Econ 476: Industrial Organization

Mergers

J. Bradley Eustice

Brigham Young University

Lecture 09

Intro

- Why do firms merge? Who benefits?
- How do regulators view mergers?

Concentration

Two factors influence industry concentration:

- the number of firms in the industry, N
- the aggregate industry output, Q

Notation

1. $Q = \sum_{i=1}^{N} q_i$
2. Let $s_i \equiv \frac{100 q_i}{Q}$ denote the market share of firm i.
    - $0 \leq s_i \leq 100$
    - $\sum_{i=1}^{N} s_i = \left(100 \sum_{i=1}^{N} q_i\right) / Q = 100$

4-firm concentration ratio

- Reorder each firm in the industry from largest market share to lowest
  - $s_1 \geq s_2 \geq \cdots \geq s_N$
- $I_4 \equiv \sum_{i=1}^{4} s_i$

4-firm concentration ratio

% share	s_1	s_2	s_3	s_4	s_5	s_6	s_7	s_8	s_9	s_{10}	I_4
Industry 1	60	10	5	5	5	0	0	0	0	0	80
Industry 2	20	20	20	20	0	0	0	0	0	0	80
Industry 3	$\frac{100}{3}$	$\frac{100}{3}$	$\frac{100}{3}$	0	0	0	0	0	0	0	?
Industry 4	49	49	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	?

Herfindahl-Hirshman index

- $I_{HH} \equiv \sum_{i=1}^{N} (s_i)^2$

Concentration measures

% share	s_1	s_2	s_3	s_4	s_5	s_6	s_7	s_8	s_9	s_{10}	I_4	I_{HH}
Industry 1	60	10	5	5	5	0	0	0	0	0	80	3850
Industry 2	20	20	20	20	0	0	0	0	0	0	80	2000
Industry 3	$\frac{100}{3}$	$\frac{100}{3}$	$\frac{100}{3}$	0	0	0	0	0	0	0	100	3333
Industry 4	49	49	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	98.5	4802

DOJ

https://www.justice.gov/atr/herfindahl-hirschman-index

Mergers

- Horizontal merger
  - same industry
  - producing identical or similar goods
  - same geographical market

Mergers

- Vertical merger
  - merge upstream or downstream
  - buyer-seller relationship

Mergers

- Conglomerate merger
  - product extension: related in production or distribution
  - market extension: different geographic markets
  - other: essentially unrelated

BERKSHIRE HATHAWAY INC.

Current Example

- https://www.nytimes.com/2016/10/23/business/dealbook/att-agrees-to-buy-time-warner-for-more-than-80-billion.html
- https://www.nytimes.com/2017/07/09/technology/att-time-warner-merger.html

Why merge?

“Mergers live or die by a single question: Do the combined businesses have more value than each one does separately? One plus one must equal at least three. And if you’re the acquirer, you can benefit in only one of four ways:

Why merge?

1. You buy an asset on the cheap (that's what portfolio managers do), but it requires being smarter than the market in pricing the asset.
2. You run the target company more effectively (that's what restructurers do), but it requires being a better parent than the current management.
3. You gain market power, allowing you to price the asset higher than you could otherwise.
4. You extract and exploit synergy, combining assets to create more value than would otherwise be possible"

Source: "AT&T, Time Warner, and What Makes Vertical Mergers Succeed" *Harvard Business Review*

Mergers - Cournot

- Consider 3 firms (A, B, C) selling a homogeneous good face inverse demand $P = a - bQ$ where total costs are $c_A q_A$, $c_B q_B$, and $c_C q_C$ for firms A, B, and C, respectively. Assume they compete by choosing quantity (Cournot).
- We found in HW2 that:
  - $q_A^* = \frac{a+c_B+c_C-3c_A}{4b}$
  - $q_B^* = \frac{a+c_A+c_C-3c_B}{4b}$
  - $q_C^* = \frac{a+c_A+c_B-3c_C}{4b}$
  - $p^* = \frac{a+c_A+c_B+c_C}{4}$
- Now lets assume that Firms A and B merge. Solve for q_i^*, p_i^*, and π_i^*.

Algorithm - conceptual

How to determine incentives/effects of mergers:

1. solve the static game before the merger takes place
   - prices, quantities, and profits of *each* firm
2. solve the static game after the merger completes
   - prices, quantities, and profits of the merged firms
   - prices, quantities, and profits of the unmerged firms
3. compare results

Mergers - Bertrand

Consider the same set-up as before except now the 3 firms compete by choosing prices (Bertrand).

- Remember that

$$\pi_i = \begin{cases} 0 & \text{if } p_{i\neg} < p_i \\ p_i \frac{Q}{N} - c_i \frac{Q}{N} & \text{if } p_i = p_{\neg} \\ p_i Q - c_i Q & \text{if } p_i < p_{i\neg} \end{cases}$$

- Lets assume that firms A and B merge.
- What happens if $c_A = c_B = c_C = c_{AB}$?
- What happens if $c_A > c_B > c_C > c_{AB}$?

Vertical (1)

- Consider 2 upstream firms (A, B) and 2 downstream firms $(1, 2)$. The upstream firms compete on price (Bertrand) and the downstream firms compete on quantity (Cournot).

Vertical (2)

Downstream competition:

- Inverse demand is given by $p = \alpha - q_1 - q_2$.
- Assume that one unit of input produces one unit of output, where c_1 and c_2 are the price paid for each unit of input from the upstream firms.
- Solve for q_i^*, p^*, and π_i^*.

Vertical (3)

Solution:

- $q_i^* = \frac{\alpha - 2c_i + c_j}{3}$
- $p^* = \frac{\alpha + c_1 + c_2}{3}$
- $\pi_i^* = \frac{(\alpha - 2c_i + c_j)^2}{9}$

Vertical (4)

Upstream competition:

- Assume $c_A = c_B = 0$.
- What are π_i^*?
- Now, what is the solution to the Cournot downstream game?

Vertical (5)

Solution:

- $q_i^* = \frac{\alpha}{3}$
- $p^* = \frac{\alpha}{3}$
- $\pi_i^* = \frac{\alpha^2}{9}$

Vertical (6)

Now suppose that the upstream firm A merges with the downstream firm 1 where the new firm is denoted $A1$. Assume that $A1$ does not sell to firm 2 and firm B does not sell to $A1$. Hence, firm B can now act as a monopoly to downstream firm 2. Firm B chooses c_2 that solves

$$\max_{c_2} \pi_B = c_2 q_2 = \frac{c_2(\alpha - 2c_2 + c_1)}{3} = \frac{c_2(\alpha - 2c_2)}{3}$$

- Solve for q_i^*, p^*, and π_i^* of each firm.

Vertical (7)

Solution:

- $c_2 = \frac{\alpha}{4}$

Plugging in c_1 and c_2 into the downstream firms yields:

- $q^*_{A1} = \frac{5\alpha}{12}$
- $q^*_2 = \frac{\alpha}{6}$
- $p^* = \frac{5\alpha}{12}$

The profit if each firm is:

- $\pi^*_{A1} = \frac{25\alpha^2}{144}$
- $\pi^*_B = \frac{\alpha^2}{24}$
- $\pi^*_2 = \frac{\alpha^2}{36}$

Who benefits?

Vertical (8)

Pre-merger:

- $\pi_A^* = 0$
- $\pi_B^* = 0$
- $\pi_1^* = \frac{\alpha^2}{9}$
- $\pi_2^* = \frac{\alpha^2}{9}$

Post-merger:

- $\pi_{A1}^* = \frac{25\alpha^2}{144}$
- $\pi_B^* = \frac{\alpha^2}{24}$
- $\pi_2^* = \frac{\alpha^2}{36}$

Vertical (9)

Results

1. The output level of the merged firm increases and the output level of the unmerged firm decreases relative to the pre-merger quantities.
2. The profit of the merged firm increases compared to the pre-merger profits.
3. A merger will not drive the unmerged downstream firm out of business (which would also drive the upstream firm out of business), but only reduce its profits.

Horizontal - complementary

Consider a market for computer systems (denoted s) which includes a computer and a monitor. Let a computer (denoted x) and a monitor (denoted y) be perfect compliments such that $x = y = Q$.

- The price of a computer system is $p_s = p_x + p_y$.
- Let demand be $Q = \alpha - p_s = \alpha - p_x - p_y$ or inverse demand be $p_s = p_x + p_y = \alpha - Q$
- Assume firm X produces computers and firm Y produces monitors. Since the products (x and y) are differentiated, let each firm compete on price (Bertrand).
- Assume marginal cost is c_x and c_y.

Solve for π_i, p_i^*, Q^*, and π_i^*.

Horizontal - complementary

Solution:

- $\pi_x = (p_x - c_x)(\alpha - p_x - p_y)$; $\pi_y = (p_y - c_y)(\alpha - p_x - p_y)$
- $p_x^* = \frac{\alpha - c_y + 2c_x}{3}$; $p_y^* = \frac{\alpha - c_x + 2c_y}{3}$
- $Q^* = \frac{\alpha - c_y - c_x}{3}$; $p_s^* = \frac{\alpha + c_x + c_y}{3}$
- $\pi_x^* = \pi_y^* = \frac{(\alpha - c_y - c_x)^2}{9}$

Now assume that firm X and firm Y merge.
Solve for π, p_s^M, Q^M, and π^M.

Horizontal - complementary

Solution:

- $\pi = (p_s - c_s)(\alpha - p_s)$
- $p_s^M = \frac{\alpha + c_s}{2}$
- $Q^M = \frac{\alpha - c_s}{2}$
- $\pi^M = \frac{(\alpha - c_s)^2}{4}$

Horizontal - complementary

- Now assume that $c_x = c_y = c_s = 0$.
- $p_x^* = p_y^* = \frac{\alpha}{3}$; $p_s^* = \frac{2\alpha}{3}$
- $Q^* = \frac{\alpha}{3}$
- $\pi_x^* = \pi_y^* = \frac{\alpha^2}{9}$
- $p_s^M = \frac{\alpha}{2}$
- $Q^M = \frac{\alpha}{2}$
- $\pi^M = \frac{\alpha^2}{4}$

Results

A merger into a single monopoly of firms producing complementary products would

1. reduce the price of the system $\left(p_s^M < p_s = p_x^* + p_y^*\right)$;
2. increase the number of systems sold $\left(Q^M > Q^*\right)$;
3. increase industry profits $\left(\pi^M > \pi_x^* + \pi_y^*\right)$.