Entry and Exit, Strategic Moves  
*(Tirole Chpt 8)*

**Oligopoly** - what's different between oligopoly and monopoly, perfect competition and monopolistic competition? Firms play a *game*... in many cases the firm has an effect on the game to be played

**Problem** - described first by Gabszewicz and Vial [1972]; oligopolist may not simply wish to maximize profit (defined with respect to an arbitrary numeraire) but to affect the equilibrium market price ratios--maximizing utility with a particular utility function may not be consistent with maximizing profit measured with respect to any single commodity

**Result** - oligopolists have different attitudes toward cost reduction, R&D, pricing policies

**Monopolistic Competition** - free entry drives profit to zero

**Long-Run Profits** - firms want to earn long-run positive profits; one way is to have large fixed costs which can lead to large positive profits (less than fixed costs);

**Barrier to Entry** - defined by Bain (1956) as anything that allows incumbent firms to earn positive "supranormal" profits (exceed fixed costs)

**Contestability**

**Baumol** - "tried to turn natural monopoly on its head"; tried to show natural monopolies might not earn positive profits due to threat of entry; research started because of antitrust lawsuit against Bell System

**Original Story** - no sunk costs (could be fixed cost, but not sunk cost; only incur cost if firm actually enters industry)

**Period 1** - new entrant must pay marginal costs plus fixed costs

**Contestability Assumption** - incumbent prices first; if he sets $P > ATC$, entrant should be able to undercut $\therefore$ incumbent keeps $P = ATC$ (potential entry disciplines monopolist)

**Problem** - entrant has to advertise (a sunk cost) $\therefore$ change the no sunk cost assumption to a small sunk cost (which is already paid by the incumbent firm)

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<th>Period 2</th>
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Period 1 - incumbent prices first, then entrant decides whether to enter and what price to set

Period 2 - firms price simultaneously with same costs so $P = MC$; that means entrant must cover his sunk cost in period 1 $\therefore$ incumbent can charge $P = ATC + S (− \varepsilon)$ and entrant stays out

**Result** - as sunk cost ↑ potential entry not as useful in disciplining monopolist

**Timing Problem** - argument above is flawed; competition between incumbent and entrant doesn't start until entrant actually enters the market; $\therefore$ incumbent can actually charge the monopoly price as long as the entrant hasn't entered

**Airline Example** - proponents pointed to airline industry, but history shows incumbent airlines only lower prices after entry occurs

Hamilton: "don't get excited about contestability"

**Commitment Models**

**Limit Pricing** - Modigliani & Slavini (1950s); like contestability model falls apart after post-entry game
Cournot as Entry Game - incumbent chooses quantity first; entrant then decides whether to enter and chooses his quantity (and has to pay fixed cost if quantity is positive)
Incumbent faces costs: $c q_1$; entrant faces costs: $c q_2 + F$

Standard Game - Cournot model looks at simultaneous game choosing $q_1$ & $q_2$

Equilibrium: $q_1 = q_2 = \frac{a - c}{3}, \quad \pi_1 = \pi_2 = \frac{(a - c)^2}{9}$

Sequential Game - incumbent sets $q_1$, then entrant decides $q_2$ ($q_2 = 0$ means no entry)

Kreps & Scheinkman - argued that justification for Cournot is based on Bertrand with capacity constraints (firms choose capacity, then price); in this case firm 1’s capacity choice will influence firm 2’s decision to enter the market

Inverse Demand - $P = a - Q \quad (Q = q_1 + q_2)$

Solve Backwards -

After entry: $\pi_2(q_1, q_2) = \begin{cases} \frac{(a - q_1 - q_2 - c)q_2 - F}{2} & \text{if } q_2 > 0 \\ 0 & \text{if } q_2 = 0 \end{cases}$

Best Reply: $R^2(q_1) = \begin{cases} \frac{a - c - q_1}{2} & \text{if } q_1 < \hat{q}_1, \quad \hat{q}_1 \text{ defined by } \pi_2(\hat{q}_1, R^2(\hat{q}_1)) = 0 \\ 0 & \text{if } q_1 > \hat{q}_1 \end{cases}$

Note: this is the standard Cournot best reply for $q_1 < \hat{q}_1$, then it jumps to zero

Firm 1’s decision:

$F = 0$ (Stakelberg Model): $q_1 = \frac{a - c}{2}, \quad q_2 = \frac{a - c}{4}$

$\pi_1 = \frac{(a - c)^2}{8}, \quad \pi_2 = \frac{(a - c)^2}{16}$

(1 does better than Cournot; 2 does worse)

$F > 0$: doesn’t affect best replies :: $\pi_1 = \frac{(a - c)^2}{8}, \quad \pi_2 = \frac{(a - c)^2}{16} - F$ (1 does better than Cournot; 2 does worse)

Firm 2’s best reply is not continuous; 3 cases:

(1) entry occurs (Stakelberg outcome)... firm 2’s fixed cost is low enough that firm 1 cannot prevent entry; firm 1 plays Stakelberg game (max profit given firm 2’s entry; same quantities as $F = 0$ case)

(2) deter entry: $q_1 = \hat{q}_1 > (a - c) / 2; \quad q_2 = 0$ ... firm 2’s fixed cost is low enough that firm 1 cannot prevent entry at monopoly output, but high enough that firm 1 can do better than Stakelberg outcome by keeping firm 2 out of the market

(3) blockaded entry (Monopoly outcome)... firm 2’s fixed cost is high enough to prevent entry regardless of firm 1’s decision ($F > (a - c)^2 / 16$)

Any fixed cost that causes jump between $q_1^m$ & Stakelberg isoprofit line
**Strategic Moves** - players take action ahead of time to change rules of game; looking ahead to price (or quantity) setting game and trying to shift the best replies

**Cournot Game** - think of heterogeneous products (general case): \( \pi_i = P_i(q_1, q_2)q_1 - C_i(q_1) \)
(revenue is function of both quantities, but not necessarily linear and not necessarily same for both firms; costs can also be different for both firms)

**FOC** - still get MR = MC, but firms are connected through MR (just like regular Cournot)

**Reduce MC** - consider firm 1 reducing MC in linear case:
\[
\pi_1 = (a - q_1 - q_2)q_1 - c_1q_1
\]
\[
\frac{\partial \pi_1}{\partial q_1} = a - q_2 - 2q_1 - c_1 = 0 \implies q_1 = \frac{a - q_2 - c_1}{2} \therefore MC \downarrow \implies q_1 \uparrow
\]
(for every quantity of firm 2, firm 1 will raise output... best reply shifts to the right)

**Single Firm R&D** - firm 1 chooses MC = \( c_1 \) or \( MC = c_1 - \delta \) if it invests \( F \) (i.e., fixed cost to reduce marginal cost... crude R&D model)

"Confounding" Factor - \( q_2^* \) also changes if \( c_1 \downarrow \)... from graph, \( R^2(q_1) \) (2’s best reply) is downward sloping so \( q_1 \uparrow \Rightarrow q_2^* \downarrow \)... firm 2 accommodates firm 1’s aggression

**Single R&D in Bertrand** - now firm 2’s best reply is upward sloping, in this case \( p_1 \downarrow \Rightarrow p_2^* \downarrow \)... firm 2 is aggressive in its response to firm 1’s R&D

**Result** - actual result on whether firm 2’s response hurts firm 1 depends on firm 1’s change in profit, but in general the result will be sensitive to whether the following game (after the R&D decision) is price or quantity setting

**Strategic Substitutes** - \( \frac{\partial \pi_1}{\partial z_1 \partial z_2} < 0 \) (where \( z_i \) represents either \( q_i \) or \( p_i \))
This says an increase in \( z_2 \) lowers the marginal profitability of \( z_1 \) (for firm 1)... in other words, the best replies slope down like in the Cournot game

**Strategic Complements** - \( \frac{\partial \pi_1}{\partial z_1 \partial z_2} > 0 \)... opposite (an increase in \( z_2 \) raises the marginal profitability of \( z_1 \); best replies slope up like the Bertrand game)

**Order Matters** - the actual result form all these games depends on the order of the decisions:

**Quantity** - already found the equilibrium profits: listed in order of preference
Lead (Stakelberg) - \( \pi_1 = (a - c)^2 / 8 \)
Simultaneous (Cournot) - \( \pi_1 = (a - c)^2 / 9 \)
Follow (2nd player in Stakelberg) - \( \pi_1 = (a - c)^2 / 16 \)

**Price** - equilibria shown in graph; listed in order of preference
Follow - firm 2 leads and puts its highest isoprofit curve tangent to firm 1’s best reply
Lead - firm 1 puts its highest isoprofit curve tangent to firm 2’s best reply
Simultaneous (Bertrand) - best replies intersect

**Too Much R&D?** - Brander and Spencer (1983)
**Single Firm** - simple case: only firm 1 can do R&D; Cournot game so firms choose quantities simultaneously
R&D Assumptions - pay \( z \) per "unit" R&D; R&D is only cost reducing (i.e. doesn't affect revenue):
\[
\pi_1 = R_1(q_1, q_2) - C_1(q_1, z_1) - z_1 \quad \text{and} \quad \pi_2 = R_2(q_1, q_2) - C_2(q_2)
\]

3 Games -
(1) \( z_1 \) (standard Cournot... doesn't say anything about level of R&D)
(2) Simultaneous choice of \( q_1, z_1, q_2 \)
(3) \( z_1 \) first, then simultaneous choice for \( q_1, q_2 \)

Nonstrategic Game - game (2)... choice of \( z_1 \) doesn't change how firm 2 was going to respond:
\[
\frac{\partial \pi_1}{\partial q_1} - \frac{\partial R_1}{\partial q_1} - \frac{\partial C_1}{\partial q_1} = 0 \quad \Rightarrow \quad \text{MR} = \text{MC} \quad \text{(standard MC = MB result)}
\]
\[
\frac{\partial \pi_1}{\partial z_1} = -\frac{\partial C_1}{\partial z_1} - 1 = 0 \quad \Rightarrow \quad \text{invest in R&D up to point that last $ saves $1 in total cost}
\]

marginal incentive to invest in R&D (i.e., \( \frac{\partial \pi_1}{\partial z_1} \)) is same as monopolist or price competitor (i.e., price taker) \( \therefore \) same level of R&D as other types of markets (this is the cost minimizing level of R&D... efficient)

Strategic Game - game (3)...

Stage 1 - firm 1 chooses \( z_1 \) based on
\[
\pi_1^*(q_1^*(z_1), q_2^*(z_1), z_1) = R_1(q_1^*(z_1), q_2^*(z_1)) - C_1(q_1^*(z_1), z_1) - z_1
\]
where \( q_1^*(z_1) \) and \( q_2^*(z_1) \) are best replies found by solving backwards (stage 2)

Stage 2 - \( z_1 \) is fixed... regular Cournot game:
\[
\frac{\partial \pi_1}{\partial q_1} = \frac{\partial R_1}{\partial q_1} - \frac{\partial C_1}{\partial q_1} = 0 \quad \text{and} \quad \frac{\partial \pi_2}{\partial q_2} = \frac{\partial R_2}{\partial q_2} - \frac{\partial C_2}{\partial q_2} = 0
\]

Solve these for \( q_1^*(z_1) \) and \( q_2^*(z_1) \)

Optimal R&D - take derivative of \( \pi_1^*(q_1^*(z_1), q_2^*(z_1), z_1) \) from stage 1
\[
\frac{\partial \pi_1^*}{\partial z_1} = -\frac{\partial R_1}{\partial q_1} \frac{dq_1^*}{dz_1} - \frac{\partial C_1}{\partial q_1} \frac{dz_1}{dz_1} - 1 = 0
\]

FOCs from stage 2 allow us to cancel the circled terms
\[
\therefore \quad \frac{\partial \pi_1^*}{\partial z_1} = -\frac{\partial R_1}{\partial q_2} \frac{dq_2^*}{dz_1} - \frac{\partial C_1}{\partial q_1} \frac{dz_1}{dz_1} - 1 = 0
\]

where \( \frac{\partial \pi_1^*}{\partial z_1} \) is FOC from non-strategic game

We showed earlier that \( dq_2^*/dz_1 < 0 \) (i.e., firm 1 lowering MC causes firm 2 to accommodate and lower output); also \( \frac{\partial R_1}{\partial q_2} < 0 \) (i.e., if firm 2 increases output, firm 1’s revenue declines... standard Cournot result) \( \therefore \) right term is positive; in order for FOC to = 0, that means \( \frac{\partial \pi_1^*}{\partial z_1} < 0 \) at the equilibrium level of R&D in the strategic game

Look at that another way, at the nonstrategic level of R&D, \( \frac{\partial \pi_1^*}{\partial z_1} = 0 \) so
\[
\frac{\partial \pi_1^*}{\partial z_1} > 0 \quad \therefore \quad z_1^S > z_1^{NS} \quad (\text{firm does more R&D in strategic game})
\]

Both Firms Do R&D - now consider the same game where both firms get to do R&D
Nonstrategic - Simultaneous choice of $q_1, z_1, q_2, z_2$

Strategic - firms choose $z_1$ & $z_2$ simultaneously, then $q_1$ & $q_2$ simultaneously

Result - same FOC for firm 1 from previous problem; firm 2's FOC mirror them.:
both firms do more R&D in strategic game... also $q_1^S + q_2^S > q_1^{NS} + q_2^{NS}$

Graphs - already showed 1’s best reply for $q_1$
shifts right when $z_1 \uparrow$... same for firm 2; best replies for $z_1$ also shift right because
$\partial \pi_1^c / \partial z_1 > 0$ at simultaneous
(nonstrategic) equilibrium... Brander & Spencer cover why the nonstrategic best replies for $z_1$ and $z_2$ are downward sloping in their paper

Symmetry - if firms have same cost functions, profits will be lower in the strategic game where both firms can to R&D

Facilitating Practices; Pricing Policies

Changing the Pricing Game - Cooper (1986); in the Bertrand game, if firm 1 could shift its best reply out at no cost (i.e., for any $p_2$, firm 1 will charge a higher price), then both firms will make more profit; if firm 2 also does it, prices rise more and so do profits.: being weak (non-aggressive) with strategic complements pays off

Supply Guarantees - rain checks are a "muddy" example (although actually do have cost implications

Facilitating Practices - big issue in antitrust literature; firms trying to change game to sustain collusive outcome by taking actions to increase profit that a monopolist wouldn't do

Ethyl Case - late 70s, early 80s; lead in gasoline was cheap way to increase octane, but bad for the environment; early 70s had tight oligopoly in lead additive; 4 firms: Ethyl, DuPont, PPG, Nalco (the last of them is now a big water treatment company); the EPA moved to ban lead in gasoline which in effect created a barrier to entry: lots of infrastructure required to make the lead additive so new firms wouldn't want to invest in a dying market; incumbent firms introduced new contract terms with customers using price protection clauses:

Price Protection Clauses

(1) Most Favored Customer (MFC) Clause - in a long-term contract, buyer gets rebate if seller cuts price in the future (intertemporal)

(2) Most Favored Nation (MFN) Clause - buyer gets rebate if someone else gets a lower price (single period)

(3) Meet or Release Clause - if other firm offers customer better price, firm either matches price or cancels contract; commit to match price cuts

Extra Benefit - firm can learn competitor's prices

Buyer Motivation - may want low price, quantity guarantees, reliability issues, but this is not a standard model of consumer behavior: buyers only care about price guarantees for their competitiveness (e.g., prefer $6 if everyone else pays $6 or more rather than $5 if everyone else pays $4.50)

Monopolist - (3) doesn't apply; no clear benefit for (1) (unless selling a durable good); (2) prevents price discrimination so monopolist wouldn't want to use it
Duopoly - 2 firm, 2 period model ⇒ 3 stage game (decide to offer MFC, first period pricing, then second period pricing where MFC is enforced)

4 Subgames - firms know who will offer MFC before the pricing decisions so there are 4 subgames: both offer (1,1), neither offers (0,0) or only 1 firm offers (1,0) and (0,1) where 1 = offer MFC; 0 = not offer

Simplification - assume only firm A can offer MFC (so we only have 2 subgames)

Notation - let $p_i^j$ be firm $i$'s price in period $j$; $Q_i^j$ be firm $i$'s demand in period $j$

Period 1 - $\pi^i(p_A^1, p_B^1) = p_i^1Q_A^1(p_A^1, p_B^1) - C^i(Q_A^1(p_A^1, p_B^1))$

Period 2 - $\hat{\pi}^i = \begin{cases} \pi^i(p_A^2, p_B^2) \text{ (same as period 1)} & \text{if } p_i^1 \geq p_i^1 \text{ (MFC doesn’t apply)} \\ \pi^i(p_A^2, p_B^2) - M_i(p_A^1 - p_A^2)Q_A^2 & \text{if } p_i^1 < p_i^1 \text{ (uses MFC)} \end{cases}$

where $M_i = 1$ if firm offers MFC; 0 otherwise

2nd Period - graph shows best replies for cases where firm A doesn't offer MFC (dashed line) and when it does (based on first period price $p_A^1$); equilibria marked as (0,0) and (1,0) show that both firms charge higher price and get higher profits if firm 1 offers MFC

1st Period - involves simultaneous pricing; firm A wants higher price in first period to guarantee higher price in second period (i.e., shift A’s best reply more in second period); can’t say how much higher price will be, but it will be between the simultaneous price setting Nash equilibrium price and the Stakelberg (leader-follower) price (i.e., $p_A^1 \in (p_A^N, p_A^L)$)

Result - firm 1 chooses to offer the MFC clause, but the clause never takes effect because firm 1 doesn’t cut price; both firms charge higher prices and earn higher profits in both periods

Follow Up - Neilson & Winter did a “hatchet job” critiquing Cooper’s paper; looked at both firms offering MFC clause; said PSNE exists for period 1 pricing only if demand is $Q' = a - bp_i + bp_j$

(i.e., if prices are equal demand is perfectly inelastic; for nonlinear case: $\partial Q' / \partial p_i = -\partial Q' / \partial p_j$, ...). Cooper result wasn't general

Problem - Neilson & Winter looked at pure strategy NE for no clear reason; if there is a mixed strategy NE with all prices above original no-clause price, Cooper’s argument still holds (prices are higher and profits are higher)

Mergers
Another big part of antitrust policy

Horizontal Mergers - firms in same industry combine to create single firm large market share; no clear benefit to consumers vs. gaining market share by product improvement or cost saving; common argument for horizontal merger is that it could lead to cost savings by “cutting overhead”, but real-world suggests savings don’t always happen as planned

Good Merger - compare pre- and post- merger welfare (consumer surplus); Salant, Switzer & Reynolds (1983) wrote early paper addressing mergers

Homogenous Products; Quantity Competition - Cournot competition with $n$ identical firms; merge two or more firms so post-merger has $n - 1$ or fewer identical firms (huge assumption; results form identical, constant marginal cost)
Inverse Demand - $P = a - Q = a - nq$

Equilibrium Output per Firm - Monopoly: $\frac{a-c}{2}$; Duopoly: $\frac{a-c}{3}$; $n$ firms: $q = \frac{a-c}{n+1}$

Price - $P = a - \frac{n}{n+1} (a-c) = \frac{n a + a - n a + n c}{n+1} = \frac{a-c + (n+1)c}{n+1} = c + \frac{a-c}{n+1}$

Profit per Firm - $\pi = (p-c)q = \left( c + \frac{a-c}{n+1} - c \right) \frac{a-c}{n+1} = \frac{(a-c)^2}{(n+1)^2}$

Merge? -

Consider going from 5 firms to 4: $\pi_s = \frac{(a-c)^2}{(6)^2}$ vs. $\pi_s = \frac{(a-c)^2}{(5)^2}$

Looks like 1/36 vs. 1/25 (good to merge), but look at combined profit for the firms that merge: 2/36 > 1/25... they don't want to merge

SSR Result - merger only profitable if large percentage of firms are in the merger (e.g., 2 to 1 compare 2/9 vs 1/4)

General Case - $m+1$ firms merge ($1 \leq m \leq n-1$)

Pre-Merger - profit per firm is $\pi = \frac{(a-c)^2}{(n+1)^2}$

Post-Merger - $n-m$ firms; profit per firm is $\pi = \frac{(a-c)^2}{(n-m+1)^2}$

Merge if... $\frac{(a-c)^2}{(n-m+1)^2} > (m+1) \frac{(a-c)^2}{(n+1)^2}$

To Monopoly - $m+1 = n-1 \Rightarrow \frac{(a-c)^2}{(n-(n-1)+1)^2} > (n-1+1) \frac{(a-c)^2}{(n+1)^2} \Rightarrow$

$$\frac{1}{(2)^2} > \frac{n}{(n+1)^2}$$ ... this holds as long as $n \geq 2$

(i.e. firms will always want to merge to a monopoly)

10 Firms - didn't go through derivation in class, but when there are 10 firms, at least 8 of them have to merge for the firms to want to it

Less Profitable - if we fix $(m+1)/n$ (i.e. fraction of firms merging is fixed), then as we increase $n$, the merger becomes less profitable (e.g., firms wanted to merge when 8 of 10 do (80%), but if it's 80 or 100 (still 80%), they don't want to merge)

Efficiency Gain - could be that merger is socially desirable even though it's unprofitable to firms merging

Problem 1 - using Cournot for merger analysis; thinking of Cournot as setting capacity (standard Kreps & Scheinkman justification for Cournot) doesn't make sense here because firms choose quantity again after merger

Problem 2 - assume firms are still identical after the merger so there is no difference in market share between participants and non-participants; results in nonparticipants gaining and merged firms doing all the capacity cutting
Heterogeneous Product; Price Competition - Davidson & Deneckere (AER, 1990); firms max profit and merged firm maxes joint profit

All Substitutes - if all product are substitutes, prices are higher for everybody, but merger is more profitable to nonparticipants... that suggests firms want to wait around for rivals to merge

Graph - supposed 1 & 3 are substitutes; 1 & 2 are substitutes, but 2 & 3 are independent (e.g., small (2), medium (1), and large (3) cars)

Divisionalization - turn merger upside down; 1 firm using independent divisions, each profit maximizing (SSR in reverse); more divisions means more total players and (assuming equal market shares for each firm) more profit... credible threat to produce large output

Detail in Pricing - charge different prices in different stores... didn't really get into this