Entry Deterrence in the Commons

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A model with positive, but finite, costs of entry into the commons.

The threat of future entry may alter the behavior of incumbents [Hudson’s Bay Company]

Addressing common property resources and one addressing entry deterrence

Externality can be static: each firm’s activities reduce its rivals’ productivity.

Or the externality can be dynamic: industry actions today reduce all firms’ productivity tomorrow

Common property resource that initially is exploited by a single incumbent (may have market power) who faces potential entry by a rival in the future

incumbent can credibly commit to entry deterrence (future stock size & incumbent’s costs)
Introduction

- Show that the threat of entry increases the pre-entry equilibrium harvest of the incumbent over the equilibrium harvest without threat of entry.
- Even when the incumbent chooses not to deter, future competition causes the incumbent to internalize less of the future costs of depleting the stock.
- The welfare consequences of potential entry are ambiguous.
THE TWO PERIOD MODEL

- An incumbent firm is the sole harvester of a CPR in the first period but faces potential entry in the second period.
- 1st Period: the incumbent chooses a harvest level (a level of stock available in the 2nd period)
- After the initial harvest decision by the incumbent, the entrant decides whether or not to enter.
- The sink costs is $\delta F$
- Once the entrant is in the market it is identical to the incumbent and the two firms compete in the second period by simultaneously choosing levels of harvest
- Subgame perfect equilibria
- $i$: incumbent and $e$:entrant
- $S_t$ is the stock size of the resource in period $t$, $t = 1, 2$
THE TWO PERIOD MODEL

- $H_t$ equal the total harvest in period $t$
- $h_{it}$ and $h_{et}$ equal the period $t$ harvest of the incumbent and entrant respectively, $H_t = h_{it} + h_{et}. H_t \leq S_t$
- $S_{t+1} = g(S_t - H_t)$. Nonrenewable resource, $g(x) = x$, and renewable resource, $g(x) > x$, $g'(x) > 0$, for all $x$.
- The cost of harvesting the resource $C(h_{jt}, H_t, S_t) = c(H_t, S_t)h_{jt}$
- $C_H(H) \geq 0$, and $C_S(\cdot) \leq 0$
- Static cost externality $C_H(H) > 0$. Dynamic cost externality $C_S(\cdot) < 0$.
- $Q_t = q_{it} + q_{et}$ and $Q_1 \leq H_1$
THE TWO PERIOD MODEL

- The per period market inverse demand function for the sales is $P(Q_t)$, $P'(\cdot) \leq 0$
- Competitive market $P'(\cdot) = 0$

We can write the incumbent’s present value of profit as

(1) $\Pi_i = P(Q_1)q_{i1} - c(H_1, S_1)h_{i1} + \delta[P(Q_2) - c(Q, S_2)]q_{i2}$.

(2) $\Pi_e = \delta\{[P(Q_2^d(S_2)) - c(Q_2^d(S_2), S_2)]q_{e2}(S_2) - F\}$ if the firm enters;

0 otherwise.
There will exist a critical value of stock size, $\overline{S}_2$.
PROPOSITION 1. Given that $c_s < 0$, there exist values of $F$ for which the subgame perfect equilibrium outcome involves entry deterrence.

PROPOSITION 2. An incumbent wishing to deter entry will destroy some of the harvest if and only if demand is inelastic at $h_{i1}(\bar{S}_2)$. 

\[
\max_{q_{i1}, h_{i1}} P(q_{i1})q_{i1} - c(h_{i1}, S_1)h_{i1} + \delta[P(q_{i2}^m(\bar{S}_2)) - c(q_{i2}^m(\bar{S}_2), \bar{S}_2)]q_{i2}^m(\bar{S}_2)
\]

s.t. $q_{i1} \leq h_{i1}$, $\bar{S}_2 \leq \bar{S}_2$

$\bar{S}_2 = g(S_1 - h_{i1})$. 

THE TWO PERIOD MODEL

\[ (6) \quad [P(q_{i1}) - c(q_{i1}, S_1) + (P'(q_{i1}) - c_H(q_{i1}, S_1))q_{i1}] \]

\[ + \delta g' \frac{\partial q_{e2}}{\partial S_2} q_{i2}(S_2)[c_H(Q_{i2}^d(S_2), S_2) - P'(Q_{i2}^d(S_2))] \]

\[ + \delta g' c_s(Q_{i2}^d(S_2), S_2)q_{i2}^d(S_2) = 0. \]

- The first term represents marginal profit from harvest and sales in period one.
- The second term represents the change in second period profit.
- (1) A demand side effect from price changes caused by different levels of sales by the entrant and (2) a cost effect through the changes in the entrant’s harvest (static externality).
- **Proposition 3.** Given that \( C_s < 0 \), an incumbent facing entry will expand first period equilibrium harvest as compared to an incumbent that faces no threat of entry.
The incumbent facing entry will expand first period harvest and sales for two reasons:

- First, the increase in harvest costs in the second period will be partially shifted to a rival firm and will not be borne entirely by the incumbent.
- Secondly, a decrease in stock will cause the entrant to harvest and sell less in the second period.
The welfare consequences are complex

- There is a cost externality (both static and dynamic) generated by the common property resource in addition to a pricing distortion.
- Increases in production in response to the threat of entry may lower price and increase current consumer welfare.
- But may also cause rent dissipation from a static cost externality and may increase future harvest costs through stock depletion.
PROPOSITION 5. A single incumbent without threat of entry will set the socially optimal level of harvest in both periods if and only if $P'(\cdot) = 0$.

PROPOSITION 6. There exists a set of parameters under which the threat of competition must lower social welfare.

PROPOSITION 7. If $P'(\cdot) < 0$, then there exists a set of parameters under which the threat of competition must raise social welfare.
**Figure 3**

Excess harvest is privately suboptimal and second-best socially optimal.
Figure 4: The Welfare Effects of an Increase in Entry Costs