Industrial Organization 07

Strategic Behaviors, Entry, Exit

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Outline

- Notion of entry barrier
 - Legal entry barriers
 - Structural entry barriers
 - Strategic entry barriers
- Structural entry barriers and the relation between concentration and market size
- Strategic entry barriers and the notion of sunk costs
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Heterogeneity of Profit Margins

We observe a a high heterogeneity of the profit margins by sectors.

For examples, Bain (1951) provides the profits margin for different sectors for the years 1935-1936:

- Cigarettes: 14.4%
- Cement: 5.4%
- Leather: 0.8%
- Dressmaking: 16%
- Aeronautics: 20.8%
- Typewriter: 15.8%
- ...

Entry Barriers

Why are profit margins so different from a sector to another?

Because it is more difficult to enter some markets rather than other?

Bain definition (1956) of entry barriers

It is what allow firms to make supranormal profit without risking entry.

Different types of entry barriers:

- Legal barriers
- Structural barriers
- Strategic barriers

Legal Entry Barriers

The Government can create legal entry barriers:

- Authorizations
- Licenses
- Patents

Example: the taxi licenses

- Licences with strict quotas
- Average value of a license around 50,000 euros in France
- 180,000 euros in Paris, 400,000 euros in Orly and Nice

 \rightarrow Attali report (2008): "Freely grant, following a two year attribution process, a nontransferable license to all enquirers registered at the end of 2007."

Structural Entry Barriers

Favorable elements to entry barriers in the market structure:

- Economies of scale
- Absolute cost advantages
- Product differentiation
- The needs of capital

Bain (1956) suggests also that active firms may modify their behavior when they face a threat of entry.

Strategic Entry Barriers

Bain identifies three types of reaction to an entry threat:

blockaded entry

Active firms behave as if there were no threat of entry.

Deterred entry

The entry cannot be blocked. Active firms modify their behavior to prevent competitors' entry.

 \rightarrow Strategic entry barriers

Accommodated entry

Active firms find it more profitable to let competitors enter rather than implementing entry barriers (and modify their behavior to account for entry).

Examples of Reaction to Competitors' Entry

The traditional air companies' reaction to the entry of low-cost companies:

- EasyJet, low-cost company launched in 1995, with the London-Lutton airport as hub
- In reaction to its entry on the route London-Amsterdam, KLM (40% of the route) aligned its prices on the ones of easyJet
- In 1997, British Airways launched its own low-cost company, "Go".
- The subsidiary Go had for objective to directly compete with low-cost companies: it should "quickly become a favorite with the budget traveler" (British Airways CEO, Bob Ayling).
- Finally bought in may 2002 by easyJet!

\rightarrow The reaction of active firms can widely vary.

Two Types of Strategic Entry Barriers

Some strategies will increase the fixed cost of entry for potential entrants:

- Learning effects
- Advertising expenses
- R&D spending
- ...

Other strategies will affect the type of behavior in case of entry and therefore the (gross) expected profit.

- Excess capacity
- Reputation of being a "tough" competitor

• ...

Market Size and Market Structure

- Let's assume a sector with *n* firms
- Cost function: $C = F + cq_i \rightarrow$ economies of scale: structural entry barriers
- The demand is Q = (a P)S
- *S* is a measure of the market size
- Firms compete à la Cournot (competition in quantity)
- We can show that the equilibrium profit of a firm from the oligopoly is

$$\pi(n) = S\left(\frac{a-c}{n+1}\right)^2 - F.$$

At the equilibrium with free entry, we have

$$n^{\star} = (a-c)\sqrt{\frac{S}{F}} - 1$$

Market Size and Market Structure

We have

$$n^{\star} = (a-c) \sqrt{\frac{S}{F}} - 1$$

Relation between concentration and market size

The number of active firms at the equilibrium varies less than proportionally with the market size.

For example, when we compare the same industries in France, Germany and Belgium, we find that the concentration coefficients C4 are:

- Comparable in France and in Germany
- More important in Belgium than in France

Market Size and Market Structure



FIGURE 14.1 INDUSTRY CONCENTRATION IN FRANCE AND IN GERMANY. 173



Source: Cabral (2000).

Entry Costs and Market Structure

We have

$$n^{\star} = (a-c)\sqrt{\frac{S}{F}} - 1$$

Relation with the Minimum Efficient Scale (MES)?

MES=smaller level of output such as the cost is minimised.

If we define more broadly the MES, such as the average cost equals *d*, then

$$MES = \frac{F}{d-c}$$

Therefore, the number of active firms decreases when the MES increases.

Entry Costs and Market Structure

Examples of MES (Source: Scherer and Ross, 1990):

Industrie	Minimum Efficient Scale	% demande US 1967	% augmentation du coût pour un tiers de la
			MES
Cigarettes	33 milliards de	6,6	2,2
	cigarettes par an		
Ciment	Capacité de 7 millions	1,7	26
	de barils par an		
Réfrigérateurs	800.000 unités par an	14,1	6,5
Chaussures en cuir	1 million de paires par	0,2	1,5
	an		
Batteries automobiles	1 million d'unités par	1,9	4,6
	an		

DuPont and the Titanium Dioxide

- The titanium dioxide: a pigment used to make paint, paper...
- In 1970, 7 firms in the industry: DuPont and 6 smaller firms
- DuPont used a different input from its competitors
- In 1970, a high increase in the input price of its competitors gave an important cost advantage to DuPont (lower cost of 44% in 1972)
- DuPont decided to use this competitive advantage to discourage the development (or entry) of its competitors **by increasing its production capacities**
- DuPont market share increased from 30% in 1972 to 55-60% at the end of the 70s
- In 1985, 5 of DuPont competitors had left the market

A Model of Strategic Entry Barriers

Stackelberg model (1934):

- Two firms: firm 1 (active firm) and firm 2 (potential entrant)
- Firm 1 chooses a level of "capital" (capacity, quantity) K₁
- Firm 2 observes K₁ and chooses its level of capital, K₂
- We assume that profits are given by

$$\Pi^1(K_1, K_2) = K_1(1 - K_1 - K_2)$$

and

$$\Pi^2(K_1, K_2) = K_2(1 - K_1 - K_2)$$

We have $\Pi_j^i < 0$ and $\Pi_{ij}^i < 0$.

We focus on the incentive for firm 1 to prevent firm 2 from entering the market.

Without Entry Fixed Cost

If firm 1 chooses a capital K_1 , the best response of firm 2 consists in choosing

$$K_2 = R_2(K_1) = \frac{1 - K_1}{2}$$

so firm 1 maximizes

$$\Pi^1 = K_1 \left(1 - K_1 - \frac{1 - K_1}{2} \right)$$

Nash Equilibrium

We have: $K_1^{\star} = 1/2$, $K_2^{\star} = 1/4$, $\Pi_1^{\star} = 1/8$ and $\Pi_2^{\star} = 1/16$.

Without Entry Fixed Cost

Comparison of a sequential game equilibrium (Stackelberg) and a simultaneous game equilibrium (Cournot)

Sequential game

We have: $K_1^{\star} = 1/2$, $K_2^{\star} = 1/4$, $\Pi_1^{\star} = 1/8$ and $\P_2^{\star} = 1/16$.

vs.

Simultaneous game

We have: $K_1^{\star} = 1/3$, $K_2^{\star} = 1/3$, $\Pi_1^{\star} = 1/9$ and $\Pi_2^{\star} = 1/9$.

How can we interpret firm 1's strategy in the sequential game?

Importance of Commitment

In the sequential game, after firm 2 has chosen its level of capital ($K_2 = 1/4$), firms 1 would benefit from reducing its own capacity!

$$R_1(1/4) = \frac{1-1/4}{2} = \frac{3}{8} < 1/2.$$

 \rightarrow If firm 1 could reduce its level of capital, it will do it.

But expecting this reaction, firm 2 would choose to increase its level of capital.

We talk about commitment and irreversible investment. Examples: "to burn bridges".

Here: the dissuation by excess capacity is credible if the costs of capacity are high and sunk.

Optimal Reaction to an Entry Threat

If we introduce a fixed cost of entry *f*, the entrant profit becomes:

$$\Pi^{2}(K_{1}, K_{2}) = \begin{cases} K_{2}(1 - K_{1} - K_{2}) - f & \text{si } K_{2} > 0\\ 0 & \text{si } K_{2} = 0 \end{cases}$$

If f < 1/16 and if firms 1 and 2 choose the same levels of capacity as in the sequential game, firm 2 enters:

$$\Pi^2\left(\frac{1}{2},\frac{1}{4}\right) = \frac{1}{16} - f > 0$$

Optimal Reaction to an Entry Threat

But firms 1 can have incentives to increase its level of capacity above 1/2 to prevent firm 2 from entering.

For this, firm 1 should choose K_1 such as

$$\max_{K_2} K_2 (1 - K_1 - K_2) - f \le 0$$

with

$$K_1 \ge K_1^d(f) = 1 - 2\sqrt{f} > 1/2$$

 \rightarrow Firm 1 could raise its level of capital to dissuade firm 2 to enter.

Optimal Reaction to an Entry Threat

If $K_1^d(f) \le K_1^m = 1/2$, we say that entry is blockaded (this is the case if f > 1/16).

If $K_1^d(f) > K_1^m$, entry is either deterred, or accommodated.

 \rightarrow Firm 1 chooses the strategy that gives it the highest profit.

There is entry deterrence if
$$f > \frac{1}{8} \left(1 - \frac{1}{\sqrt{2}} \right)^2$$
.

If f is sufficiently low, it is more profitable to let the competitor enter rather than preventing it from entering.

Different Strategies of Entry Deterrence

Different strategies to deter competitors' entry:

- Excess capacity
- Predation
- Limit price
- Increase of competitors costs
- Creation of switching costs
- Tying practices
- Long-term contracts with customers
- ...

Different Strategies of Entry Deterrence

Survey on product managers in 1988: 52% have declared that entry deterrence strategies were as or more important as production decisions or marketing strategies.

Ranking of product dissuasion strategies for product managers:

- Hide the profits
- 2 Take all market niches
- Advertising
- Patents (R&D)
- Seputation
- Strategies of limit prices
- Second Excess production capacities

Source: Smiley, 1988, "Empirical Evidence on Strategic Entry Deterrence".

Different Strategies of Entry Deterrence

How to classify these entry deterrence strategies? Which strategy to use for which case?

In case of a threat of entry, is it better to over- or under-invest in capacity, R&D, publicity ?

 \rightarrow For an active firm, the strategy to use to prevent or accommodate a competitor entry depends on the competitor's reaction to this strategy.

 \rightarrow Notion of strategic complements or substitutes.

Strategic Complements or Substituts

Strategies strategic substitutes

If I use my strategy more intensely, my competitor will use it its strategy less intensely.

Examples: Quantity choice in Cournot (if I increase my output, my competitor decreases its output).

Strategies Strategic Complements

If I use my strategy more intensely, my competitor will also use it its strategy more intensely.

Examples: prices choice in Bertrand (if I increase my price, my competitor also increases its price).

A Taxonomy

Let's consider the following model:

- Two firms: firm 1 (an active firm) and firm 2 (a potential entrant)
- In the first stage, firm 1 chooses an action *K*₁
- Firm 2 observes K₁ and decides whether to enter
- In case of entry, at stage 2, firms compete by choosing actions *x*₁ and *x*₂

Without entry

 $\Pi_1 = \Pi_1^m(K_1, x_1^m(K_1))$ and $\Pi_2 = 0$.

With entry

$$\Pi_1 = \Pi_1(K_1, x_1, x_2)$$
 and $\Pi_2 = \Pi_2(K_1, x_1, x_2)$.

A Taxonomy

We denote $x_1^*(K_1)$ and $x_2^*(K_1)$ the actions' equilibrium payoffs at stage 2.

We consider as possible solutions:

- Entry deterrence
- Entry accommodation

and ignore the possibility of blockaded entry.

Entry Deterrence

Which investment K_1 firm 1 should make to exclude firm 2?

We can ignore the effect of K_1 on Π_2 over the second period (envelope theorem):

$$\frac{\partial \Pi_2}{\partial x_2} = 0$$

therefore

$$\frac{d\Pi_2}{dK_1} = \underbrace{\frac{\partial\Pi_2}{\partial K_1}}_{\text{Direct effect}} + \underbrace{\frac{\partial\Pi_2}{\partial x_1}\frac{dx_1^*}{dK_1}}_{\text{Strategic effect}} + \underbrace{\frac{\partial\Pi_2}{\partial x_2}\frac{dx_2^*}{dK_1}}_{=0}$$

Entry Deterrence

Two possibilities:

- The investment makes firm 1 *tougher* if $d\Pi_2/dK_1 < 0$
- The investment makes firm 1 *softer* if $d\Pi_2/dK_1 > 0$

Fudenberg and Tirole terminology

- Invest more to deter entry: top dog (ex: excess capacity)
- Invest less to deter entry: lean and hungry look (ex: decrease the number of captive customers)

Entry Accommodation

Which investment K_1 firm 1 should make if it decides to let firm 2 enter?

As in the previous case, we have:

$$\frac{d\Pi_1}{dK_1} = \underbrace{\frac{\partial\Pi_1}{\partial K_1}}_{\text{Direct effect}} + \underbrace{\frac{\partial\Pi_1}{\partial x_2}\frac{dx_2^*}{dK_1}}_{\text{Strategic effect}} + \underbrace{\frac{\partial\Pi_1}{\partial x_1}\frac{dx_1^*}{dK_1}}_{=0}$$

If we ignore the direct effect, firm 1 should increase K_1 if the strategic effect is positive and decrease K_1 otherwise.

We can show that the sign of the strategic effect is equal to:

sign(deterrence strategic effect) x sign(slope of firm 2's best response function)

The Taxonomy

Entry deterrence

- If the investment makes firm 1 tougher: top dog
- If the investment makes firm 1 softer: lean and hungry look

Entry accommodation

- If period 2 strategies are strategic substitutes: same strategies as for deterrence
- If period 2 strategies are strategic complements: puppy dog for "tough" and fat cat for "soft"

The Taxonomy

	L'investissement rend la firme 1		
	Fort	Conciliant	
Compléments stratégiques	A Puppy dog Top D dog	A Fat cat Lean and hungry D look	
Substituts stratégiques	A et D Substituts tratégiques Top Dog		

The Taxonomy

Examples: In 1982, Philips should decide to establish CD pressing factory and of the size of this factory. Philips fears Sony's reaction.

Puppy Dog: Don't enter and Sony won't enter (The investment will make us tougher and Sony will react TOUGHER).

Top Dog: Enter by building a massive factory, Sony will stay out of the market. Commitment to be TOUGH to make its rival SOFT.

Fat Cat: Enter by building a small factory, Sony won't feel threatened. Commitment to be SOFT to also make its rival SOFT.

Lean and Hungry Look: Stay out of the market. But the commitment to be SOFT makes the rival TOUGHER.

Preemption

Preemption

Preemption

Strategy consisting in getting ahead of its potential competitors (on new markets, new technologies...) to maintain its dominant position.

To preempt the retail high speed broadband market for a incumbent telecommunication operator?

To preempt the web browser market for a software editor?

Is Preemption Rational?

A model:

- An active firm (1) is in monopoly to produce product A
- A new market (product B): entry with an entry cost F
- Products A and B are imperfect substitutes
- A potential entrant, firm 2
- Firm 1 chooses first to enter or not on market B
- Firm 2 observes firm 1's choice and then decides whether to enter

Hypotheses:

- Market profitable only for one of the two firms
- It is profitable for firm B to enter alone in market 2
- Efficiency effect: monopoly profit in A and B ≥ duopoly profits in A and B

Is Preemption Rational?

Monopoly persistence

Firm 1 preempts the new market and firm 2 stays outside.

Comparison for the active firm:

- If it does not preempt market B, it gets a duopoly profit for the provision of product A only
- If it preempts market B, it gets a monopoly profit for the provision of product A and product B
- Due to the efficiency effect, firm 1 has incentives to preempt the market as soon as there is an entry threat

New Technology Adoption Race

In the previous example, firms 1 plays first. We give it the possibility to preempt the market.

Dynamic adoption game:

- Same framework as previously
- We assume that the entry cost decreases over time
- And at the start of the game (*t* = 0) it is not profitable for any firm to enter the new market
- Quasi-continuous time: firms play at regular intervals, alternatively, but the laps of time between the two periods is infinitesimal

Result

The active firm enters the new market just before the new entrant does.

Preemption Credibility

Judd (1985) highlights that preemption is credible only if the cost of exit is high.

If the cost of exit is low:

- let's assume firm 1 preempts the new market
- firm 2 enters after in the new market
- both firms compete à la Bertrand in this market
- if the cost of exit is low, but non null, firm 2 has no incentives to exit the market
- on the contrary, firm 1 has incentives to exit due to the cannibalization of its captive markets

Predation

If a firm cannot prevent its competitors from entering, it can nevertheless seek to exclude them.

We talk about predation.

Predatory pricing

When a firm set its prices to a level implying a profit loss in the short-term to get rid of its competitors and then get higher long-term profits.

Difficult to identify predatory pricing: how to differentiate between competitive prices and predatory prices?

Firms which face a predation strategy should never leave the market.

- Two firms: an active firm (firm I) and a potential entrant (firm E)
- Let's consider a two periods game
- At the first stage: the entrant enters the market
- The active firm can either:
 - Set a predatory price:, $\pi_L^1 = \pi_E^1 = -L < 0$
 - Set an accommodating price: $\pi_I^1 = \pi_E^1 = \pi^D > 0$
- After the choice of firm I pricing strategy, firm E decides to remain on the market or to exit
- If it exits the market, firm I get a monopoly profit π^M in period 2
- Otherwise, the same interaction happens in period 2

Second period

If firm E did not exit, firm I should accommodate its competitor, so $\pi_I^2 = \pi_E^2 = \pi^D$.

First period

- If firm I sets a predatory price, should firm E exit the market?
- It knows that firm I would be accommodating in period 2 if it enters
- Therefore, it decides to enter as long as $L < \pi^D$, for example by borrowing money to a bank to cover its losses in period 1

 \rightarrow Critic of the Chicago School.

In the previous case, predation cannot be an equilibrium if we take into account some level of imperfection of the financial markets.

Let's assume that firm E does not get a loan with the probability $\rho > 0$ (it goes bankrupt).

If there is predation, firm E stays on the market if $(1 - \rho) \pi^D > L$.

Viewpoint of the active firm

- accommodate entry: $\pi^D + \pi^D$
- predation: $-L + \rho \pi^M + (1 \rho) \pi^D$.

Firm I prefers predation if $\rho \pi^M > L + (1 + \rho) \pi^D$.

If ρ is sufficiently high and L sufficiently low, predation is rational.

Deep pockets theory

An active firm has less financial constraints than a entrant. This can allow it to exclude its competitor with a predation strategy.

Two Important Conditions for Predation

Two important conditions for predation to be rational:

The predation phase should be possible.

- The predatory firm should have a competitive advantage
- The prey should give up quickly

Entry should not happened after predation.

- Entry barriers
- Reputation of the predatory firm that it would make a war price in case of entry
- Signal send by the predatory firm that it has low costs

The Reputation Models

Could we make an "example" to deter future entries?

Selten model (chain-store):

- An active firm present in two identical markets
- Threatened on both markets by a different potential entrant
- Both entrants decide one after another to enter the market
- The active firm can either accommodate entry or fight
- Fighting leads to losses
- We assume that it is weak, meaning it faces the same costs as the entrants

Chain-store paradox

The active firm will accommodate entry on both markets.

\rightarrow Not possible to make an "example" in perfect information

The Reputation Models

This result comes from the fact that the entrants know that the firm will be accommodating at the last period.

Kreps and Wilson (1982), several markets, (several periods)

- There are two types of active firms "weak" and "strong"
- The entrants do not know of which type is "their" active firm
- A "strong" active firm does not face losses if it fights
- Kreps and Wilson show that a "weak" firm will fight entry in the first periods to make believe it is "strong"
- And accommodate entry in the last periods

 \rightarrow To make an "example", we need imperfect information.

The Signal Models

"Modern" version of the limit pricing theory (Milgrom and Roberts model, 1982):

- A potential entrant should decide whether to enter a market
- The active firm is "weak" (high cost) or "strong" (low costs)
- If it is weak, entry is profitable
- If it is strong, entry is not profitable
- But the entrant does not know of which type is the active firm

If the "weak" and "strong" firms set different prices, the entrant may know if the active firm is "strong" by observing its price (a "strong" active firm sets a low price. A "weak" active firm sets its monopoly price).

But a "weak" firm could bluff by setting the same price as a "strong" firm. In this case, the entrant cannot know if the active firm is "weak" or "strong".

An Example: The Detroit-Philadelphia Liaison

- In December 1995, the Spirit company started to run the Detroit-Philadelphia liaison
- The price (single ticket) of Northwest was 170 dollars
- Spirit lowered its price to 49 dollars
- Northwest reacted by lowering its price to 49 dollars and increasing its capacity by 30%
- Spirit exited the market in September 1996
- Northwest: "We're being criticized for matching a competitor's action, which I view as pro-consumer"
- But few months later, Northwest increased its price to 230 dollars and decreased its capacity on this line

Example: Tetra-Pack

- Tetra-Pack: Swedish company, worldwide leader of carton packaging for food products.
- Quasi-monopoly position on the aseptic packaging segment, 90% margins of its profits.
- In other markets, competition with other specialized providers.
- According to European competition authorities, Tetra-Pack would have benefited from several financial advantages coming from the aseptic packaging market to implement a predation strategy in the non-aseptic packaging market.
- In the Italian market, Tetra-Pack has sold for 7 years its "Rex" at a price largely inferior (between 30 and 35%) to its direct variable costs. Present only on the non-aseptic packaging market, its competitor Elopak could not respond by lowering its prices.

Public Policy

Different difficulties to implement a public policy:

Does predation exist?

A high price decrease after a competitor entry can be a normal competitive reaction. But there are arguments in favor of the existence of predation strategies.

How to identify predatory behaviors?

- Areeda-Turner test: predatory pricing = price below the marginal cost
- In practice: short-run average variable cost
- Increase of prices after the exit of a competitors? (predatory intention)

Public Policy

Effects in terms of social welfare?

Trade off for consumers between a war price in the short-term and a risk of higher prices in the long-term.

Public Policy in the US

Two conditions:

- Pricing below costs
- Predation is rational: the firm could in the long-term reasonably recoup its losses due to the transitory price war.

Public Policy in Europe

- Forbidden by the Article 86 of the Roma Treaty (now 82) which sanctions the abuse of dominant position
- A firm which does not have market power (in particular, market share < 40%) would probably not be condemned

Take-Aways (1)

- The existence of entry barriers (legal, structural, strategic) prevents supranormal profits from being eroded by the entrance of new competitors in the market.
- Bain identifies three types of reaction to a threat of entry: the entry is blockaded or deterred or accommodated.
- The number of active firms at the equilibrium varies less than proportionally with the market size. The number of active firms decreases when the MES (minimum scale efficiency) increases.
- The sunk costs have a commitment value for the firms which spend them. In the Stackelberg model, the "leader" commits itself to excessive capacities to limit the entrant capacities.

Take-Aways (2)

- In the strategic taxonomy model of Fudenberg and Tirole, there are 4 possible strategic behaviors (fat cat, top dog, lean and hungry look & puppy dog).
- The preemption of a market also constitutes a type of strategic entry barrier, if the exit costs are high.
- Another strategy consists in setting a low price to push the competitor to exit the market (predation strategy). The predation strategy can be rational if firms are sufficiently asymmetric and if there are entry barriers and if the exit costs are low.