Firms' Strategies and Markets Entry

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Introduction

- Entrant's strategy: "Judo economics"
  - A case study
  - Exercice
- Incumbent's strategies vis-à-vis entry
  - Entry deterred
  - Entry Accomodated

Entrant's strategy: Judo Economics

In the art of "judo", a combatant uses the weight and strenght of his opponent to his own advantage.

- *Rule-based* judo strategy
- *Value-based* judo strategy

- Case study: Four short stories about small firms challengings large incumbent firms!
  1. Softsoap on the liquid soap market
  2. Red Bull on the energy drinks market
  3. UK supermarket chains on the gazoline retail
  4. Freeserve against AOL.

Judo Economics: Exercice

- Consumers have an inelastic demand of size D if $p \leq p_{max}$.
- An incumbent I has an installed capacity D and no production cost.
- An entrant E has a variable cost $c_E > 0$

1. Determine the price and profit of a monopoly I.
2. If E chooses to enter the market, he chooses both its capacity K_E and its price p_E. If E enters, I observes K_E and p_E and adapts its price denoted p_I.
    a. What is the demand for each firm with respect to p_E, p_I and K_E?
    b. Given (K_E, p_E), determine the best pricing strategy of firm I, denoted $p_I(K_E, p_E)$.
    c. Given the reaction of firm I, determine the optimal decisions (K_E, p_E) of the entrant. What is the effect of c_E on these decisions?
    d. Determine the profit of the two firms.
    e. What is the equilibrium if the incumbent can set a personalized price for each customer?

1. A monopolist I sets a price p_{max} and its profit is $p_{max}D$.
2. Entry
   a. Demand
      - If $p_I > p_E$ the firm E $D_E = K_E$ and $D_I = D - K_E$
      - If $p_I \leq p_E$, the firm I has a demand $D_I = D$ and $D_E = 0$
   b. Given (K_E, p_E), the firm I can sell at p_{max} and obtain a profit

$$p_{max}(D - K_E)$$

   The firm can also sell at p_E and obtain $p_E D$. I chooses the price that maximises its profit i.e.: p_{max} if $p_E \leq \frac{p_{max}(D-K_E)}{D}$ and p_E otherwise.
   c. The firm E can sell if and only if I chooses p_{max}. Therefore, E must set $p_E = \frac{(D-K_E)p_{max}}{D}$, that is a sufficiently low price and maximises

$$K_E(\frac{D - K_E}{D} p_{max} - c_E)$$

   which gives $K_E^* = \frac{D}{2}(1 - \frac{c_E}{p_{max}})$ and $p_E^* = \frac{p_{max}+c_E}{2}$. if $c_E = 0$, i.e; the entrant is as efficient as the incumbent, $K_E^* = \frac{D}{2}$, the two firms share the market and the price is $\frac{p_{max}}{2}$.

d. In equilibrium, profits are:

$$\Pi_I = p_{max}(D - K_E^*) = \frac{D(p_{max} + c_E)}{2}$$

$$\Pi_E = \frac{D}{p_{max}} \frac{(p_{max} - c_E)^2}{4}$$

A less efficient entrant can enter the market and realise a positive profit when facing an incumbent more efficient and with more capacity. The entrant chooses a relatively low size to make it very costly for the incumbent to go into a price war.

e. With personnalized prices, I would sell at $p_E - \epsilon$ at population K_E but at P_{max} to other consumers and entry would be always deterred.

Strategic Incumbent and entry

1. A taxonomy of incumbent's investments strategies
   - “Top-dog strategy": investment in capacity
   - “Lean and hungry look strategy": an innovation model
2. The chain store paradox : a reputation game
3. Exclusive dealing: a contracting strategy

A taxonomy of incumbent's investments strategies

- In stage 1, the incumbent chooses the level of some irreversible investment K_1.
- In stage 2, after observing K_1, E decides to enter or not. Products market decisions are taken, denoted σ_1 and σ_2 (price or quantity).
  - If E enters, σ_1 and σ_2 are chosen simultaneously, and profits are denoted $\pi_1(K_1, \sigma_1, \sigma_2)$ and $\pi_2(K_1, \sigma_1, \sigma_2)$. We assume that $\pi_2(K_1, \sigma_1, \sigma_2)$ includes entry cost if any.
    We assume that there exists a unique Nash equilibrium of this competition stage that results in $(\sigma_1^*(K_1), \sigma_2^*(K_1))$.
  - If E does not enter, the incumbent obtains $\pi_1^m(K_1, \sigma_1^m(K_1))$.
- Two strategies: Entry deterrence and Accomodation.

Entry deterrence

- K_1 is set at a level sufficient to deter entry i.e. such that:

$$\pi_2(K_1, \sigma_1^*(K_1), \sigma_2^*(K_1)) = 0$$

- To see how K_1 must be distorted, we totally differentiate π_2 with respect to K_1 :

$$\frac{d\pi_2}{dK_1} = \underbrace{\frac{\partial \pi_2}{\partial K_1}}_{\texttt{Direct Effect}} + \underbrace{\frac{\partial \pi_2}{\partial \sigma_1}\frac{\partial \sigma_1^*(K_1)}{\partial K_1}}_{\texttt{Strategic Effect}} + \underbrace{\frac{\partial \pi_2}{\partial \sigma_2}\frac{\partial \sigma_2^*(K_1)}{\partial K_1}}_{\texttt{0 Envelop theorem}}$$

  - Sign of direct effects (advertising informative ($\frac{\partial \pi_2}{\partial K_1} > 0$) or persuasive ($\frac{\partial \pi_2}{\partial K_1} < 0$), investment in capacity ($\frac{\partial \pi_2}{\partial K_1} = 0$)
  - Strategic effect : given K_1 it is a commitment for the incumbent to be tough or weak in its decision of $\sigma_1(K_1)$
  - If $\frac{d\pi_2}{dK_1} < 0$, investment makes the incumbent tough: "top dog"; If $\frac{d\pi_2}{dK_1} > 0$, investment makes the incumbent soft: "lean and hungry look".

Entry accomodation

- K_1 is set at its best accomodating level, i.e. :

$$\max_{K_1} \pi_1(K_1, \sigma_1^*(K_1), \sigma_2^*(K_1))$$

- To see how K_1 must be distorted, we totally differentiate π_1 with respect to K_1 :

$$\frac{d\pi_1}{dK_1} = \underbrace{\frac{\partial \pi_1}{\partial K_1}}_{\text{Direct Effect}} + \underbrace{\frac{\partial \pi_1}{\partial \sigma_1}\frac{\partial \sigma_1^*(K_1)}{\partial K_1}}_{\text{0 Envelop theorem}} + \underbrace{\frac{\partial \pi_1}{\partial \sigma_2}\frac{\partial \sigma_2^*(K_1)}{\partial K_1}}_{\text{Strategic Effect}}$$

- The direct effect is the "profit maximizing effect" with no effect on firm 2.
- The strategic effect:

$$Sign(\frac{\partial \pi_1}{\partial \sigma_2}\frac{\partial \sigma_2^*(K_1)}{\partial K_1}) = Sign(\frac{\partial \pi_2}{\partial \sigma_1}\frac{\partial \sigma_1^*(K_1)}{\partial K_1})xSign(\frac{d\sigma_2^*}{d\sigma_1})$$

Table: TAXONOMY

	Tough	Soft
Strategic substitutes	(D) Top Dog	(D) Lean & Hungry
$\frac{d\sigma_2^*}{d\sigma_1} < 0$	(A) Top Dog	(A) Lean & Hungry
Strategic complements	(D) Top Dog	(D) Lean & Hungry
$\frac{d\sigma_2^*}{d\sigma_1} > 0$	(A) Puppy Dog	(A) Fat Cat

- Top Dog: Overinvestment;
- Lean & Hungry: Underinvestment;
- Puppy Dog: Overinvestment for (D) and Underinvestment for (A);
- Fat Cat: Underinvestment for (D) and Overinvestment for (A).

A top dog example: Investment in capacity

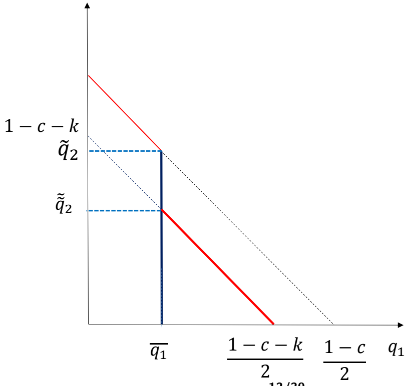
- In stage 1, an incumbent firm 1 sets its capacity $\bar{q}_1$.
- In stage 2, the entrant 2 decides to enter or not. In case of entry the two firms set additional capacity $\Delta\bar{q}_1$ and $\Delta\bar{q}_2$ respectively and produce at most $\bar{q}_1 + \Delta\bar{q}_1$ for the incumbent and $\Delta\bar{q}_2$ for the entrant.
- Products are homogeneous and the inverse demand function is $P = 1 - q_1 - q_2$.
- Entry cost : e
- k is the marginal cost of capacity.
- c the marginal cost of production.

Assume that 2 has entered. The incumbent's profit is:

$$\pi_1 = (1 - q_1 - q_2 - c)q_1 - k\Delta\bar{q}_1$$

Maximizing this function with respect to q_1 it follows that the best reaction function is:

$$q_1(q_2) = \begin{cases} \frac{1}{2}(1 - q_2 - c - k) & \text{for } q_1 > \bar{q}_1, \\ \frac{1}{2}(1 - q_2 - c) & \text{for } q_1 \leq \bar{q}_1 \end{cases}$$



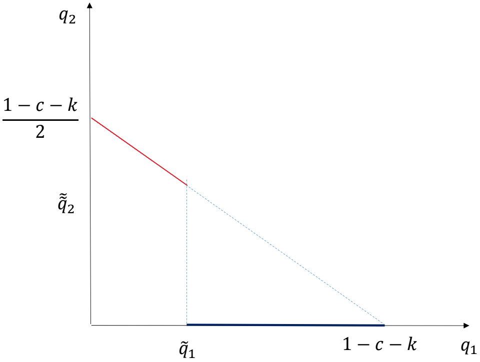
The entrant's profit is:

$$\pi_2 = (1 - q_1 - q_2 - c)q_2 - k\Delta\bar{q}_2 - e$$

Maximizing this function w.r.t.q_2, the best reaction function is:

$$q_2(q_1) = \begin{cases} \frac{1}{2}(1 - q_1 - c - k) & \text{for } q_1 < \tilde{q}_1, \\ 0 & \text{for } q_1 \geq \tilde{q}_1 \end{cases}$$

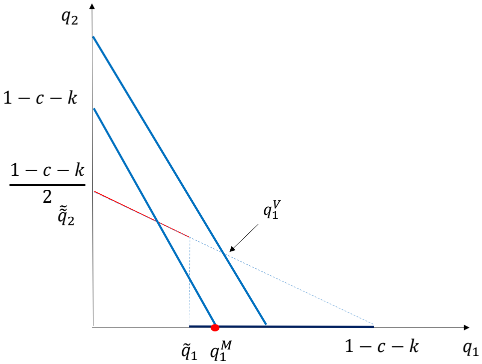
with $\tilde{q}_1 = 1 - c - k - 2\sqrt{e}$ such that $\pi_2(q_2(q_1), q_1) = 0$



4 cases to consider

1. Inevitable entry: $\tilde{q}_1 > q_1^V \Rightarrow e < e^- = \frac{1}{9}(1-c-2k)^2$. q_1^V corresponds to a Nash equilibrium between the entrant 2 and an unconstrained firm 1.

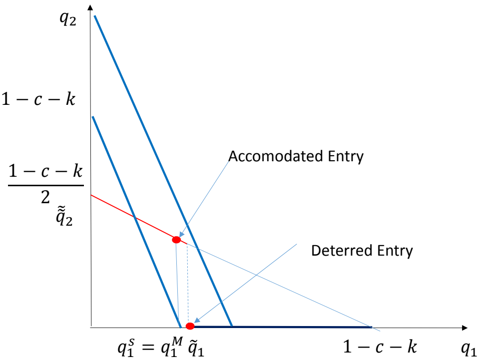
2. Blockaded entry
   - $q_1^M = \frac{1}{2}(1-c-k)$ and $q_1^M > \tilde{q}_1 \Rightarrow e > e^+ = \frac{1}{16}(1-c-k)^2$



4 cases to consider

If $q_1^M < \tilde{q}_1 < q_1^V$

3. Deterred entry $q_1 = \tilde{q}_1$
4. Accomodated entry
   - $q_1^S = \frac{1}{2}(1 - c - k) = q_1^M < \tilde{q}_1$



If $q_1^M < \tilde{q}_1 < q_1^V$

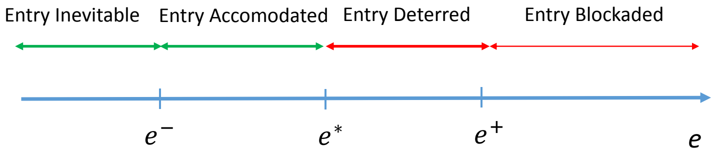
- The profit obtained in case of accomodation is:

$$\max_{q_1^s} \pi_1(q_1^s, q_2(q_1^s)) = \frac{1}{2}(1-c-k-q_1^S)q_1^S \Rightarrow \frac{1}{8}(1-c-k)^2$$

- To deter entry, the incumbent must install a larger capacity $\tilde{q}_1$ and its profit is:

$$\pi_1^D = (1-c-k-\tilde{q}_1)\tilde{q}_1 = 2\sqrt{e}(1-c-k-2\sqrt{e})$$

It is possible to show that $\pi_1^D > \pi_1^A$ if $e > e^* = \frac{(2-\sqrt{2})^2(1-c-k)^2}{64}$.



Remember

This investment capacity model illustrates the TOP DOG strategy for Deterrence:

- Deterrence $\rightarrow q_1 = \tilde{q}_1$ which corresponds to a capacity expansion above the monopoly level.
- Accomodation $\rightarrow q_1^S = q_1^M$ which corresponds to a capacity expansion above the competition level.

Lean and Hungry look: An innovation model

Assumptions

- **Period 1**: Firm 1 can make an investment K_1 to reduce its marginal cost $c(K_1)$ and obtains a corresponding gross profit $\pi^M(c(K_1))$ which strictly increases in K_1 in period 1.
- **Period 2** Firm 2 enters and 1 and 2 compete in $R\&D$ by investing $\rho_i^2/2$ they innovate with probability ρ_i. Innovation is drastic and therefore the table of gains is as follows:

Table: Gains in period2

Innovation probabilities	ρ_2	$(1-\rho_2)$
ρ_1	$(0,0)$	$(\pi^M(c),0)$
$(1-\rho_1)$	$(0,\pi^M(c))$	$(\pi^M(c(K1),0)$

Period 2: Firms 1 and 2 choose their $R\&D$ levels ρ_1 and ρ_2 to maximize their expected profit:

$$\begin{cases} \pi_1 = \rho_1(1-\rho_2)\pi^M(c) + (1-\rho_1)(1-\rho_2)\pi^M(c(K1)) - \rho_1^2/2, \\ \pi_2 = \rho_2(1-\rho_1)\pi^M(c) - \rho_2^2/2 \end{cases}$$

FOCS are:

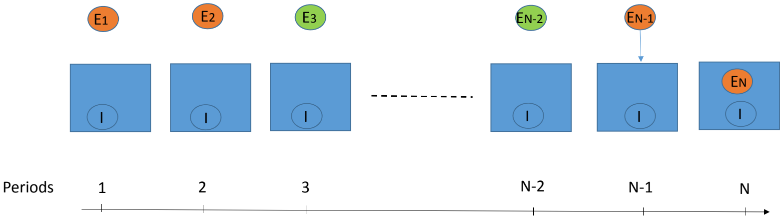
$$\begin{cases} (1-\rho_2)(\pi^M(c) - \pi^M(c(K1)) = \rho_1, \\ (1-\rho_1)\pi^M(c) = \rho_2 \end{cases}$$

Period 1: It is immediate that $R\&D$ investments are strategic substitutes and that the stronger $K1$ the higher $\pi^M(c(K1))$ and therefore the lower the incentive to invest in the second period. (Arrow replacement effect)

Lean and Hungry look

In period 1 firm 1 underinvests in K_1 to commit itself to being more aggressive in its $R\&D$ race in period 2. This is the best strategy both to deter entry or accomodate.

The chain store paradox



- An incumbent firm I which owns stores in N markets.
- Entry takes place sequentially
  1. E_1 enters or not in period 1 on a first market.
  2. Another E_2 enters or not on a second market in period 2.
  3. ...
  4. The last E_N enters or not on market N in period N.

- Without entry the gain of I in each store is: a
- In case of entry, gains of firm I are:

Table: Payoffs in case of entry

Choice of I	Fight	Accomodate
Payoffs (I,E)	(-1,-1)	(0,b)

- In period N, if E_N enters, the best choice for player I is to accomodate. Long run consideration do not come in, since after period N the game is over.
- In period $N-1$, a fight in period $N-1$ would not deter player N to enter, therefore in $N-1$ the best strategy for I is to accomodate.
- By induction theory, the unique sequential equilibrium is such that in each period t, E_t enters and I
- Selten Paradox (1978): Incomplete information framework, i.e. I can be of type tough or weak with a probability => a reputation issue!!

The chain store game with reputation

- Same framework except that I can be tough (on all markets) with probability (p) and weak with proba (1-p)
- Each E can be tough with probability (q) and weak with proba (1-q)
- Tough I always fights ; Tough E always enters.

Table: Payoffs in case of entry

Choice of a weak I	Fight	Accomodate
Payoffs (I,E)	(-1,-1)	(0,b)

- We solve the game backward.

The case $N = 1$

It is a one period game $\Rightarrow$ **No reputation effect**.

- A tough I fights and a weak I accomodates.
- p is the probability that the incumbent is tough.
- When the expected gain of a weak E is $-p + (1-p)b > 0$, i.e. $p < \underline{p} = \frac{b}{b+1}$, E enters. Otherwise, E stays out.
- If $p < \underline{p} = \frac{b}{b+1}$, I gains 0. If $p \geq \underline{p} = \frac{b}{b+1}$, I gains a.

The case $N = 2$

It is a two-periods game $\Rightarrow$ **A reputation effect may take place**.

- A tough I fights.
- What is the strategy for a weak I?
  - If it accomodates in period 1, in period 2, E_2 knows that I is weak and always enters. The expected gain of a weak I is 0.
  - If it fights in period 1, and if then in period 2 E_2 believes that I is tough and stays out, the expected gain of a weak I is $-1 + \delta(1-q)a$

If $-1 + \delta(1-q)a < 0$, there is **No reputation strategy** for a weak I.

In period 1, a weak E_1 enters if $p < \underline{p} = \frac{b}{b+1}$ and stays out otherwise. If I accomodates in period 1, a weak E_2 enters. If I fights in period 1, a weak E_2 stays out.

If $-1 + \delta(1-q)a > 0$, **A reputation strategy** for a weak I may arise.

A weak I wants to fight in period 1 with a positive probability to deter entry in period 2.

We focus directly on the interesting case in which E_2 is a weak entrant.

- If $p > \underline{p}$,
  - If I does not fight in period 1, a weak E_2 knows for sure that I is weak (and will accomodate) and always enters.
  - If I fights in period 1, the revised probability that I is tough is at least $\underline{p}$ and a weak E_2 stays out.
  - Because fighting in period 1 always deter entry in period 2, a weak I always fights in period 1 and earns the expected profit : $(1-q)a - q + \delta(1-q)a$

- If $p < \underline{p}$, the weak I must fight with a positive probability β.
  - E_2 then revises its beliefs accordingly and now believes that I is tough with a higher probability:

$$p(tough/fight) = \frac{p}{p + \beta(1-p)} > p.$$

  - In period 2, still E_2 knows that a weak I accomodates and a tough I fights (last period)! But E_2 takes into account the revised probability that I is tough $p(tough/fight)$. E_2 is indifferent between entering or not if: $-\frac{p}{p+\beta(1-p)} + (1 - \frac{p}{p+\beta(1-p)})b = 0$, i.e. if $\beta = \frac{p}{(1-p)b}$.
  - Going backward to period 1, E_1 knows that I plays this reputation effect to deter entry in period 2 and therefore anticipates that I fights with a probability $p + (1-p)\beta = p\frac{(1+b)}{b}$.
  - A weak E_1 prefers to stay out if $-p\frac{(1+b)}{b} + (1 - p\frac{(1+b)}{b})b < 0$, i.e. if $p > (\frac{b}{1+b})^2$.
  - if E_1 enters the expected profit of a weak I is $-\beta + \delta a(1-q)$

Conclusion

Because there are at least two-periods, E_1 anticipates that I has an incentive to create a reputation of being tough in the first period to deter entry in the second period, and therefore E_1 is less likely to enter also in period 1.

The generalization to any N is possible

- Assuming that $N = 3$, we now find that E_1 enters if and only if $p < (\frac{b}{1+b})^3$ and so on for $N = T$ for $p < (\frac{b}{1+b})^T$.

Exercice: Exclusive dealing to deter entry

M sells a good to A who is willing to pay at most $p = 1$ for one unit. The unit cost of M is $c_M = \frac{1}{2}$. An entrant, E can produce the same good at an unknown unit cost c_E uniformly distributed over $[0, 1]$.

- In $t = 0$, A and M sign a contract or not;
- In $t = 1$, E observes the contract, learns its unit cost c_E and chooses to enter or not.
- In $t = 3$, A decides where to buy.

1. Without contract, the competition is a la Bertrand.
   a. Determine the equilibrium and the probability ϕ of entry.
   b. What are the expected profits?
2. M offers a take-it-or-leave-it contract (P, P_0) where P is the price that A must pay if he chooses to buy the good from M and P_0 is the penalty A must pay to M if he buys from E.
   a. Given (P, P_0), under which conditions does E enter?
   b. What is the profit of A if he accepts a contract (P, P_0) ?
   c. Determine the optimal contract $(P, P0)$ for M.
   d. What are the expected profits under this contract? Comment!

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