# Lecture 10: Collusion and Hidden Demand

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# Collusion with hidden demand:

- One of the funny aspects of the collusion models we've seen is that there is never any use of the "grim trigger". Firms always collude if the discount parameter is high enough, or they don't. We never see defection and punishment.
- We often see long periods of cooperation interrupted by price wars.
  - 1955 Price War in Cars: 5 percent drop in pricing of cars, 55 percent increase in sales.
  - Joint Executive Cartel: Railroad cartel for Chicago to New York railroad routes: price wars interrupted by by high prices.
- Suppose we can't see demand exactly: we can't tell who has cheated, or if cheating has happening at all: we might have a problem of detecting defections in collusion.
- Notice that these price wars are a "smoking gun" for looking for evidence of collusion: don't happen in competitive markets.

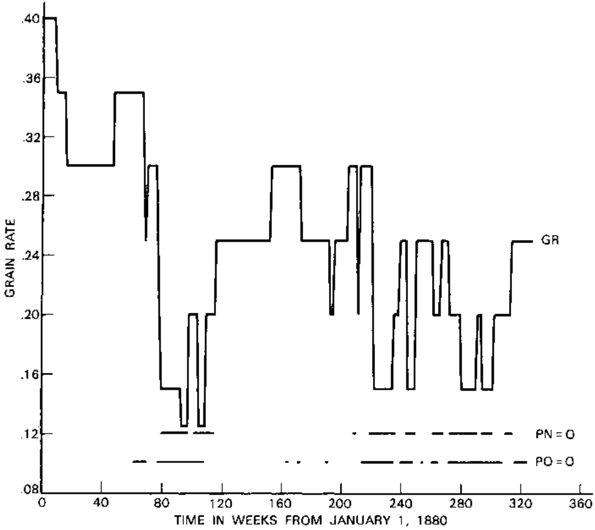
# Joint Executive Cartel

- Active in the 1880's.
- Cartel controls shipments by rail from Chicago to the Atlantic Seaboard.
- Most of the shipments are grain.
- Notice that competition comes from the Great Lakes: these are shutdown during the winter.
- Records of meetings between cartel members: used a trigger strategy to punish deviations from the Cartel.
- Entry of new railroads in 1880 and 1886: accommodated into the cartel.

# Joint Executive Cartel Ctd.

FIGURE 1

PLOT OF GR, PO, PN AS A FUNCTION OF TIME



# Model with Hidden Demand

- Bertrand Competition.
- Demand Process (Low and High Demand States):

$$D^*(p) = \begin{cases} D(p) & \text{with probability } \alpha \\ 0 & \text{with probability } 1-\alpha \end{cases}$$

- Monopoly price $p^M$, and profits $\pi^M$.
- Suppose I don't sell anything:
  - My opponent cheated and the demand state is high.
  - The demand state is low.
- There is signal extraction problem.

# Punishment and Accommodation

- Suppose I use the “Grim Trigger”: if I sell $q = 0$ at $p^M$, I assume that my cartel partner has defected, and in the punishment phase, set $p = 0$ forever.
- Then with probability $\alpha$ each period, I will enter the punishment phase, and remain there forever. So collusion unravels for sure.
- An issue here is that having a punishment phase, $T = \infty$, the number of periods that I punish for, is too much. My cartel-mates will stay in line with a $T$ that is much smaller.

# Incentive Constraint

- Suppose I use a "Forgiving Trigger": if I sell $q = 0$ at $p^M$, I assume that my cartel partner has defected, and in the punishment phase, set $p = 0$ for $T$ periods, before reverting to $p^M$ (cooperation phase).
- The incentive constraint for my partner has to do with the value of staying in the cartel versus defecting.
- Value of being in the cartel (net present value): $V^+$ (collusive phase), and $V^-$ (punishment phase). Need the difference to be large enough to keep defections from happening.

# Value Function

- $V^+$ collusive phase:

$$V^+ = \underbrace{(1-\alpha)(\frac{\pi^M}{2} + \delta V^+)}_{\text{High Demand}} + \underbrace{\alpha(\delta V^-)}_{\text{Low Demand}} \tag{1}$$

- $V^-$ punishment phase:

$$V^- = \delta^T V^+ \tag{2}$$

- Keeping firms from colluding:

$$V^+ \geq (1-\alpha)(\underbrace{\pi^M}_{\text{One Period of Defection}} + \underbrace{\delta V^-}_{\text{Punishement}}) + \alpha(\delta V^-)$$

- Let's put this stuff together

$$(1-\alpha)(\frac{\pi^M}{2}+\delta V^+)+\alpha(\delta V^-)\geq(1-\alpha)(\pi^M+\delta V^-)+\alpha(\delta V^-)$$
$$\rightarrow \frac{\pi^M}{2}+\delta V^+\geq\pi^M+\delta V^-$$
$$\delta(V^+-V^-)\geq\frac{\pi^M}{2}$$

- Rexpress the value function:

$$V^+ =(1-\alpha)(\frac{\pi^M}{2}+\delta V^+)+\alpha(\delta V^-)$$
$$V^+ =(1-\alpha)(\frac{\pi^M}{2}+\delta V^+)+\alpha(\delta^{T+1}V^+)$$
$$(1-(1-\alpha)\delta+\alpha\delta^{T+1})V^+=(1-\alpha)(\frac{\pi^M}{2})$$
$$V^+=\frac{(1-\alpha)}{(1-(1-\alpha)\delta+\alpha\delta^{T+1})}\frac{\pi^M}{2}$$

- Now let's look at the defection constraint (IC Condition):

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

- Now, we find the smallest $T$, smallest punishment phase, that keeps this IC Condition holding, since this will maximize the profits of the firms in this industry. What the smallest $T$? Because lower $T$ means a higher value $V^+$ from collusion.
- Example: $\alpha = 0.1$ and $\delta = 0.8$. Let's see this:

$$1 = 2 \times 0.90 \times 0.80 + (0.2 - 1)0.8^{T+1}$$
$$-0.44 = -0.8 \times 0.8^{T+1}$$
$$log(0.44) - log(0.8) = (T+1)log(0.8)$$
$$T = 1.69$$

So the punishment phase is for 2 periods.

# What would happen under Cournot Competition Instead?

- What are profits from collusion: $\frac{\pi^M}{2}$?
- What are profits from defection: $\pi^M$?
- What are profits from punishment phase?
- What is $V^+$?
- What is $V^-$?
- What is the IC Condition.