Horizontal Mergers

What is a "Merger"?

Merger: The process in which two or more independently owned firms join under the same ownership.

- Includes takeover, integration or acquisition
- May affect internal governance of the firm

We distinguish between horizontal and vertical mergers.

Horizontal Mergers

Horizontal merger: Two firms that compete against each other in the same market merge with each other.

Examples: Ford and Volvo, MCI and Worldcom, AT&T and Cingular. Anheuser Busch InBev & SABMiller

Vertical Mergers

Vertical merger: A manufacturer and a retailer merge with each other. More generally, it involves two firms at different stages in the supply chain.

Examples: Tesoro and USA Petroleum, Disney and ABC (content and delivery), AT&T and Time Warner (content and delivery).

Remark 1: We need an additional mathematical tool to develop the theory to properly understand these mergers, so we'll focus on these types of mergers in a couple weeks.

Many mergers have both horizontal and vertical dimensions:
e.g., Exxon & Mobil, BP & ARCO.

Remark 2: There are also mergers of **conglomerates** which amounts to mergers between firms which operate in unrelated industries. This is a puzzling but surprisingly common occurrence. We will not deal with these kinds of mergers.

e.g., Phillip Morris acquires Miller Brewing Co in the 1970s and later Kraft in 1988 (both since divested). Also look at General Electric for an on-going case study.

Lecture Outline

I. Data: Mergers are a common occurrence.

II. Theory: Why do firms merge?

- Homogenous goods markets.
- Differentiated goods markets.

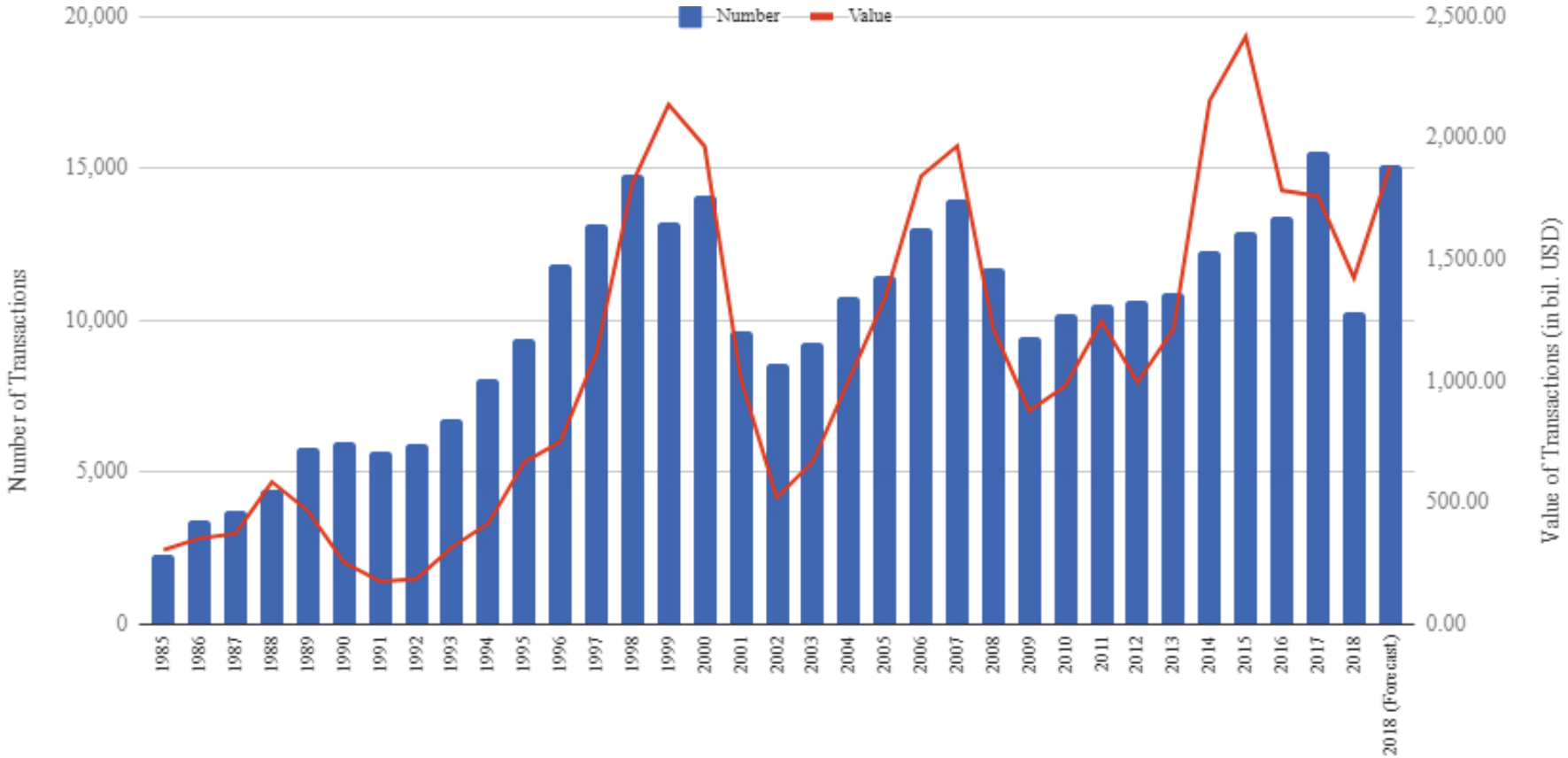
III. Department of Justice (DOJ) Merger Guidelines.

- Market definition.
- Concentration measures.
- Diversion ratios.
- Challenge criteria.

I. Data Facts

I. Data Fact 1

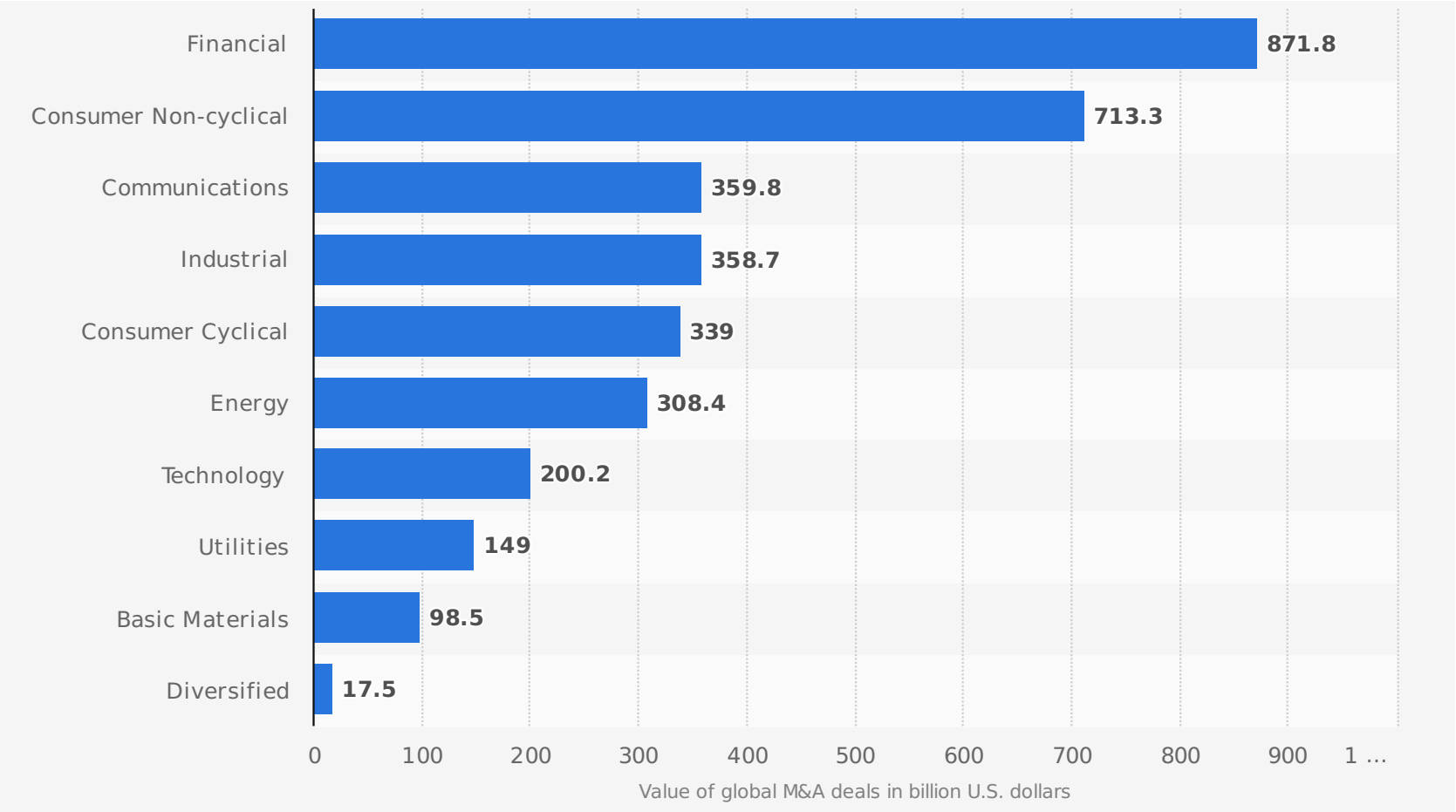
Figure: Mergers & Acquisitions in the United States



- Mergers are increasingly common (bars, left y-axis) and the overall value of M&A activity is also increasing (red line, right y-axis).
- US M&A looks pro-cyclical: When times are bad (i.e., 90-91, 01, & 08-09 recessions), M&A activity (number, value) seems to decrease. Why?

I. Data Fact 2

Figure: Value of Announced Mergers & Acquisitions (2017)



- Mergers are common across a variety of industries.
- In some of these industries firms produce homogeneous goods (e.g., energy, utilities) while in other industries firms produce differentiated goods (e.g., consumer goods).

II. Theory

II. Theory: Why do competing firms choose to merge?

1. Reduce competition, raising prices and profits.
2. Coordination of prices or quantities.
3. Production efficiencies: lower fixed and/or marginal costs (greater economies of scale or scope), leads to higher profits.
4. Other efficiencies: Eliminate inefficient competitors. Takeovers, or the threat of takeovers, may discipline bad management.

Let's start by focusing on the effects of mergers on competition.

Example 1

Number of Firms: $N = 3$
Demand: $P(Y) = 1 - Y,\ Y = y_1 + y_2 + y_3$
Costs: $c = 0$

Firm 1 chooses output to maximize

$$\max_{y_1} \left\{ \underbrace{(1 - y_1 - y_2 - y_3)}_{p(Y)} \times y_1 - 0 \right\}$$

Differentiating and solving for firm 1's best reply

$$y_1 = \frac{1 - y_2 - y_3}{2}$$

Problem is symmetric so the best replies for Firms 2 and 3 are identical.
Solving for the symmetric solution, the Nash equilibrium outcome is

$$y_i^\star = 1/4, p^\star = 1/4, \pi_i^\star = 1/16, S^\star = 9/32, T^\star = 15/32$$

A Merger

Now suppose Firms 1 and 2 merge into firm 12. The merged firm chooses its output y_{12} to

$$\max_{y_{12}} (1 - y_{12} - y_3) \times y_{12}$$

Differentiating and solving for firm 12's best reply:

$$y_{12} = \frac{1}{2}(1 - y_3)$$

Firm 3's best reply is identical. Solving for the symmetric duopoly outcome yields

$$\tilde{y}_{12} = y_3 = 1/3, \tilde{p} = 1/3, \tilde{\pi}_{12} = \pi_3 = 1/9, \tilde{S} = 2/9, \tilde{T} = 4/9$$

Results

- Output falls from 3/4 to 2/3
- Price increases from 1/4 to 1/3.
- Profits to merging firms fall - their combined pre-merger profits are 1/8, but their post merger profits are 1/9.

  If they were to split the post-merger pie, both firms are worse off than before the merger. Why?

- Consumer surplus falls, deadweight loss increases, social welfare falls by 5.2%.

Intuition:

The merger confers a positive externality on firm 3, the outside firm. As the merger firm tries to exercise market power by cutting back its output, the outside firm increases its output.

- Its market share increases from 1/4 to 1/3.
- Its profits rise from 1/16 to 1/9.

More General Model

$$\begin{aligned} \text{Firms:} &\ N > 1 \text{ firms} \\ \text{Demand:} &\ P(Y) = A - BY \\ \text{Costs:} &\ C_i(y_i) = c \times y_i, \ \forall i = 1, ..., N \end{aligned}$$

Firm i chooses its output to solve

$$\max_{i_i} \left(A - B(y_i + Y_{-i}) - c \right) \times y_i$$

where $Y_{-i} = \sum_{j \neq I} y_j$. Differentiating and solving for firm i's best reply:

$$y_i = (A - c - BY_{-i})/2B$$

The symmetric solution is

$$y^\star = (A - c)/B(N + 1), P^\star = (A + Nc)/(N + 1)$$

$$\pi^\star = (A - c)^2/B(N + 1)^2$$

A Merger

Now suppose $M < N$ of the firms merge so there are $N - M + 1$ firms in the market. Each firm earns

$$\pi_i = (A - c)^2/[B(N - M + 2)^2]$$

Profits for outside firms are clearly higher since $N + 1 > N - M + 2$.

Profits for the M merging firms are higher if and only if:

$$(A - c)^2/[MB(N - M + 2)^2] > (A - c)^2/B(N + 1)^2$$

$$\rightarrow (N + 1)^2 > M(N - M + 2)^2$$

This condition is not easily met. The number of merging firms typically needs to represent more than 80% of the firms.

Main point:

Effects of mergers are not so obvious. Not always profitable.

- Strategic thinking is essential! Need to think through the consequences of the merger on behavior of rivals.

Resolving the Merger Paradox with Fixed Costs

Example 2: $n = 3, P(Y) = 150 - Y, C(y) = f + 30y$

Firm 1 chooses y_1 to solve

$$\max_{y_1} (150 - y_1 - y_2 - y_3 - 30) \times y_1 - f$$

Differentiating and solving for Firm 1's best reply

$$y_1 = \frac{1}{2}(120 - y_2 - y_3)$$

Note: fixed costs do not affect optimal output.

In symmetric equilibrium, all three firms produce the same output. The equilibrium outcome is

$$y^\star = 30, P^\star = 60, \pi^\star = 900 - f$$

A Merger

Now suppose Firms 1 and 2 merge. The merged firm has to pay only one fixed cost to operate.

- E.g.: when AT&T and Cingular merged, they need only one of the two sets of cell towers.

Repeating the above steps yields the duopoly equilibrium outcome

$$\tilde{y}_{12} = \tilde{y}_3 = 40, \tilde{P} = 70, \tilde{\pi} = 1600 - f$$

Hence, the merger is profitable if

$$1600 - f > 1800 - 2f \rightarrow f > 200$$

Main Point:

Mergers can be profitable if they reduce fixed costs.

- Price always rises, consumer surplus always falls.

Another kind of cost efficiency arises when one of the firms in the merger has higher marginal costs.

In this case, there is a trade-off that can benefit the consumer.

Mergers Could Also Eliminate Inefficient Firms

Example 3: $n = 3, P(Y) = 150 - Y, C_1(y) = C_2(y) = 30y, C_3(y) = 60y$. In this case the system of best replies is given by

$$y_1 = \frac{1}{2}(120 - y_2 - y_3)$$
$$y_2 = \frac{1}{2}(120 - y_1 - y_3)$$
$$y_3 = \frac{1}{2}(90 - y_1 - y_2)$$

Solving the system yields

$$y_1^\star = y_2^\star = \frac{150}{4};\ y_3^\star = \frac{30}{4}$$

$$P^\star = \frac{270}{4},\ \pi_1^\star = \pi_2^\star = \frac{150^2}{16},\ \pi_3^\star = \frac{900}{16}$$

Learning Checkpoint

- Suppose Firms 2 and 3 merge and produce at the lower marginal cost of $30.
- What are the Nash equilibrium output choices of the firms?
- Is the merger profitable? Will the firms agree to it?

Results

- Best replies are

$$y_1 = \frac{1}{2}(120 - y_{23})$$
$$y_{23} = \frac{1}{2}(120 - y_1)$$

- Solving the system of two equations and two unknowns yields the Nash equilibrium output:

$$\tilde{y}_1 = \frac{120 - y_{23}}{2}$$
$$\tilde{y}_{23} = \frac{120 - y_1}{2}$$

$$\Rightarrow \tilde{y}_1 = \tilde{y}_{23} = 40; \text{ therefore } \tilde{P} = 70.$$

Results, cont'd

- Is the merger profitable? Will the firms agree to it?

$$\tilde{\pi}_1 = \tilde{\pi}_{23} = 1600$$

The merger is profitable since

$$1600 > 1406.25 + 56.25 = 1462.25$$

Main Points

1. Mergers can be profitable if they eliminate a higher marginal cost (i.e., less efficient) firm.
2. Here, CS$\downarrow$ (since $P \uparrow$) but perhaps eliminating efficiency could be good for consumers (if equilibrium prices fall).

Extension: Cost "Synergies"

Consider a similar same set-up but firms have the same constant marginal cost.

Firms 1 and 2 merge. By doing so, they decrease their marginal cost by s (i.e., cost synergies).

The cost function for these firms is now $c_i(y_i) = (1 - s) \times 30y_i$.

Questions

- At what value of s is the merger profitable?
- At what value of s does the third firm choose to shut-down?
- Are there values of s where consumer prices actually fall and consumers benefit from the merger?

Solution

- Best replies:

$$y_{12} = \frac{120 + 30s - y_3}{2}$$
$$y_3 = \frac{120 - y_{12}}{2}$$

  Note: Firm 12's BR shifts out as $s \uparrow 1$ (*i.e.*, as the firm's costs fall).

- Nash equilibrium:

$$y'_{12} = 40 + 20s;\ y'_3 = 40 - 10s$$
$$Y' = 80 + 10s$$
$$P' = 70 - 10s$$
$$\pi'_{12} = (40 + 20s)^2$$

Questions

- When is the merger profitable?

$$\begin{aligned} \text{Post-Merger Profits} &\geq \text{Pre-Merger Profits} \\ (40 + 20s)^2 &\geq 1800 \\ s &\geq 0.12 \end{aligned}$$

- For what values of s does the merger improve consumer surplus?

$$\begin{aligned} \text{Post-Merger CS} &\geq \text{Pre-Merger CS} \\ \frac{(80 + 10s)^2}{2} &\geq 4,050 \end{aligned}$$

  which is true only when $s = 1$, or equivalently when the merger eliminates Firm 12's marginal cost.

  - Alternatively, you could note that cost synergies affect demand only via equilibrium price, an you could therefore solve for the value of s such that equilibrium price is the same after the merger.Of course, the answer is $s = 1$ using this approach but the analysis is much easier. This little bit of insight though saved time and effort!

Horizontal Mergers in Differentiated Good Markets

Previous analysis assumed homogenous good markets. But most markets are differentiated good markets. What are the gains to merging in these kinds of markets?

Example: Three firms, three goods, marginal costs are zero and demands are given by

$$y_1 = 1 - p_1 + s(p_2 + p_3)$$
$$y_2 = 1 - p_2 + s(p_1 + p_3)$$
$$y_3 = 1 - p_3 + s(p_1 + p_2)$$

Assume substitutes so $1 > s > 0$. Firms compete in prices.

Benchmark Nash Equilibrium

Firm 1 chooses price to solve

$$\max_{p_1} p_1 \times \left(1 - p_1 + s(p_2 + p_3)\right)$$

Differentiating and solving for best reply,

$$p_1 = \frac{1}{2}[1 + s(p_2 + p_3)]$$

Imposing symmetry,

$$p^\star = \frac{1}{2(1-s)},\ y^\star = \frac{1}{2(1-s)},\ \pi^\star = \frac{1}{4(1-s)^2}$$

Merger Nash Equilibrium

Suppose Firms 1 and 2 merge. The firms hire a marketing firm to conduct focus groups and choose "Firm 12" as the new name.

Important In contrast to homogenous good case, the new firm continues to produce both types of goods.

Firm 12 chooses p_1 and p_2 to maximize profits from both products:

$$\max_{p_1,p_2} \left\{ \underbrace{p_1\Big(1-p_1+s(p_2+p_3)\Big)}_{\pi_1(p_1,p_2,p_3)} + \underbrace{p_2\Big(1-p_2+s(p_1+p_3)\Big)}_{\pi_2(p_1,p_2,p_3)} \right\}$$

Differentiating,

$$\frac{\partial \pi_{12}}{\partial p_1} = 0 \Rightarrow \underbrace{1-2p_1+s(p_2+p_3)}_{\frac{\partial \pi_1}{\partial p_1}} + sp_2 = 0$$

$$\frac{\partial \pi_{12}}{\partial p_2} = 0 \Rightarrow \underbrace{1-2p_2+s(p_1+p_3)}_{\frac{\partial \pi_2}{\partial p_2}} + sp_1 = 0$$

Merger Effects on Nash Eqm. Prices and Profits

One Strategy: Solve for the new Nash Equilibrium. Address the merger's effects by comparing equilibrium prices and profits to the benchmark Nash Equilibrium.

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Alternative Strategy: Evaluate $\frac{\partial \pi_{12}}{\partial p_1}, \frac{\partial \pi_{12}}{\partial p_2}$ at $(p_1^\star, p_2^\star, p_3^\star)$. This tells us whether the new firm will increase prices at the old Nash Equilibrium, ceteris paribus.

Note that $\frac{\partial \pi_1(p^\star)}{\partial p^\star} = 0$, $\frac{\partial \pi_2(p^\star)}{\partial p^\star} = 0$, and $sp^\star > 0$ so the derivatives for Firm 12 at the old equilibrium prices are strictly greater than zero.

To lower the value of the derivatives:

- Firm 12 increases the prices of its goods ($p_1 \uparrow$, $p_2 \uparrow$) and
- Firm 3 responds by also raising its price ($p_3 \uparrow$) because prices are strategic complements (look at the BRs).

Results:

1. Merger leads to higher prices.
2. Merger is profitable since profits for the merged firm are $\pi_1 + \pi_2$ and it can generate the old equilibrium profits by choosing $p^\star$.

Motivating Case

Coca-Cola Bottling Company of the Southwest vs Federal Commission

The Market: Bottling, distribution, and sale of carbonated soft drinks (CSDs) in San Antonio.

- Take-home market consists of all soft drinks sold for consumption at some place other than where they are purchased - i.e., stores.
- Cold drink market is composed of those outlets where soft drinks are purchased for immediate consumption - vending machines, restaurants, etc.

Main Suppliers:

- Four branded CSD suppliers: Coca-Cola Bottling Co. (CCSW), San Antonio Dr. Pepper Bottling Co. (DP-SA), and Pepsi.
- CCSW is a franchisee for Coca-Cola, Sunkist, and other concentrate companies. DP-SA was a wholly own subsidiary of Dr. Pepper and a franchisee for Canada Dry, Big Red, RC, Crush, Hires and other brands. Pepsi is company owned.

- Private label CSD are sold in retail chains that own the trademark (e.g., HEB).
- Warehouse suppliers (e.g., Shasta).

Note: Franchisor grants franchisee an exclusive right in a specified geographic area to make and sell soft drinks in bottles and cans bearing the franchisor's trademark.

The Merger:

CCSW acquired Dr. Pepper and Canada Dry franchises from DP-SA.

- DP-SA sold its other franchisees to Grant- Lydick.

The Charge

The acquisition of Dr. Pepper and Canada Dry substantially lessened competition, violating Section 5 of FTC Act and Section 7 of the Clayton Act.

- Administrative law judge had ruled in favor of the acquisition.
- Complaint Counsel appealed and the case was reviewed by the Commission.

Main Issue: Market Definition

III. Mergers and Acquisitions in Practice: Government Guidelines

III. DOJ Merger Guidelines: How is a merger evaluated?

- The Department of Justice (DOJ) is tasked with approving potential mergers and acquisitions in order to ensure that such changes of ownership meet the standards of antitrust law (e.g., Sherman, Clayton, Robinson-Patman).
- Usually, the DOJ has only a matter of months to understand the implications of a merger and we've already established that each year there are thousands of mergers across disparate industries.
- To increase efficiency, the DOJ simplifies things in two important ways:
  1. It uses several "sufficient statistics" to simplify the analysis. Conducting a merger analysis properly requires computing pre and post equilibria which requires a lot of time and data to do properly. Instead, the hope that is with a handful of simple statistics (and perhaps a simple model), we can capture 80% of the truth.
  2. It publishes guidelines for how it evaluates mergers. This is useful for prospective firms since a merger between two firms can be costly and time-consuming. These costs multiply when the government challenges the merger.

     For example, both companies are required to submit detailed (and proprietary) information about their business.

     Making the guidelines public enables firms to make better decisions about the future costs of a merger.

Market Definition

- Economic definition typically based on price correlations and cross price elasticities. Products that are close substitutes are in the same market.
- Antitrust definition is based on the Hypothetical Monopolist test:

"A market is defined as a product or group of products and a geographic area in which it is sold that a hypothetical, profit-maximizing firm, not subject to price regulation, that was the only present and future seller of those products in that area would impose a small but significant and non-transitory increase in price (SSNIP) above prevailing or likely future levels."

Idea: A "market" should contain products which compete with each other and be small enough such that consumers can choose not to participate. But how to define what a market is?

Big Question: Is there a simple, yet effective way (*i.e.*, a "sufficient statistic") of to identify a market as well as use the current equilibrium to forecast a future one?

Concentration Measures

- Order the firms by market share from largest to smallest. The m firm "concentration ratio" is given by

$$CR_m = \sum_{i=1}^{m} s_i$$

  Most frequently used indices are CR_4 and CR_8.

- Herfindahl-Hirschman Index (HHI) is given by

$$HHI = \sum_{i=1}^{N} (100 s_i)^2$$

  Range of the index is from 10,000/N (equal- sharing) to 10,000.

Properties of HHI

a. HHI decreases with number of firms.

b. HHI increases with the variance of the distribution of firm sizes.

c. Recall from the Cournot model that in equilibrium, each firm i's output satisfies the first order condition

$$(P^\star - c_i)/P^\star = s_i/\eta(Y^\star)$$

Multiplying by $10000 s_i$ and summing over all i yields

$$\sum_{i=1}^{N} 10000 s_i((P^\star - c_i)/P^\star = (HHI)/\eta(Y^\star)$$

In other words, HHI is proportional to a weighted average of the firms' percentage markups of price over cost. It is a summary statistic of market power.

- A market with a higher HHI has a higher average markup.
- Useful, since markups are not observable.

Diversion Ratios

- Relevant to industries where firms produce horizontally-differentiated goods.
- Consider the discrete choice framework we discussed earlier (*i.e.*, multinomial logit) where a consumer buys one of $J+1$ products.
- A diversion ratio, which measures the fraction of consumers that switch from one product to an alternative after a price increase, is a central calculation of interest to antitrust authorities for analyzing horizontal mergers.
- Mathematically, define (q_j, q_k) as demand for products j and k, respectively, and p_j as the price for product j then the Diversion ratio of product j to product k is

$$D_{jk}(p_j, p_{-j}) = \frac{\frac{\partial q_k}{\partial p_j}}{|\frac{\partial q_j}{\partial p_j}|} .$$

- Comments:
  - Similar to a cross-price elasticity.
  - Summing across options k (including option of not buying) implies ratios sum to one.

Why Are Diversion Ratios Useful?

- Consider an industry populated by J single-product firms. If firms j and k merge, the FOC for product j holding other prices including k fixed (*i.e.*, p_{-j}) is

$$\max_{p_j} (p_j - c_j) \times q_j(p_j, p_{-j})$$

The FOC is

$$0 = \underbrace{q_j + (p_j - c_j) \times \frac{\partial q_j}{\partial p_j}}_{\frac{\partial \pi_j}{\partial p_j}} + \underbrace{(p_k - c_k) \times \frac{\partial q_k}{\partial p_j}}_{\frac{\partial \pi_k}{\partial p_j}}$$

which is equivalent to

$$p_j = -q_j \times \left[\frac{\partial q_j}{\partial p_j}\right]^{-1} + c_j + (p_k - c_k) \times \underbrace{\frac{\partial q_k}{\partial p_j} / -\frac{\partial q_j}{\partial p_j}}_{D_{jk}}.$$

- Therefore, if a proposed merger involves firms with
  - high diversion ratios, we would expect a large increase in prices post-merger.
  - low diversion ratios, we would expect a small small in increase prices post-merger.

An Example

- Define the following matrix of diversion ratios where D_{j0} is diversion to the outside good:

$$D(p) = \begin{bmatrix} D_{10} & D_{12} & D_{13} \\ D_{21} & D_{20} & D_{23} \\ D_{31} & D_{32} & D_{30} \end{bmatrix}$$

- Consider consumers deciding between three fuel-efficient cars:
  Honda Civic, Toyota Prius, and a Tesla. The matrix of Diversion Ratios is:

from / to:	Civic	Prius	Tesla
Civic	50	40	10
Prius	50	30	20
Tesla	0	80	20

- If Honda and Toyota propose a merger, should the DOJ be primarily interested

  1. Diversion between the Civic and the Prius?
  2. Diversion from the Prius to all possible alternatives (the entire row)?
  3. All diversion ratios (e.g., diversion from Prius to Tesla, or aggregate diversion for the Prius)?

Challenge Criteria

The DOJ says it will not challenge a merger if post-merger HHI is

- Less than 1000
- Between 1000 and 1800, and $\Delta HHI < 100$;
- > 1800 and $\Delta HHI < 50$.

Remark: Post-merger HHI is calculated on the basis of pre-merger shares. Theory suggests that this is not a reasonable assumption.

What about Diversion Ratios?
The 2010 U.S. merger guidelines:

> *Diversion ratios between products sold by one merging firm and products sold by the other merging firm can be very informative for assessing unilateral price effects, with higher diversion ratios indicating a greater likelihood of such effects.*

Other Considerations

- Efficiency gains cannot be achieved by other means.
- Entry would be timely, likely and sufficient to deter or counteract any potential competitive effects.
- In the absence of merger, either party would be likely to fail, causing its assets to exit the market.

Back to the Coca-Cola Case

What is the Market Definition?

A. Product Market

1. CCSW argued that the relevant product market consists of all carbonated soft drinks (including national brand, private label, and warehouse brands) and certain non-carbonated soft drinks like iced tea, lemonade, and isotonic drinks.

2. Complaint Counsel argued that the relevant product market consists of all branded CSD.

- Branded CSD are characterized by: wide availability in take-home and cold drink distribution channels, direct-store-door delivery, and heavy promotion.

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2. Complaint Counsel argued that the relevant product market consists of all branded CSD.

- Branded CSD are characterized by: wide availability in take-home and cold drink distribution channels, direct-store-door delivery, and heavy promotion.

$\Rightarrow$ Commission ruled in favor of the latter definition.

Reasons:

1. Statements from both of CCSW's competitors that a 10% increase in price of all branded carbonated drinks would be profitable.

2. Internal documents indicate that the three suppliers of branded CSD only monitored prices of branded drinks.

3. Business records characterize competition as branded drinks only; they do not consider private label or warehouse brands as competition.

4. Testimony from managers of the bottling firms indicate that CSD suppliers only react to prices of other branded CSD, not to non-CSD prices.

B. Geographic Market

1. CCSW argued for a geographical market definition that included most of Texas, including the major cities of Austin, Houston, and Dallas.

2. Complaint Counsel argued for a narrower definition: the ten counties centered in San Antonio.

$\Rightarrow$ Commission rules in favor of the narrower market definition.

Reasons:

1. Testimony from bottlers in San Antonio indicated that they could profitably raise prices by as much as 10% without fear of outside competition.

2. Bottlers outside San Antonio testified that they would not ship into the San Antonio market even if price of branded CSD increased by 10%.

3. Exclusive territory contracts covered San Antonio, not Texas. They also prevent competition from outside bottlers and are vigorously enforced.

Market Concentration:

Dr. Pepper acquisition:

Pre-acquisition HHI	2807
Post-acquisition HHI	3421
$\rightarrow$ HHI increase	614

Canada Dry acquisition:

Pre-acquisition HHI	2807
Post-acquisition HHI	2862
$\rightarrow$ HHI increase	55

Ruling: Dr. Pepper acquisition denied, Canada Dry approved.