MEASURING THE INCENTIVE TO COLLUDE
The Vitamin Cartels, 1990–1999

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Measuring the Incentive to Collude

- **Collusion** *(cooperation with competitors)*
  - Core issue in **IO**
  - Main application of **repeated games**

- **Measuring the incentives of colluding firms**
  - Key step for economic analysis & antitrust policy

- **Mission impossible…**
  - Theory says anything can be equilibrium *(Folk Theorem)*.
    - Need to know firms’ payoffs, strategies, and beliefs.
  - But data don’t exist because:
    - Explicit collusion *(= cartel)* is *per se* illegal.
    - Tacit collusion is… tacit.

⇒ **End of the theorist-empiricist cooperation?**
## The Vitamin Cartels, 1990–1999
### One of the biggest Antitrust cases ever

<table>
<thead>
<tr>
<th>Rank</th>
<th>Product</th>
<th>Firm</th>
<th>Year</th>
<th>Country</th>
<th>Geographic scope</th>
<th>Fine ($ million)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Vitamins</td>
<td>Roche</td>
<td>1999</td>
<td>Switzerland</td>
<td>International</td>
<td>500</td>
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<tr>
<td>2</td>
<td>LCD panels</td>
<td>AU Optronics</td>
<td>2012</td>
<td>Taiwan</td>
<td>International</td>
<td>500</td>
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<td>3</td>
<td>Car parts</td>
<td>Yazaki</td>
<td>2012</td>
<td>Japan</td>
<td>International</td>
<td>470</td>
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<td>Car parts</td>
<td>Bridgestone</td>
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<td>Japan</td>
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<td>LG Display</td>
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<td>Korea</td>
<td>International</td>
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<td>6</td>
<td>Air transport</td>
<td>Air France &amp; KLM</td>
<td>2008</td>
<td>France &amp; Netherlands</td>
<td>International</td>
<td>350</td>
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<td>7</td>
<td>Air transport</td>
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<td>2007</td>
<td>Korea</td>
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<td>300</td>
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<td>7</td>
<td>Air transport</td>
<td>British Airways</td>
<td>2007</td>
<td>UK</td>
<td>International</td>
<td>300</td>
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<td>DRAM</td>
<td>Samsung</td>
<td>2006</td>
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<td>300</td>
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<td>10</td>
<td>Vitamins</td>
<td>BASF</td>
<td>1999</td>
<td>Germany</td>
<td>International</td>
<td>225</td>
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</table>

Source: U.S. Department of Justice, Antitrust Division. Ranking as of September 12, 2016.
# The Vitamin Cartels, 1990–1999

## Global Market Shares (%)

<table>
<thead>
<tr>
<th>Firm</th>
<th>Market</th>
<th>A</th>
<th>B1</th>
<th>B2</th>
<th>B5</th>
<th>B6</th>
<th>B9</th>
<th>B12</th>
<th>C</th>
<th>D3</th>
<th>E</th>
<th>H</th>
<th>Carotinoids</th>
<th>All</th>
</tr>
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<tbody>
<tr>
<td><strong>Roche</strong></td>
<td></td>
<td>48</td>
<td>44</td>
<td>54</td>
<td>36</td>
<td>49</td>
<td>39</td>
<td>–</td>
<td>46</td>
<td>43</td>
<td>46</td>
<td>45</td>
<td>83</td>
<td>46</td>
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<tr>
<td><strong>BASF</strong></td>
<td></td>
<td>30</td>
<td>2</td>
<td>30</td>
<td>21</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>7</td>
<td>13</td>
<td>28</td>
<td>–</td>
<td>16</td>
<td>17</td>
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<tr>
<td><strong>RP</strong></td>
<td></td>
<td>21</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>62</td>
<td>–</td>
<td>–</td>
<td>13</td>
<td>–</td>
<td>–</td>
<td>8</td>
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<tr>
<td><strong>Takeda</strong></td>
<td></td>
<td>–</td>
<td>31</td>
<td>3</td>
<td>–</td>
<td>12</td>
<td>23</td>
<td>–</td>
<td>26</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>7</td>
</tr>
<tr>
<td><strong>Eisai</strong></td>
<td></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>12</td>
<td>–</td>
<td>–</td>
<td>2</td>
<td></td>
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<tr>
<td><strong>Daiichi</strong></td>
<td></td>
<td>–</td>
<td>–</td>
<td>29</td>
<td>12</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>E. Merck</strong></td>
<td></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>5</td>
<td>–</td>
<td>–</td>
<td>10</td>
<td>–</td>
<td>10</td>
<td>–</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hoechst</strong></td>
<td></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>7</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>35</td>
<td>–</td>
<td>44</td>
<td>42</td>
<td>–</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cartel total</strong></td>
<td></td>
<td><strong>90</strong></td>
<td><strong>77</strong></td>
<td><strong>87</strong></td>
<td><strong>86</strong></td>
<td><strong>81</strong></td>
<td><strong>97</strong></td>
<td><strong>69</strong></td>
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<td><strong>97</strong></td>
<td><strong>100</strong></td>
<td><strong>93</strong></td>
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<tr>
<td><strong>Non-cartel</strong></td>
<td></td>
<td>1</td>
<td>23</td>
<td>13</td>
<td>14</td>
<td>19</td>
<td>3</td>
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<td>11</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

The Vitamin Cartels, 1990–1999

- Primary evidence
  - FBI investigation & DOJ prosecution in 1999, plus:
    - Litigation in America (Bernheim 2002)
    - EC enforcement in 2001 (EC 2003)
  - UK Competition Commission’s merger report (UKCC 2001)
    - BASF acquired Takeda’s vitamin business after the cartel

- Secondary evidence (books):
  - Connor, Global Price Fixing (2007)

⇒ Road map
  - Bernheim data → stage-game payoffs
  - EC & UK evidence → strategies & beliefs
  - Repeated-game model → incentives to collude
  - Counterfactuals → demand, fringe, & merger
QUESTIONS

- Why did some cartels survive for a decade while others collapsed after only a few years?

- How do mergers affect the incentive to collude?
Road Map

1. Data & Industry

2. Theory & Empirics

3. Findings
   (A) Who killed the vitamin C cartel?
   (B) Would BASF-Takeda merger have helped?
   (C) What kind of merger helps collusion?
FINDING THE BERNHEIM REPORT (2002)

**Background**

- Dr. B. Douglas Bernheim, expert witness and Stanford economist
- Report written in 2002 for the plaintiffs (= 4,000+ buyers of bulk vitamins)
- Multi-district class-action litigations, consolidated at the U.S. District Court for the District of Columbia
- Included in jury trials in 2003, which made it publicly available

**U.S. District Court for the District of Columbia**

(November 3, 2016)

Boxes full of documents

I was about to give up
VITAMIN C: PRICE & COST

Vitamin C: Production by Firm

Output (1,000 kg)

PRODUCT CHARACTERISTICS

- Each vitamin constitutes a separate market.
  - Demand side: Unique metabolic functions
  - Supply side: Unique manufacturing processes

- Homogeneous within each vitamin
  - Price is king in wholesale bulk chemicals.
  - No differentiation across producers
  - Widely viewed as commodities

- Geographically global market
  - Value >>> transport cost & import tariffs
  - Cross-border arbitrage by independent traders

DEMAND

Why we need vitamins
- Avoidance of deficiency symptoms
- Broader “health benefits” for humans
  - 92% of vitamin C and β-carotene is for human use.
- Animal nutrition
  - 87% of vitamin A, and 73% of vitamin E, are for animals.

Steady growth
- Population of humans and animals; GDP per capita
- “Perceived benefits” and “educational marketing”
- Sophistication of animal husbandry

Many small buyers
- 4,000+ class plaintiffs; 9,000+ purchasers
- Manufacturers of feeds, foods/beverages, and drugs
- Farmers, cooperatives, and premix blenders
  - Even Coca-Cola is only 2.14% of the vitamin C market.

DIFFERENT STROKES FOR DIFFERENT FOLKS

Figure 6-2: Premix composition by value

Source: Roche and BASF transaction data and premix formulations

Source: Bernheim (2002), p. 60.
SUPPLY

- All major suppliers in the cartels
  - About four cartel members in each vitamin
- European “Big Three”
  - Roche (Hoffmann-La Roche): a pioneering Swiss drug company
  - BASF (Badische Anilin und Soda Fabrik): a German chemical giant
  - RP (Rhône-Poulenc): a French chemical maker
- Japanese drug makers
  - Takeda, the largest in Japan, followed by Eisai, Daiichi
  - American companies had exited by the 1980s
    - E.g., Pfizer, Merck, American Home Products
- Mature technologies, stable market structure
  - No major innovations in production processes since 1980
  - No major entry or exit, except for the Chinese fringe

Source: Bernheim (2002); Conner (2007), Global Price Fixing, second edition.
THE CARTELS (I): BEGINNING

“We need to talk”
- June 7, 1989, Basel: Roche × BASF (vitamin heads)
  - Met to discuss cooperation in vitamins A & E
- August 1989, Zurich: RP (head of Animal Nutrition division)

Design
- Freeze market shares in 1988 for “foreseeable future”
- Split predicted 1990 sales proportionally to the quotas
- Quarterly meetings

“Let’s invite other people”
- 1990: Hoechst & Eisai
  - Vitamin B12, beta carotene, canthaxanthin, premixes
- 1991: Daiichi, E. Merck, Takeda + {Sumitomo, Tanabe, Kongo}
  - Vitamins B1, B2, B5, B6, B9, C, H

THE CARTELS (II): OPERATIONS

“Perfect” monitoring (with time lag)
- Self-reported sales data
- Verified with government trade statistics
  - Published with lag

Punishment
- Threats of:
  - Reversion to competitive pricing
  - Indefinite breakdown of cartel
    - EC (2003) reports that “the three European producers presented Takeda with an ultimatum: unless it agreed to cut back its vitamin C sales, they would withdraw from the agreement” (p. 44)

- No indication of:
  - “Multi-market contact” style threats
  - “Carrot-and-stick” or other complicated punishment strategies
  - Nothing like “Price wars as part of equilibrium”

The Cartels (III): End

- Six “natural deaths” in 1994 or 1995
  - Unexpected fringe entry & expansion
    - Chinese state-owned enterprises (SOEs): B1, B6, B9, C
    - Il Sung of Korea: H
    - Archer Daniels Midland (ADM) & Coors Biotech: B2
  - August 24, 1995: Final meeting of vitamin C cartel

- Ten “forced terminations” in 1998 or 1999
  - January 1999: RP applied for Corporate Leniency Program
  - February 1999: RP managers tape-recorded the cartel meeting
    - Roche & BASF pled guilty and agreed to pay $725 million fines

- Mergers
  - RP’s merger with Hoechst to become Aventis
  - BASF’s acquisition of Takeda’s vitamin businesses in 2001

ROAD MAP

1. DATA & INDUSTRY

2. THEORY & EMPIRICS
   Step 1: Demand & Costs
   Step 2: Profits
   Step 3: Values

3. FINDINGS
   (A) Who killed the vitamin C cartel?
   (B) Would BASF-Takeda merger have helped?
   (C) What kind of merger helps collusion?
**Step 1**
**Demand & Supply**

- **Linear demand**
  
  \[ Q_t^D = \alpha_0 + \alpha_1 P_t + \alpha_2 X_t + \epsilon_t. \]  

- **Market clearing (demand = supply)**
  
  \[ Q_t^D = Q_{car,t} + Q_{fri,t}. \]  

- **Fringe supply**
  
  \[ Q_{fri,t} = \kappa_t, \]  
  \[ Q_{fri,t} = \lambda_t P_t, \text{ and} \]  
  \[ Q_{fri,t} = \kappa + \lambda_t P_t. \]
**Step 1**

**Demand & Supply (cont.)**

- Cournot FOC (before/after the cartel)

\[
P_t + \frac{dP}{dQ_t} \times q_{i,t} = c_{roche,t}^{obs} + \gamma_i + \eta_{i,t} \quad \text{if } I_t = 0
\]

(8)

- GMM with 3 moment conditions

\[
\bar{m}_1 (\theta) = \sum_y \bar{\varepsilon}_y \cdot Z_y,
\]

\[
\bar{m}_2,i (\theta) = \sum_y \bar{\eta}_{i,y} \cdot W_{i,y},
\]

\[
\bar{m}_3 (\theta) = \sum_t \bar{\eta}_t \cdot X_t,
\]

\[
\hat{\theta}_{gmm} = \arg \min_{\theta} \bar{m} (\theta)' I \bar{m} (\theta),
\]
# Step 1

## Demand & Supply (cont.)

### Table 2: GMM Estimates of Demand and Costs (Vitamin C)

<table>
<thead>
<tr>
<th>Model Specification of fringe</th>
<th>Time-varying intercept ( Q_{frt} = \kappa_t ) (Baseline)</th>
<th>Time-varying slope ( Q_{frt} = \lambda_t P_t )</th>
<th>Time-invariant intercept and time-varying slope ( Q_{frt} = Q_{frt,1990} + \lambda_t P_t )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha_0 )</td>
<td>-0.434 ( (3.375) )</td>
<td>0.066 ( (2.313) )</td>
<td>-0.068 ( (2.330) )</td>
</tr>
<tr>
<td>( \alpha_1 )</td>
<td>-0.330 ( (0.002) )</td>
<td>-0.248 ( (0.002) )</td>
<td>-0.312 ( (0.005) )</td>
</tr>
<tr>
<td>( \alpha_2 )</td>
<td>0.391 ( (0.011) )</td>
<td>0.323 ( (0.007) )</td>
<td>0.364 ( (0.009) )</td>
</tr>
<tr>
<td>( \gamma_{roche} )</td>
<td>0.011 ( (2.597) )</td>
<td>-0.188 ( (4.400) )</td>
<td>0.107 ( (11.813) )</td>
</tr>
<tr>
<td>( \gamma_{takeda} )</td>
<td>3.194 ( (0.626) )</td>
<td>3.136 ( (0.925) )</td>
<td>3.262 ( (2.263) )</td>
</tr>
<tr>
<td>( \gamma_{c.merck} )</td>
<td>4.474 ( (0.168) )</td>
<td>4.426 ( (0.234) )</td>
<td>4.485 ( (0.580) )</td>
</tr>
<tr>
<td>( \gamma_{basf} )</td>
<td>4.882 ( (0.152) )</td>
<td>4.880 ( (0.157) )</td>
<td>4.914 ( (0.300) )</td>
</tr>
<tr>
<td>Moment conditions ( m_1, m_2, m_3 )</td>
<td>( m_1, m_2 )</td>
<td>( m_1, m_2 )</td>
<td>( m_1, m_2 )</td>
</tr>
<tr>
<td>Number of months</td>
<td>112</td>
<td>112</td>
<td>112</td>
</tr>
</tbody>
</table>

*Note: Standard errors in parentheses are based on 1,000 block-bootstrap samples, where each block consists of 12 consecutive months of a calendar year. See Appendix C.3 for vitamins A and E, and beta carotene.*
STEP 2
PROFITS UNDER CARTEL, DEVIATION, & COMPETITION

- Profits

\[ \pi_{i, \tau | t} = (P_{i, \tau | t} - c_{i, t}) q_{i, \tau | t}, \]  

(7)

- Three cases

  - \( \pi^C_{i, \tau | t} \): Cartel maximizes its joint profit via quotas
    - Its target price is “monopoly” price
  
  - \( \pi^D_{i, \tau | t} \): Deviation (non-compliance) for 3 periods
    - Lagged perfect monitoring
  
  - \( \pi^N_{i, \tau | t} \): Static Nash if someone has ever cheated
    - Punishment (trigger strategy)
STEP 2
Actual cartel price ≈ Monopoly price

Graph showing the comparison of actual cartel prices and monopoly prices from 1991 to 1998.
**Step 3**

Values & ICCs

- Payoff if comply with the cartel agreement
  \[ V_{i,\tau|t}^{C} = \sum_{s \geq \tau} \beta^{s-\tau} \pi_{i,s|t}^{C}, \]  
  \[ (9) \]

- Payoff if not comply
  \[ V_{i,\tau|t}^{D} = \sum_{s = \tau}^{\tau+2} \beta^{s-\tau} \pi_{i,s|t}^{D} + \sum_{s \geq \tau+3} \beta^{s-\tau} \pi_{i,s|t}^{N}, \]  
  \[ (10) \]

- Incentive compatibility constraint (ICC)
  - The trigger strategy is equilibrium iff
  \[ \min_{i \in I, \tau \geq t} (V_{i,\tau|t}^{C} - V_{i,\tau|t}^{D}) \geq 0. \]  
  \[ (11) \]
**Step 3**

**Values & ICCs (cont.)**

![Graph showing Fringe Output over time with annotations](image)

*Note: The explosion mark in 1992 represents the NATO bombing of vitamin C plants in Bosnia, which ignited the Chinese industrial policy. Source: EC (2003), Bernheim (2002).*
A string of “shocks”:
(1) “Two-step fermentation” method invented
(2) The Bosnian war, ’92–’95
(3) Economic liberalization (Deng’s speech ‘92)

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Source: EC (2003), Bernheim (2002).
**Step 3**
**Values & ICCs (cont.)**

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2. The Bosnian war, ’92–’95
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*Note:* The explosion mark in 1992 represents the NATO bombing of vitamin C plants in Bosnia, which ignited the Chinese industrial policy.
*Source:* EC (2003), Bernheim (2002).
STEP 3
VALUES & ICCs: INDIVIDUAL INCENTIVES

Individual Firms' Incentives
(Point estimates at beta = 0.8)
Collective Incentive = Lower Envelope of Individual Incentives
(Point estimates and confidence intervals at beta = 0.8)
...Meanwhile in Other Vitamin Markets

Vitamin A

- Estimate (beta = 0.8)
- 95% confidence interval
- 99% confidence interval

Vitamin E

- Estimate (beta = 0.8)
- 95% confidence interval
- 99% confidence interval

Beta Carotene

- Estimate (beta = 0.8)
- 95% confidence interval
- 99% confidence interval
ROAD MAP

1. DATA & INDUSTRY

2. THEORY & EMPIRICS
   Step 1: Demand & Costs
   Step 2: Profits
   Step 3: Values

3. FINDINGS
   (A) Who killed the vitamin C cartel?
   (B) Would BASF-Takeda merger have helped?
   (C) What kind of merger helps collusion?
Let’s compare the following counterfactuals:

- The cartel’s “dream world” scenario, in which
  - Fringe supply had stopped growing after 1994; and
  - Demand growth had not slowed down after 1994.
  - Let’s call it Scenario #1

- But things happened:
  - Scenario #1 – “no China” dream = Scenario #2
  - Scenario #1 – “no slow-down” dream = Scenario #3

- And the reality:
  - Scenario #1 – ALL DREAMS = Actual
FINDING 1
WHO KILLED THE VITAMIN C CARTEL?

($ million)

- Actual Cartel Period
- Scenario 1 (Demand slowdown = NO; Fringe growth = NO)
- Scenario 2 (Demand slowdown = NO; Fringe growth = YES)
- Scenario 3 (Demand slowdown = YES; Fringe growth = NO)
- Actual (Demand slowdown = YES; Fringe growth = YES)
Could this merger have saved the vitamin C cartel?

Assumptions:
1. BASF-Takeda inherits Takeda’s marginal costs.

\[
C_{basf, \tau | t}^{post} = (1 - \sigma) \times \min \left\{ C_{takeda, \tau | t}^{pre}, C_{basf, \tau | t}^{pre} \right\} = (1 - \sigma) \times C_{takeda, \tau | t}^{pre}
\]

(18)

2. Physical capacities do not bind.

3. Cartel quotas are based on static-Nash shares in 1990.

Based on:
- The U.K. Competition Commission’s assessment (‘01)
- The EC judgment (‘03)
**Finding 2**

If BASF-Takeda Merger *before 1991*

---

**Table 3: Cartel Stability under Hypothetical BASF-Takeda Merger in 1990**

<table>
<thead>
<tr>
<th>Merger scenario</th>
<th>No merger</th>
<th>0</th>
<th>0.05</th>
<th>0.1</th>
<th>0.15</th>
<th>0.2</th>
<th>0.25</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
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<tbody>
<tr>
<td>Synergy ((\sigma))</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collusive incentive</td>
<td>329</td>
<td>485</td>
<td>512</td>
<td>483</td>
<td>450</td>
<td>411</td>
<td>367</td>
<td>318</td>
<td>202</td>
<td>64</td>
</tr>
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<td>Coordinated effect</td>
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<td>156</td>
<td>183</td>
<td>154</td>
<td>121</td>
<td>82</td>
<td>38</td>
<td>-12</td>
<td>-127</td>
<td>-264</td>
</tr>
<tr>
<td>(% change)</td>
<td>±0%</td>
<td>+47%</td>
<td>+55%</td>
<td>+47%</td>
<td>+37%</td>
<td>+25%</td>
<td>+11%</td>
<td>-4%</td>
<td>-31%</td>
<td>-80%</td>
</tr>
</tbody>
</table>

*Note:* The numbers (in thousand dollars) indicate the point estimates of the cartel’s collective incentive in equation (14) as of August 1995 under \(\beta = 0.8\). The first column shows our baseline estimates without merger. The other columns show results under the counterfactual BASF-Takeda merger in 1990 with specific levels of efficiency gain ("synergy"). See equation (22) for the definition of synergy, \(\sigma\).
# Finding 3

**Which Merger Helps Cartel Stability?**

Table 4: Cartel Stability under Six Different Mergers

<table>
<thead>
<tr>
<th>Merger scenario</th>
<th>Marginal cost* ($/kg)</th>
<th>Num. of firms*</th>
<th>HHI* ($ thousand)</th>
<th>Collusive incentive** (%) change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Roche</td>
<td>Takeda</td>
<td>E. Merck</td>
<td>BASF</td>
</tr>
<tr>
<td>No merger</td>
<td>6.26</td>
<td>9.44</td>
<td>10.72</td>
<td>11.13</td>
</tr>
<tr>
<td>Merger 1</td>
<td>6.26</td>
<td>9.44</td>
<td>10.72</td>
<td>-</td>
</tr>
<tr>
<td>Merger 2</td>
<td>6.26</td>
<td>9.44</td>
<td>-</td>
<td>11.13</td>
</tr>
<tr>
<td>Merger 3</td>
<td>6.26</td>
<td>-</td>
<td>10.72</td>
<td>11.13</td>
</tr>
<tr>
<td>Merger 4</td>
<td>6.26</td>
<td>9.44</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Merger 5</td>
<td>6.26</td>
<td>-</td>
<td>10.72</td>
<td>-</td>
</tr>
<tr>
<td>Merger 6</td>
<td>6.26</td>
<td>-</td>
<td>-</td>
<td>11.13</td>
</tr>
</tbody>
</table>

*Note: We do not consider synergy in this subsection (i.e., $\sigma = 0$).

* As of December 1990 (i.e., immediately before the beginning of the vitamin C cartel).

** Collective incentive to collude as of August 1995 (i.e., its final month of operation on record) under $\beta = 0.8$. 
CONCLUSION

- With “right” data & a repeated-game model, we can:
  1. Explain diverging fates of cartels
  2. Quantify the effects of demand & fringe
  3. Measure the “coordinated effects” of merger

- This research
  - “Perfect” monitoring (“Textbook” repeated-game model)
  - Quantity game (“Textbook” IO model)

- Future research
  - Private monitoring
  - Tacit collusion
  - Antitrust policy when cartels and mergers interact
  - Collusion & innovation