Course outline II

- Product differentiation
- Advertising competition
- Compatibility competition

Heterogeneous goods

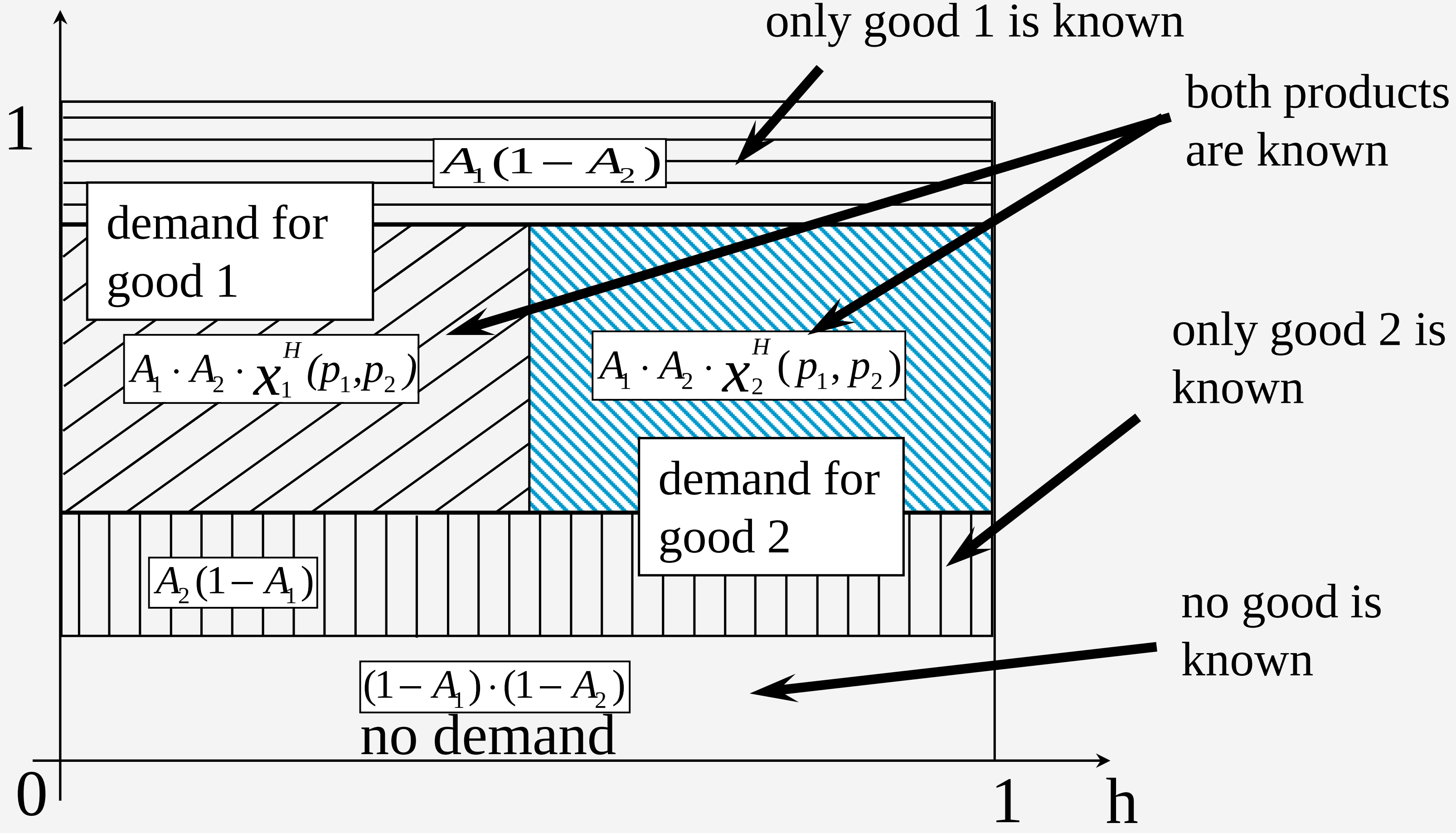
Advertising competition I

- Advertising and price competition for established products
- Advertising and price competition for new products
- Sequential advertising competition - entry and deterrence of entry
- Executive summary

Advertising competition II

- Grossman & Shapiro (1984)
- Two firms differ with regard to two aspects:
  - Information policy,
  - Horizontal differentiation (model “Hotelling“); here $\Delta a = 1$.
- We consider four groups of consumers:
  - Consumers are informed about both goods,
  - Consumers are informed about good 1 only,
  - Consumers are informed about good 2 only,
  - Consumers are not informed about any good.

Brand demand with name recognition A_1 and A_2



The demand function

Firm 1’s demand function:

$$x_1\left(p_1, p_2, A_1, A_2\right) = A_1\left[\left(1 - A_2\right) + A_2\left(\frac{1}{2} + \frac{p_2 - p_1}{2t}\right)\right]$$

$$= \underbrace{\underbrace{A_1\left(1 - A_2\right)}_{\text{monopolistic part of demand}} + \frac{A_1 A_2}{2}}_{\text{demand in case of equal prices}} + \frac{A_1 A_2}{2t}\left(p_2 - p_1\right)$$

intensity of competition

price advantage

Assumption:
price cap!

Cost of advertising

$$C(A_i) = \frac{1}{2}\gamma A_i^2 \quad (i = 1, 2)$$

γ is called the cost rate of advertising.

Exercise (fixed prices, simultaneous vs. sequential competition)

Consider two insurance companies being forced to sell their policies at a fixed price of 5.

Find the equilibrium name recognitions in a simultaneous advertising competition assuming

$c = 3, C(A_i) = 2A_i^2.$

Now assume that one company is the advertising leader.

S.: $A_1^{sim} = A_2^{sim} = A = \frac{2}{5}$ and $A_1^{seq} = \frac{3}{7}$, A_2^R

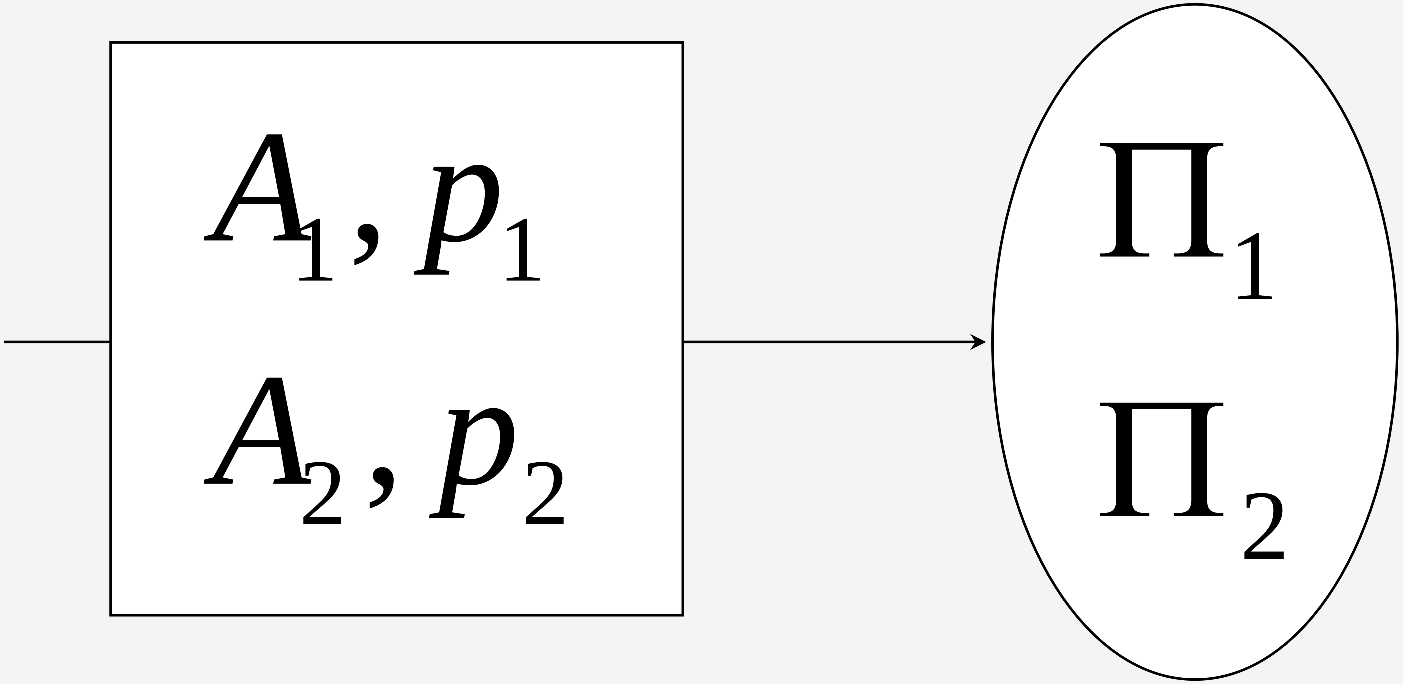
How does the price elasticity depend on name recognition?

Special case: $p_1 = p_2 = p \quad and \quad A_1 = A_2 = A$

$$\left|\varepsilon_{x_1,p_1}(A)\right| = \left|\frac{\partial x_1}{\partial p_1}\frac{p_1}{x_1}\right|_{\substack{p_1=p_2,\\ A_1=A_2}}\Bigg| = \frac{A^2}{2t}\frac{p_1}{A(1-A)+\frac{A^2}{2}} = \frac{Ap}{t(2-A)}$$

$$\frac{\partial\left|\varepsilon_{x_1,p_1}\right|}{\partial A} > 0$$

Advertising and price competition for established products



A_1, p_1

A_2, p_2

Π_1

Π_2

The simultaneous game

- Firm 1’s profit function:

$$\Pi_1(p_1, p_2, A_1, A_2) = (p_1 - c)x_1(p_1, p_2, A_1, A_2) - C(A_1)$$

$$= (p_1 - c)\left[A_1(1 - A_2) + A_1 A_2\left(\frac{1}{2} + \frac{p_2 - p_1}{2t}\right)\right] - \frac{\gamma}{2}A_1^2$$

- Firm 1’s “reaction functions”:

$$\frac{\partial \Pi_1}{\partial p_1} \overset{!}{=} 0 \rightarrow p_1 \overset{!}{=} \frac{p_2 + c + t}{2} + t\frac{1 - A_2}{A_2}$$

scope for raising prices due to incomplete information

$$\frac{\partial \Pi_1}{\partial A_1} \overset{!}{=} 0 \rightarrow \gamma A_1 \overset{!}{=} (p_1 - c)\left[1 - A_2 + A_2\left(\frac{1}{2} + \frac{p_2 - p_1}{2t}\right)\right]$$

Symmetric equilibrium

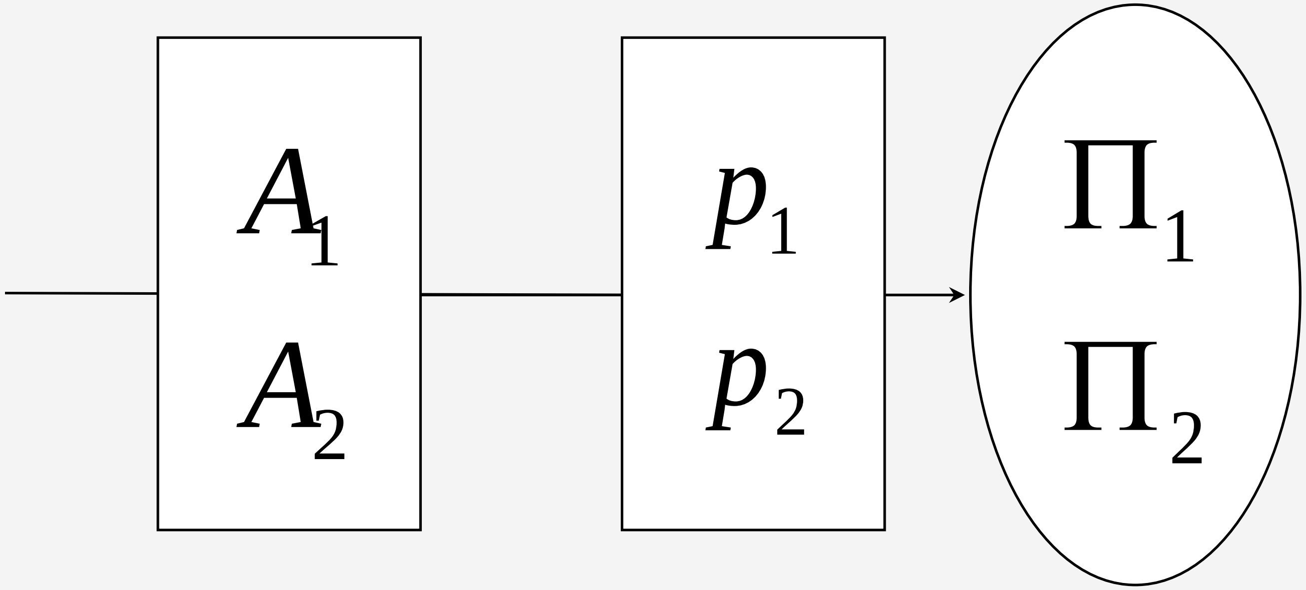
$$A_1^{sim} = A_2^{sim} = \frac{2}{1+\sqrt{\frac{2\gamma}{t}}} \text{ (need to assume } \gamma \geq \frac{t}{2}\text{)}$$

$$p_1^{sim} = p_2^{sim} = c + \sqrt{2\gamma t} \geq c + t = p^B$$

$$x_i^{sim} = \frac{2\sqrt{\gamma}}{\left(1+\sqrt{\frac{2\gamma}{t}}\right)^2} \quad and \quad \Pi_i^{sim} = \frac{2\gamma}{\left(1+\sqrt{\frac{2\gamma}{t}}\right)^2} \quad with \ \frac{\partial \Pi_i^{sim}}{\partial \gamma} > 0$$

Equilibrium: $\left(\left(c+\sqrt{2\gamma t}, \frac{2}{1+\sqrt{2\gamma/t}}\right), \left(c+\sqrt{2\gamma t}, \frac{2}{1+\sqrt{2\gamma/t}}\right)\right)$

Advertising and price competition for new products



Solving the pricing game (2^{nd} stage)

- Firms' reaction functions

$$p_1^R(p_2)=\frac{p_2+c+t}{2}+t\frac{1-A_2}{A_2} \quad and \quad p_2^R(p_1)=\frac{p_1+c+t}{2}+t\frac{1-A_1}{A_1}$$

- Bertrand-Nash equilibrium

$$\left(p_1^B=c+t\left(\frac{2}{3}\frac{A_2+2A_1}{A_2A_1}-1\right), p_2^B=c+t\left(\frac{2}{3}\frac{A_1+2A_2}{A_1A_2}-1\right)\right)$$

- Effect of name recognition on prices:

$$\frac{\partial p_1^B}{\partial A_1}=-\frac{2}{3}\frac{t}{A_1^2}<0 \quad and \quad \frac{\partial p_1^B}{\partial A_2}=-\frac{4}{3}\frac{t}{A_2^2}<0$$

Analyzing the advertising competition (1st stage)

$$\Pi_1^B(A_1, A_2) = \Pi_1\left(A_1, A_2, p_1^B(A_1, A_2), p_2^B(A_1, A_2)\right)$$

$$\frac{\partial \Pi_1^B}{\partial A_1} = \frac{\partial \Pi_1}{\partial A_1} + \frac{\partial \Pi_1}{\partial p_2} \cdot \frac{\partial p_2^B}{\partial A_1} + \frac{\partial \Pi_1}{\partial p_1} \cdot \frac{\partial p_1^B}{\partial A_1}$$

? ? >0 <0 =0

direct effect | strategic effect | (optimal prices)

Sequential versus simultaneous game

- In the simultaneous game, optimal advertising levels are chosen according to : $$\left.\frac{\partial \Pi_1^{sim}}{\partial A_1}\right|_{A_1 = A^{sim}} = 0$$

  (the direct effect - the only effect in this case - should be zero)
- In the sequential game, we found a negative strategic effect of advertising.
- This yields: $$A_i^{seq} < A_i^{sim}$$ $$x_i^{seq} < x_i^{sim}$$ $$p_i^{seq} > p_i^{sim}$$ $$\Pi_i^{seq} > \Pi_i^{sim} \quad (as\ can\ be\ shown)$$

Exercise (advertising competition)

Two tax consultants compete by fixing their level of advertising expenses, A_1 and A_2. The price of 10 for one consulting hour is given by regulation. Demand and profit functions are given by

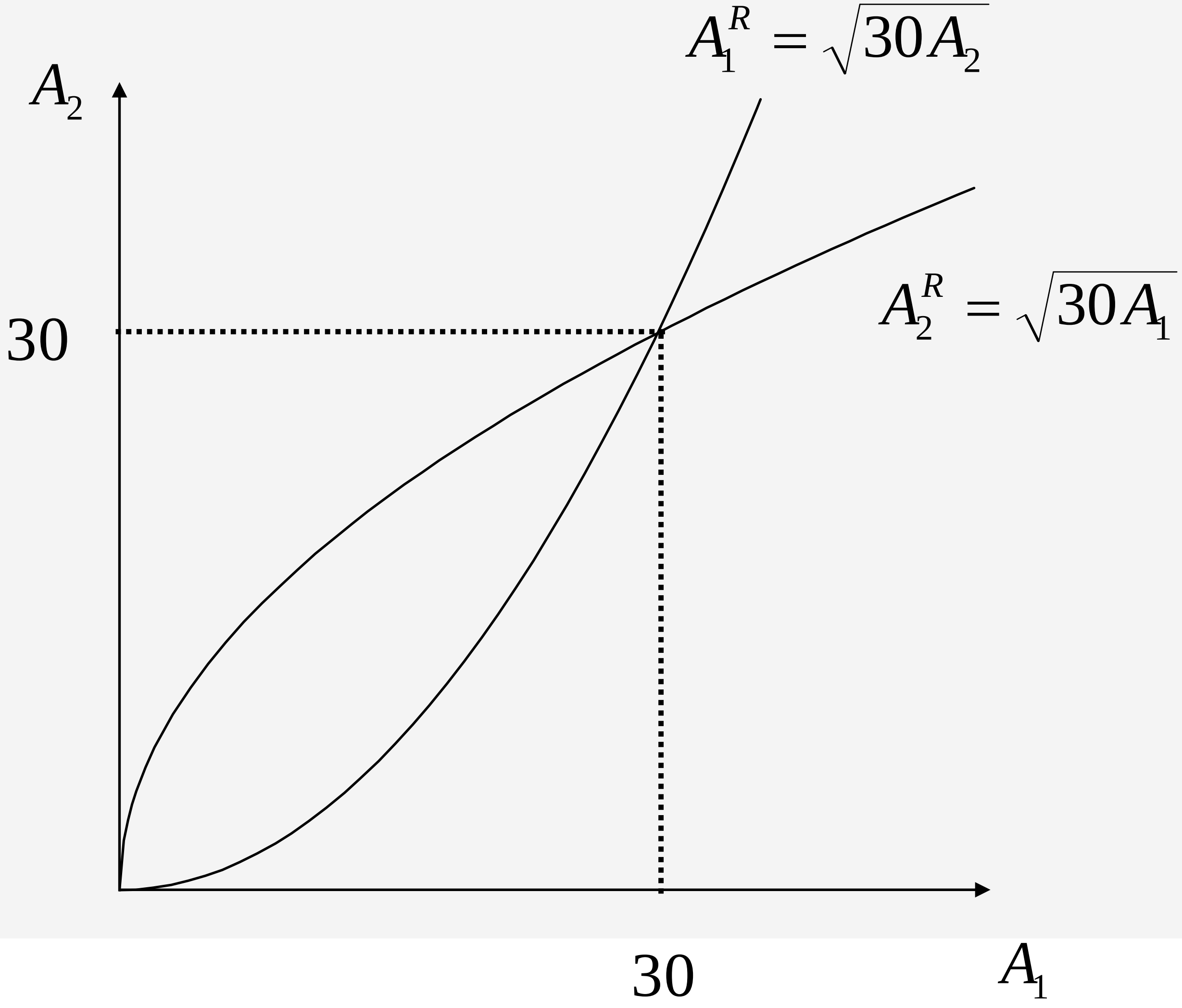
$$x_i(A_i, A_j) = 6 - 3\frac{A_j}{A_i} \quad with \quad \frac{A_1}{A_2} = \frac{A_2}{A_1} = 1 \quad for \quad A_1 = A_2 = 0$$

$$\Pi_i(A_i, A_j) = 10 \cdot x_i(A_i, A_j) - A_i \qquad (i, j = 1,2, i \neq j).$$

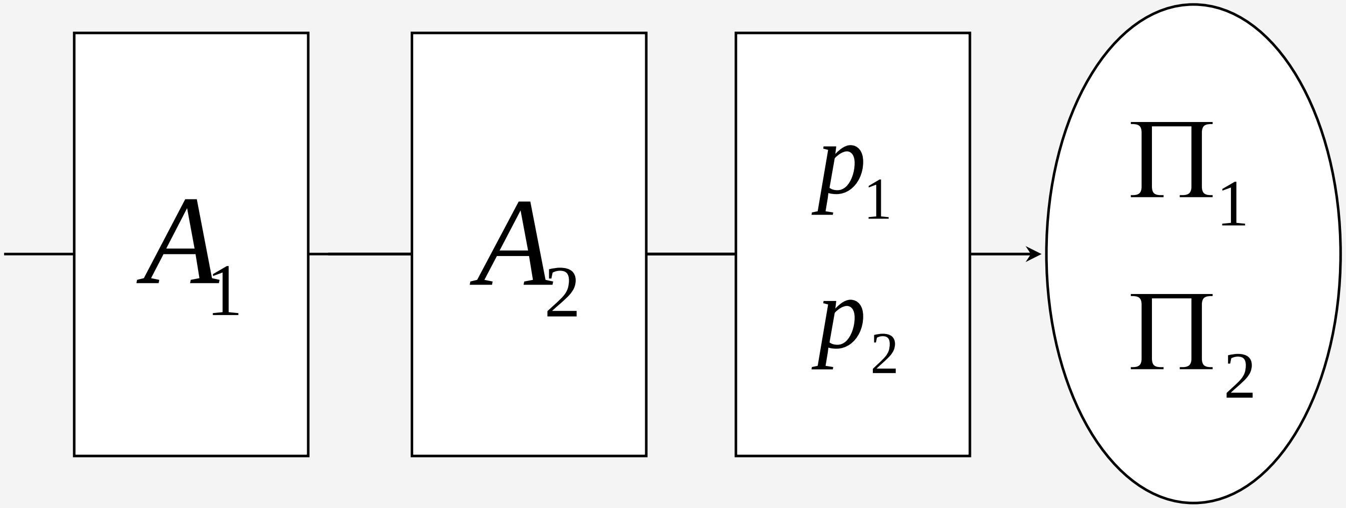
Calculate and interpret the reaction functions. Find the equilibria! How will the consultants feel about a law prohibiting advertising?

$\text{S.}:(30,30)$

Solution (advertising competition) graphically



Advertising and price competition with advertising leader



A_1

A_2

p_1

p_2

Π_1

Π_2

Entry deterrence

- Follower’s reduced profit function:

$$\Pi_2^B(A_1) = \Pi_2\left(A_1, A_2(A_1), p_1^B(A_1, A_2(A_1)), p_2^B(A_1, A_2(A_1))\right)$$

$$\frac{\partial \Pi_2^B}{\partial A_1} = \frac{\partial \Pi_2}{\partial A_1} + \frac{\partial \Pi_2}{\partial A_2}\frac{dA_2}{dA_1} + \frac{\partial \Pi_2}{\partial p_1}\cdot\left(\frac{\partial p_1^B}{\partial A_1} + \frac{\partial p_1^B}{\partial A_2}\frac{dA_2}{dA_1}\right) + \frac{\partial \Pi_2}{\partial p_2}(\ldots)$$

=0, optimal prices at 3rd stage

$$= \frac{\partial \Pi_2}{\partial A_1} + \frac{dA_2}{dA_1}\underbrace{\left[\frac{\partial \Pi_2}{\partial A_2} + \frac{\partial \Pi_2}{\partial p_1}\frac{\partial p_1^B}{\partial A_2}\right]}_{} + \frac{\partial \Pi_2}{\partial p_1}\frac{\partial p_1^B}{\partial A_1}$$

=0, optimal advertising at 2nd stage

$$= \frac{\partial \Pi_2}{\partial A_1} + \frac{\partial \Pi_2}{\partial p_1}\frac{\partial p_1^B}{\partial A_1} < 0$$

Executive summary

- Incomplete information about the products (A_i<1) increases the scope for raising prices.
- High advertising costs may have positive effects on firm’s profits.
- The advertising leader has the opportunity to build up a strategic entry barrier (limit advertising expenditure or limit name recognition).