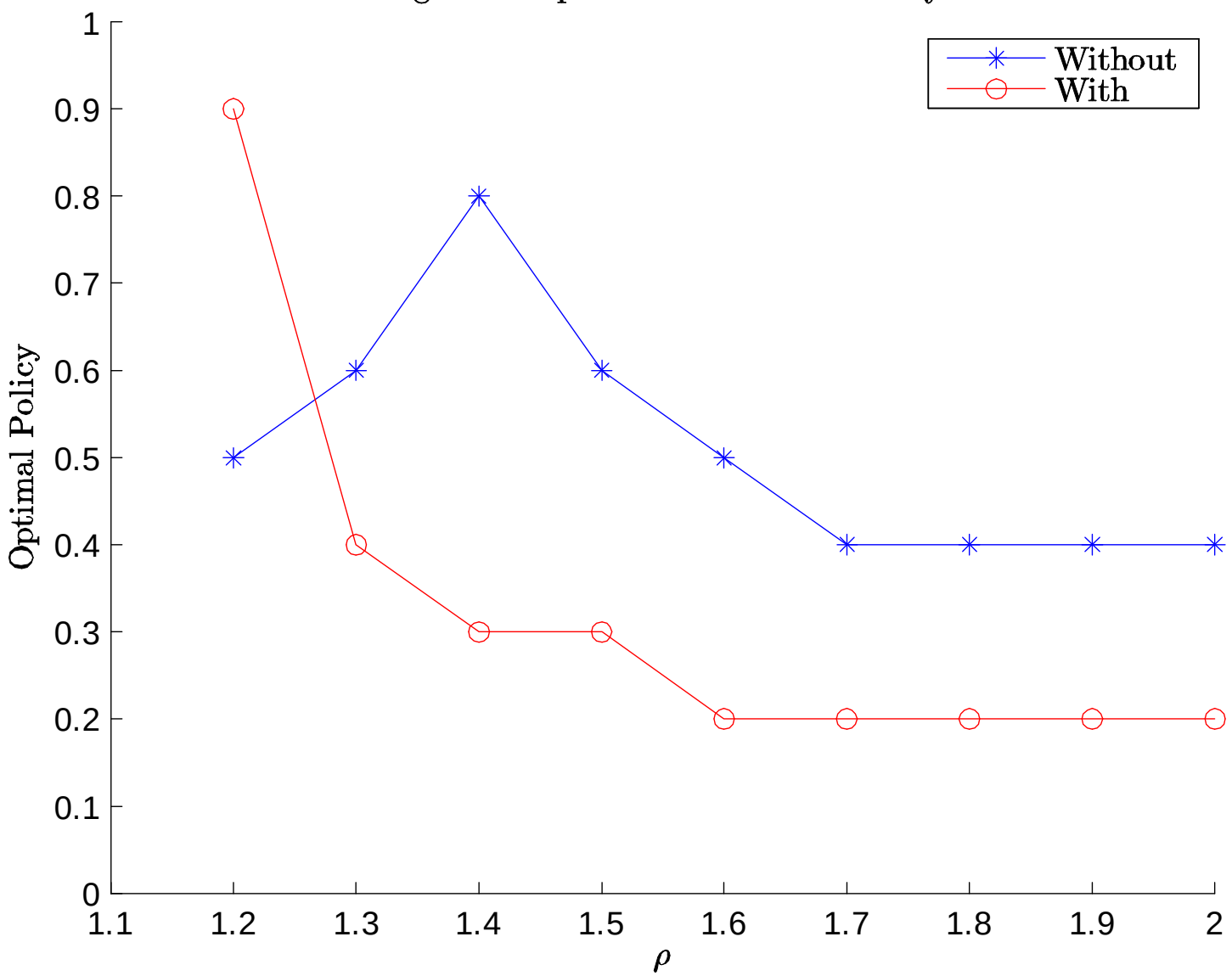
Preliminary Results

Figure 2: Optimal Prosecution Policy



Preliminary Results

Figure 2: Optimal Prosecution Policy



Preliminary Results

Property 1 Given the competition authority's enforcement policy (i.e., r is fixed), the introduction of a leniency program reduces the cartel rate.

Property 2 *Generally, the introduction of a leniency program results in the competition authority pursuing a less aggressive enforcement policy (i.e., it prosecutes a smaller fraction of non-leniency cases).*

Preliminary Results

Table 3: Effect of a Leniency Program on the Cartel Rate

ρ	r^*_{NL}	cartel rate ($r = r^*_{NL}$)		r^*_L	cartel rate ($r = r^*_L$)
		no leniency	leniency		
1.2	50%	.240	.141	90%	.133
1.3	60%	.203	.065	40%	.101
1.4	80%	.139	.005	30%	.094
1.5	60%	.091	.020	30%	.081
1.6	50%	.087	.032	20%	.107
1.7	40%	.099	.047	20%	.105
1.8	40%	.093	.044	20%	.101
1.9	40%	.091	.044	20%	.101
2.0	40%	.089	.044	20%	.100

NL = no leniency program, L = leniency program

Preliminary Results

Property 1 Given the competition authority's enforcement policy (i.e., r is fixed), the introduction of a leniency program reduces the cartel rate.

Property 2 Generally, the introduction of a leniency program results in the competition authority pursuing a less aggressive enforcement policy (i.e., it prosecutes a smaller fraction of non-leniency cases).

Property 3 *When the competition authority chooses its optimal enforcement policy, the introduction of a leniency program can either lower or raise the cartel rate (depending on the parameter values).*

Future Directions

- With a leniency program, should a competition authority's budget be increased or decreased?
- What is the impact of a leniency program that accepts applications after an investigation has started?
- What are alternative objectives for a competition authority?
- What is the optimal incentive scheme for a competition authority?