Entry Deterrence in the Commons

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Introduction

- 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 het 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, $g(x) > x$, $g'() > 0$, 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 $P'(\cdot) = 0$
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We can write the incumbent's present value of profit as

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

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

0 otherwise.

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$$(3) \qquad [P(Q_2^d(S_2)) - c(Q_2^d(S_2),\ S_2)]q_{e2}^d(S_2) \leq F.$$

- There will exist a critical value of stock size, $\overline{S}_2$
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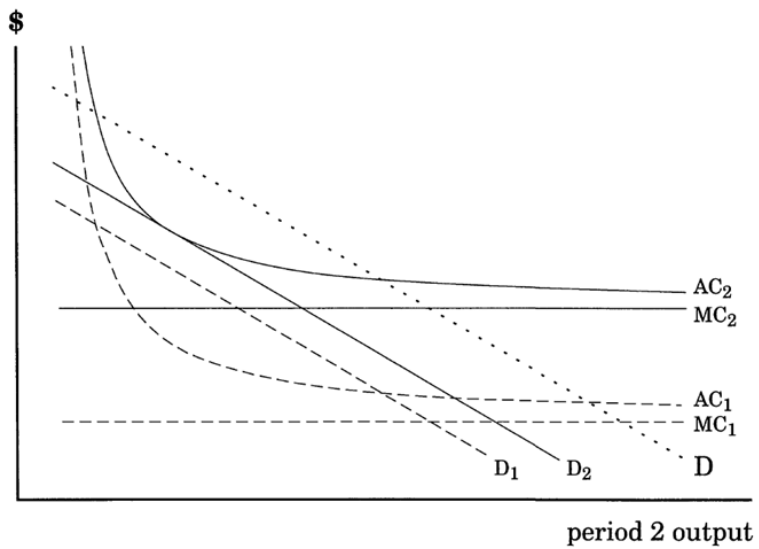

FIGURE 1

DETERRENCE BY INCREASED HARVEST: THE EFFECT ON AVERAGE COST AND RESIDUAL DEMAND

- $$(4)\quad \max_{q_{i1},h_{i1}} P(q_{i1})q_{i1} - c(h_{i1}, S_1)h_{i1} + \delta[P(q_{i2}^m(\bar{S}_2)) - c(q_{i2}^m(\bar{S}_2), \bar{S}_2)]\, q_{i2}^m(\bar{S}_2)$$

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

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

- **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 $h_{i1}(\overline{S}_2)$.

- $$(6)\quad [P(q_{i1}) - c(q_{i1}, S_1) + (P'(q_{i1}) - c_H(q_{i1}, S_1))q_{i1}]$$
$$+ \delta g' \frac{\partial q_{e2}}{\partial S_2} q_{i2}^d(S_2)[c_H(Q_2^d(S_2), S_2) - P'(Q_2^d(S_2))]$$
$$+ \delta g' c_S(Q_2^d(S_2), S_2) q_{i2}^d(S_2) = 0.$$

- *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

- $$\Omega = \int_0^{Q_1} P(x)\,dx - c(H_1, S_1)H_1 + \delta\left\{\int_0^{Q_2} P(x)\,dx - c(H_2, g(S_1 - H_1))H_2\right\}.$$

- **PROPOSITION 5.** A single incumbent without threat of entry will set the socially optimal level of harvest in both periods if and only if $P'() = 0$.
- **PROPOSITION 6.** There exists a set of parameters under which the threat of competition must lower social welfare.
- **PROPOSITION 7**. If $P'() < 0$, then there exists a set of parameters under which the threat of competition must raise social welfare

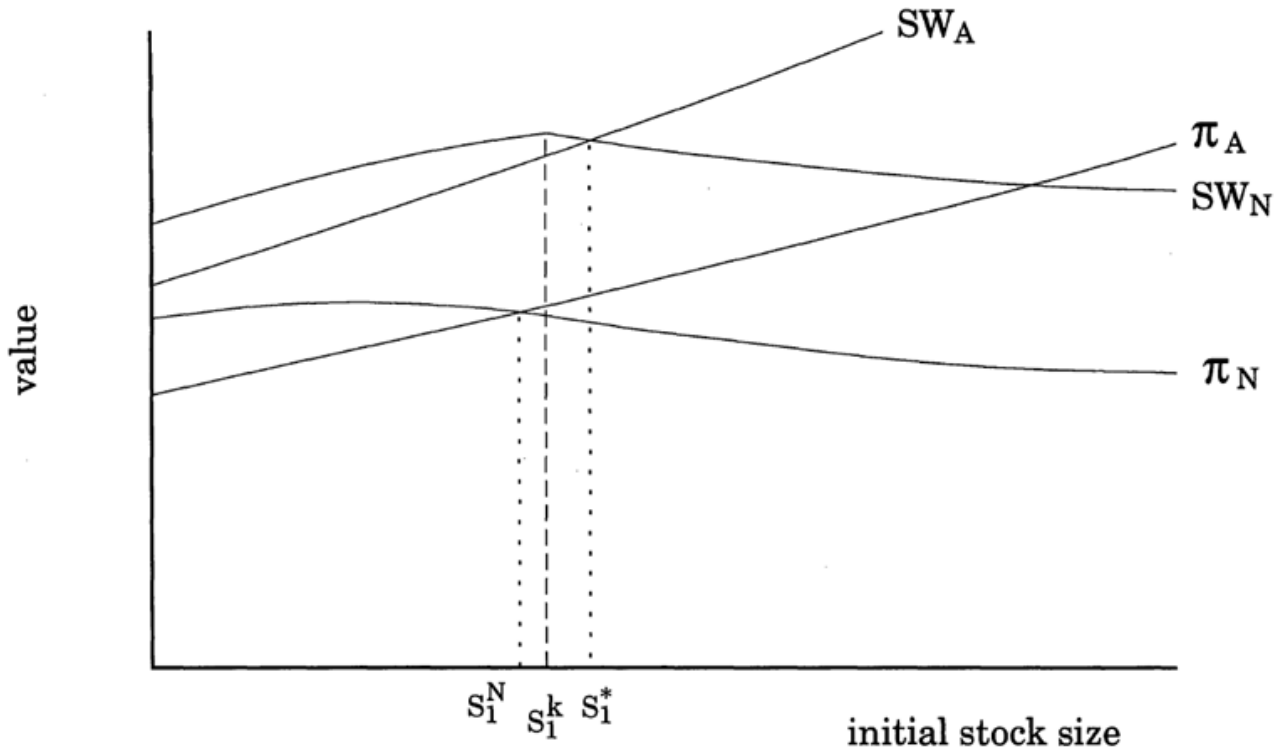

FIGURE 3

EXCESS HARVEST IS PRIVATELY SUBOPTIMAL AND SECOND-BEST SOCIALLY OPTIMAL

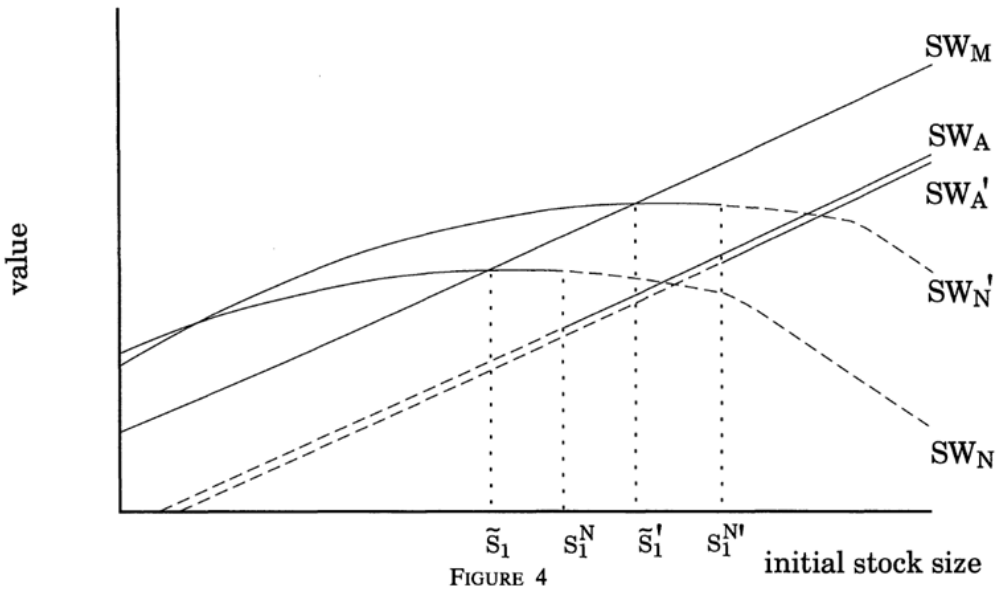

FIGURE 4

THE WELFARE EFFECTS OF AN INCREASE IN ENTRY COSTS