

More Ways to Price Discriminate: Alcoa, Vertical Integration, and Intertemporal Pricing

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Key Definitions

Vertical Integration

*When a single firm participates in more than one successive stage of the production process
(C&P p.395)

-Arbitrage

*When a consumer purchases a good with the intent to immediately resell in another market at a higher price and enjoy the profit

-Ingot

*A chunk of metal

History

- Aluminum Company of America (Alcoa) dominated the market for aluminum during the first half of the 20th century.
- 1912: Alcoa found guilty of using contracts to eliminate competition and entering into non-aggressiveness pact with foreign competitors.
- 1940: A case against Alcoa is dismissed
- 1945: Appellate court rules Alcoa guilty of antitrust violations.
- Alcoa controlled 91% of the primary market. In the 1940 case, including the secondary market and excluding the aluminum used by Alcoa gave Alcoa 33% market share, not enough to be a monopoly. Judge Hand reversed that decision in 1945.

Issues

- Dominant Firm and Competitive Fringe (domestic entry, imports, secondary aluminum, magnesium)
- Does the extent of the fringe matter?
- Judge Hand:
- “Nothing compelled [Alcoa] to keep doubling and redoubling its capacity before others entered the field. It insists that it never excluded competitors; but we can think of no more effective exclusion than progressively to embrace each new opportunity as it opened.”
- “Alcoa always knew that the future supply of ingot would be made up in part of what it produced at the time, and, if it was far sighted, as it proclaims itself, that consideration must have had its share in determining how much to produce.”

Sources:

Swan, Peter L. 1980. *Alcoa: The Influence of Recycling on Monopoly Power*, *Journal of Political Economy*, 88:1, pp. 76-99;

Econ 349 course website:

<http://www.faculty.econ.northwestern.edu/faculty/hendel/durables.pdf>

Uses of Aluminum Ingots

- Iron and Steel Industry
 - * Reducing Agent
- Aircraft Industry
 - * Airplane parts
- Electric Cable
- Cooking Utensils
 - * Alzheimer's cookware
- Automobile Parts

The Firm's Derived Demand

- Each firm has a derived demand curve for aluminum
- Derived demand based on final output price, production technology, and input costs
- Derived demand obtained by setting value of marginal product of aluminum equal to price and solving for quantity of aluminum

Numeric Example (Lecture Notes)

-Assume Alcoa selling to two customers

1) Electric Cable (High elasticity because of copper substitute)

$$q_e = 60 - p_e$$

2) Aircraft industry (Inelastic because there were no substitutes)

$$q_a = 100 - p_a$$

-Assume Alcoa has a constant marginal cost = 20

Nondiscriminatory Pricing

-Use aggregate demand to find MR curve,
set $MR=MC$, find corresponding price

Aggregate Demand is: $P = 100 - Q$ if $Q < 40$

$$P = 80 - 0.5Q \text{ if } Q > 40$$

Use above to find: $MR = 100 - 2Q$ if $Q < 40$

$$MR = 80 - Q \quad \text{if } Q > 40$$

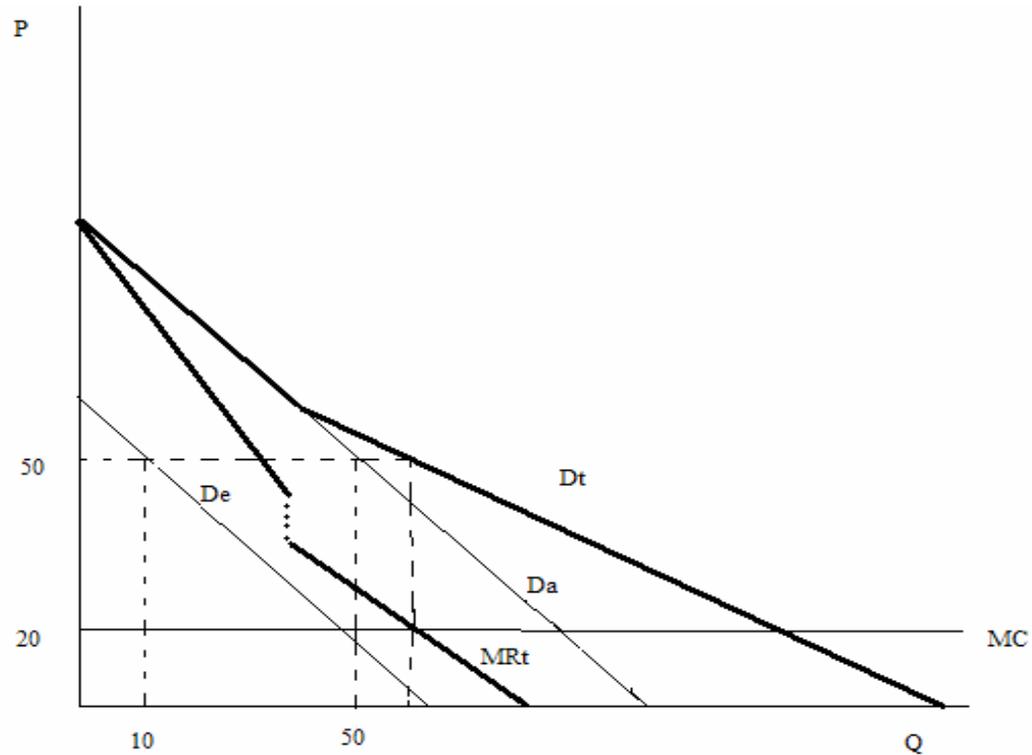
$$80 - Q = 20 \rightarrow Q = 60 \rightarrow P_a = P_e = 50$$

$$\pi = 1800$$

$$CS_a = .5(100 - P_a)q_a = .5(50)(50) = 1250$$

$$CS_e = .5(60 - P_e)q_e = .5(10)(10) = 50$$

Nondiscriminatory Pricing Graph



Third Degree Price Discrimination

- Alcoa could have maximized profits by charging separate prices in the two markets
- *Higher price to aircraft industry because demand was more elastic
- *Same parameters as previous example

3rd Degree Price Discrimination

Electric Cables

$$p_e = 60 - q_e$$

$$MR_e = 60 - 2q_e$$

$$MR_e = MC$$

$$60 - 2q_e = 20$$

$$q_e = 20$$

$$p_e = 40$$

$$\varepsilon_e = 2$$

$$CS_e = 200$$

Aircraft

$$p_a = 100 - q_a$$

$$MR_a = 100 - 2q_a$$

$$MR_a = MC$$

$$100 - 2q_a = 20$$

$$q_a = 40$$

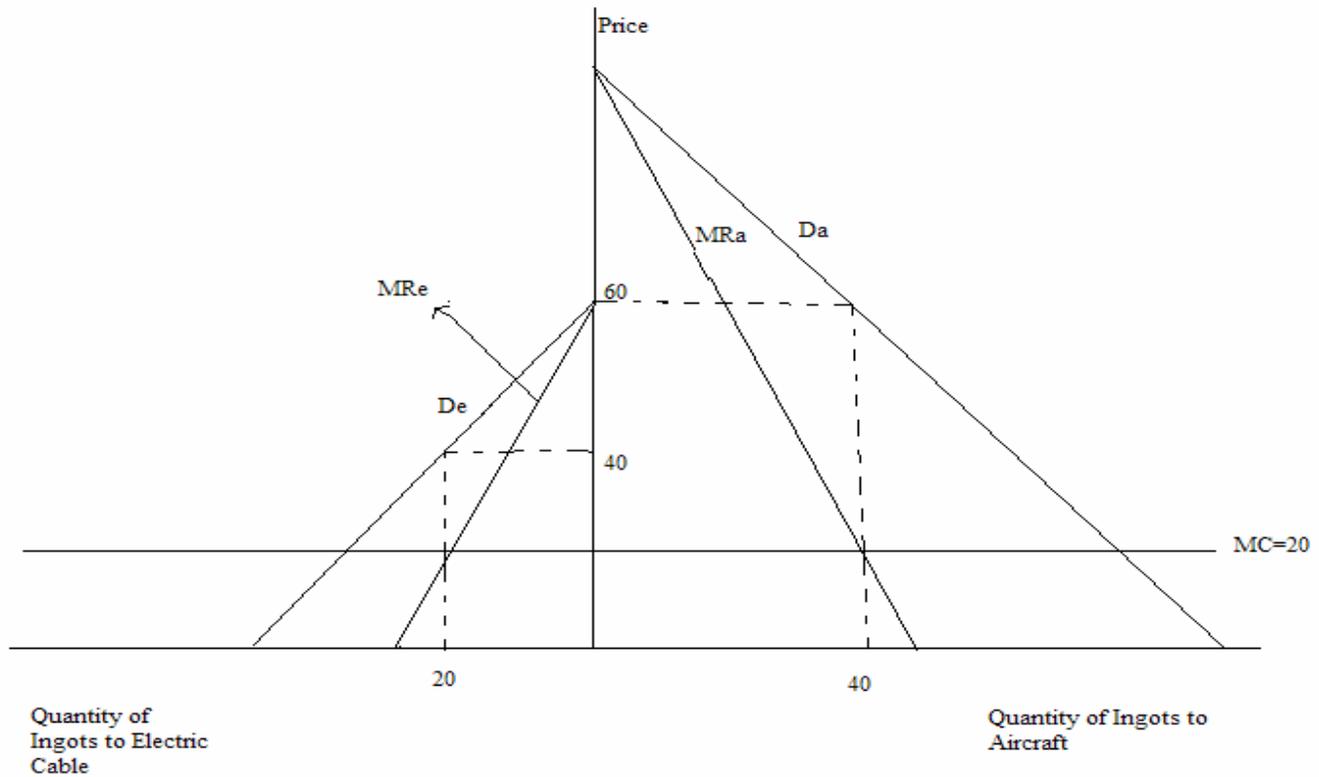
$$p_a = 60$$

$$\varepsilon_a = 1.5$$

$$CS_a = 800$$

$$\pi = p_e q_e + p_a q_a - c(60) = 2000$$

3rd Degree PD Graph



Comparison

Price Discrimination

$$p_a = 60$$

$$q_a = 40$$

$$CS_a = 800$$

$$p_e = 40$$

$$q_e = 20$$

$$CS_e = 200$$

$$\pi = 2000$$

Common Price

$$p_a = 50$$

$$q_a = 50$$

$$CS_a = 1250$$

$$p_e = 50$$

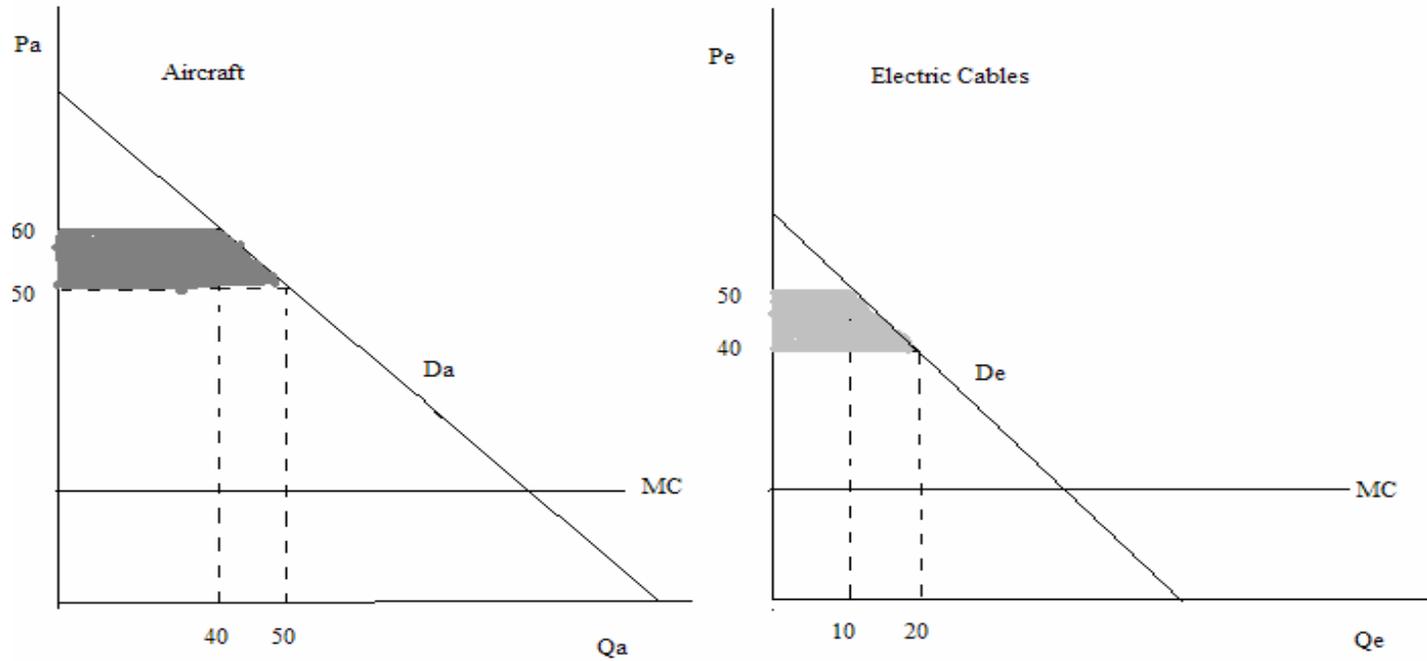
$$q_e = 10$$

$$CS_e = 50$$

$$\pi = 1800$$

Question: Does 3rd degree PD always lead to a less efficient outcome (relative to nondiscriminatory monopoly)?

Comparison Graph



NOTE: Figure Not Drawn to Scale (SAT Disclaimer)

But, was 3rd degree PD possible for Alcoa?

- NO!
- Arbitrage
 - * Easy for members of low price industries to turn around and resell ingots.
 - * Question: In the example, who would sell to who?

So, possibilities of arbitrage prevented Alcoa from using standard 3rd degree PD

So what to do?

- Vertical Integration

- *Alcoa could integrate into certain industries to prevent arbitrage

- *Which industries would it have made sense for Alcoa to integrate into?

- ~ If Alcoa integrates into the aircraft industry they must charge a low price to electric cable companies. The cable companies could then use the cheap ingots to produce aircraft parts!

- ~ If Alcoa integrates into the electric cable company they can charge a high price to the aircraft industry. Arbitrage is prevented because of Alcoa's vertical linkages.

RESULT: Made sense for Alcoa to integrate into industries with elastic derived demand curves.

Relative Elasticities

Industry

Cookware

Elasticity

Elastic ($\epsilon = -1.6$)

Electric Cable

Elastic (copper substitute)

Auto Parts

Elastic ($\epsilon = -1.5$)

Iron and Steel

Inelastic (no substitutes)

Aircraft

Inelastic (no substitutes in 1930)

Sources: Perry (1980) & Example 9.4 on p. 298 of text

What did they do?

- Sure enough Alcoa established vertical linkages in the cookware, electric cable, and auto parts industries.
- Alcoa did not vertically integrate into the two industries with inelastic derived demand curves.
- This behavior is consistent with the theory of Perry.
- Total welfare effect is ambiguous

Conclusions

- Alcoa's integration patterns were consistent with the hypothesis regarding 3rd degree Price Discrimination.
- But, could it have been something else?
 - * Correlation is not causation
 - * Maybe it was something else about the industries w/ high elasticities that caused Alcoa to integrate
 - * Costs of integration?
- A good argument, but strength of empirical evidence is questionable

Intertemporal Price Discrimination

- Main rationale: Alcoa knows that a certain percent of the aluminum it sells NOW will be recycled and resold (or reused) in the future.
- Problem: Alcoa will be competing with its own aluminum.
- Solution: take resale of aluminum into account when making quantity and price decisions.

Numerical Example

- Two time periods (no discounting) and growing demand:

$$Q_1 = 100 - P_1$$

$$Q_2 = 120 - P_2$$

Assume $MC = 0$

Source: Econ 349 course website;

<http://www.faculty.econ.northwestern.edu/faculty/hendel/durables.pdf>

Case 1: no recycling

- $MR=MC$ in every time period

$$TR_1 = P_1 * Q_1 = (100 - Q_1) * Q_1$$

$$MR_1 = 100 - 2Q_1 = 0$$

$$Q_1 = 50$$

$$P_1 = 50$$

$$\text{Profit} = 2500$$

$$TR_2 = P_2 * Q_2 = (120 - Q_2) * Q_2$$

$$MR_2 = 120 - 2Q_2 = 0$$

$$Q_2 = 60$$

$$P_2 = 60$$

$$\text{Profit} = 3600$$

Case 2: Competitive recycling

- Assume no marginal cost, but everything sold to firms in the first time period is sold competitively as recycled aluminum in the second period (i.e. Alcoa is a monopolist in the first period and a dominant firm in the second period).

$$P_2 = 120 - Q_2 - Q_1$$

$$Q_1 = 100 - P_1 + P_2$$

$$P_1 = 100 - Q_1 + P_2$$

Why?

Solve for Alcoa's P and Q

$$\text{Profit} = Q_1 \cdot (100 - Q_1 + P_2) + Q_2 \cdot (120 - Q_1 - Q_2)$$

$P_2 = 120 - Q_1 - Q_2$ implies:

$$\begin{aligned} \text{Profit} &= Q_1 \cdot (220 - 2Q_1 - Q_2) + Q_2 \cdot (120 - Q_1 - Q_2) \\ &= 220Q_1 - 2Q_1^2 - Q_1Q_2 + 120Q_2 - Q_1Q_2 - Q_2^2 \end{aligned}$$

...after taking derivatives and setting equal to 0...

$$Q_1 = 50$$

$$P_1 = 110$$

$$\text{Profit} = 5500$$

$$Q_2 = 10$$

$$P_2 = 60$$

$$\text{Profit} = 600$$

Was Alcoa affected by fringe?

- No!
- TOTAL profit is 6100 in both cases
- Supply of aluminum remains the same (the total supply in the second period is $Q_1+Q_2=60$)
- The fringe makes 0 profit (in the second period, it earns back what it paid in the first period)

Conclusions #2

- The presence of a secondary market does not necessarily affect a monopoly.
- Judge Hand's analogy to a legal monopoly (i.e. copyright-holders)
 - “The monopolist cannot prevent those to whom he sells from reselling at whatever prices they please...At any moment his control over the market will therefore be limited by that part of what he has formerly sold, which the price he now charges may bring upon the market, as second hand or reclaimed articles. Yet no one would think of saying that for this reason the patent or copyright did not confer a monopoly.”

Source: Swan (1980)