Chapter H.3 – Horizontal and Vertical Cooperation

Competition Policy and Strategy

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English version of my 2020 lecture

Horizontal and Vertical Cooperation – Basics

- In addition to collusion (101(1) TFEU), there is legal horizontal cooperation
- Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements (2011/C 11/01), par. 20:
  1. Check whether agreement is capable of affecting trade between member states (101(1))
  2. If yes to 1., then "determine the pro-competitive benefits produced by that agreement and to assess whether those pro-competitive effects outweigh the restrictive effects on competition"
- ibid., par. 49: "The application of the exception rule of Article 101(3) is subject to four cumulative conditions, two positive and two negative:"
  - the agreement must contribute to improving the production or distribution of products or contribute to promoting technical or economic progress, that is to say, lead to efficiency gains;
  - the restrictions must be indispensable to the attainment of those objectives (. . .)
  - consumers must receive a fair share of the resulting benefits (. . .) so that they are at least compensated for the restrictive effects of the agreement; hence, efficiencies only accruing to the parties to the agreement will not suffice (. . .)
  - the agreement must not afford the parties the possibility of eliminating competition (. . .)

Horizontal and Vertical Cooperation – Basics

- Examples for horizontal cooperation (cf 2011/C 11/01 and 2000/C 118/03)
  - Information exchange
  - Agreements on R&D
  - Production/specialisation agreements
  - Purchasing agreements
  - Commercialisation/joint marketing activities
  - Agreements on standards
- Information exchange (paras. 55 et seq.)
  - Data shared directly or indirectly (e.g., through trade association or market research organization) between competitors
  - Possible efficiency gains: reduction of information asymmetries, benchmarking, inventory management, reduction of consumers' search costs and the improvement of consumers' choice
  - Possible detrimental effects: might facilitate collusion (awareness of competitors' market strategies); depends of characteristics of the market (concentration, transparency, stability, symmetry, complexity) and type of information
  - Possible that the object of the information sharing is actually a cartel

Horizontal and Vertical Cooperation – Information Exchange

- Cf pp. 362-363 in Tirole (1988)
- Differentiated goods Bertrand duopoly
- Each firm $i \in \{1, 2\}$ offers own variant
- Demand for variant i: $q_i(p_i, p_j) = a - bp_i + dp_j$ with $0 < d < b$ (see also Ch. G).
- Constant marginal cost of production
  - Marginal cost c_2 common knowledge
  - Marginal cost c_1 firm 1's private information; either low ($c_1 = c_L$) or high ($c_2 = c_H$).
  - Firm 2's beliefs $\Pr(c_1 = c_L) = y$ (accordingly, $\Pr(c_1 = c_H) = 1 - y$). Firm 2 thus expects 1's marginal cost:
$$c_1^e = yc_L + (1 - y)c_H.$$
- Both firms are risk-neutral
- Let p_1^L and p_1^H be firm 1's price for $c_1 = c_L$ and $c_2 = c_H$, respectively.

Horizontal and Vertical Cooperation – Information Exchange

- From firm 1's maximization problem,

$$\max_{p_1} \pi_1(p_1, p_2) = (p_1 - c_1)(a - bp_1 + dp_2),$$

- we get firm 1's reaction function

$$p_1(p_2) = \frac{a + dp_2 + bc_1}{2b}.$$

- Thus, firm 2 expects firm 1's best response:

$$\hat{p}_1^e(p_2) = yp_1^L + (1-y)p_1^H \tag{1}$$

$$= y\left(\frac{a + dp_2 + bc_L}{2b}\right) + (1-y)\left(\frac{a + dp_2 + bc_H}{2b}\right) \tag{2}$$

$$= \frac{a + dp_2 + bc_1^e}{2b}. \tag{3}$$

Horizontal and Vertical Cooperation – Information Exchange

- From firm 2's optimality condition,

$$\max_{p_2} \mathbb{E}(\pi_2(p_1, p_2)) = y(p_2 - c_2)(a - bp_2 + dp_1^L) + (1 - y)(p_2 - c_2)(a - bp_2 + dp_1^H)$$
$$= (p_2 - c_2)(a - bp_2 + dp_1^e),$$

- with $p_1^e = yp_1^L + (1 - y)p_1^H$, we get firm 2's reaction function:

$$p_2(p_1^e) = \frac{a + dp_1^e + bc_2}{2b}. \tag{4}$$

- Using (3) and (4), we get firm 2's equilibrium price

$$p_2^* = \frac{2ab + 2b^2c_2 + ad + bdc_1^e}{4b^2 - d^2}.$$

- Firm 2 expects an "average" best response function that lies between firm 1's actual reaction functions.

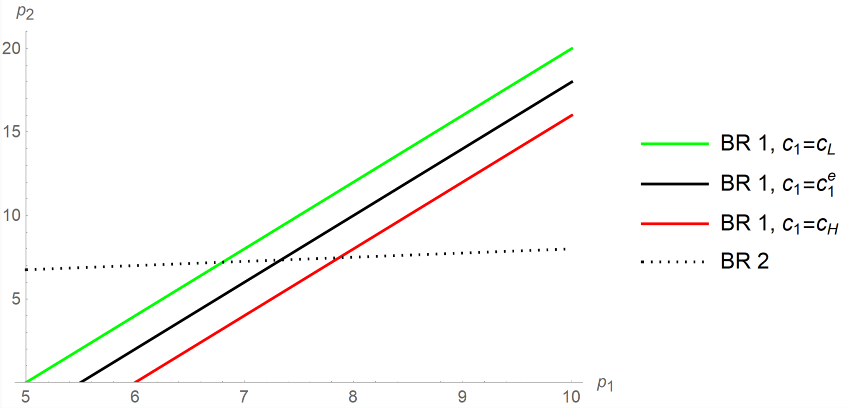

Figure 1: Best response functions with $a = 10$, $b = 1$, $d = 0.5$, $c_2 = 1$, $c_L = 0$, $c_H = 2$ and $y = 0.5$, such that $c^e = 1$.

Horizontal and Vertical Cooperation – Information Exchange

- Let p_2^L and p_2^H be firm 2's prices for $c_1 = c_L$ and $c_1 = c_H$, respectively, in case of full information.
- Firm 2's equilibrium price with uncertainty, p_2^* (intersection black and dotted line in Figure 1)
  - When firm 1 has low marginal cost, firm 2 sets a higher price than with full information ($p_2^* > p_2^L$, intersection green and dotted line in Figure 1)
  - When firm 1 has high marginal cost, firm 2 sets a lower price than with full information ($p_2^* < p_2^H$, intersection red and dotted line in Figure 1)
- Assume that the firms are allowed to exchange information before they compete in the market.
  - When marginal cost are low, firm 1 has no incentive to reveal its type as this would lead to a price reduction of firm 2 ($p_2^* > p_2^L$, see above), i.e., a reduction in firm 1's profits compared to the outcome with uncertainty.
  - When marginal cost are high, firm 1 has an incentive to reveal its type as this would lead to an increase in firm 2's price ($p_2^* < p_2^H$, see above), i.e., an increase in firm 1's profits compared to the outcome with uncertainty.

Horizontal and Vertical Cooperation – Information Exchange

- Case 1: verfiable information
    - When $c_1 = c_L$: firm 1 has no incentive to reveal information about its marginal cost because it pays off to keep firm 2 uninformed.
    - When $c_1 = c_H$: firm 1 truthfully reveals its cost type to firm 2.
    - Firm 2 knows that firm 1 only reveals its type when marginal costs are high. If firm 2 receives no information about firm 1's cost type, it knows that firm 1 has low cost!
    - Effect of information exchange is unclear as higher prices are possible.
- Case 2: non-verifiable information
    - When $c_1 = c_L$: firm 1 benefits from firm 2 believing that firm 1 has high marginal costs
    - When $c_1 = c_H$: firm 1 has an incentive to reveal its cost type.
    - Firm 1 would always claim to have high marginal costs, irrespective of its true cost type (Pooling-Equilibrium)
    - Firm 2 cannot verify the information on firm 1's cost type and anticipates that it will receive information that firm 1 had high cost $\Rightarrow$ information exchanged are not credible

Horizontal and Vertical Cooperation – Research and Development Agreements

- Research joint ventures (RJVs, paras. 111 et seq. in 2011/C 11/01)
  - Outsourcing certain R&D activities
  - Joint improvement of existing technologies
  - Cooperation in research and development and marketing
  - Cooperation agreement or jointly controlled company
  - May also affect “future” product markets
  - Potentially slows down (!) R&D activity (see next slides) or leads to collusion

- RJV-model; first w/o RJV.
- Stage 1
  - Firm $i \in \{1,2\}$ chooses research activity $x_i \in \mathbb{R}_+$.
  - Marginal cost $c_i = c - x_i - \beta x_j$, with $\beta \in [0,1]$ measuring the spillover of R&D activities between firms $\Rightarrow$ R&D-activity of firm i also reduces j's marginal cost (free-riding; increases in β).
  - Firm i's R&D-cost are x_i^2
- Stage 2
  - Firms compete in quantities (Cournot).
  - Demand function $q(p) = a - p$.
- Backwards induction

$$\max_{q_i} \ \pi_i(q_i, q_j, x_i, x_j) \ \forall i \in \{1,2\} \ \Rightarrow \ q_i(x_i, x_j) = \frac{a - 2c_i(x_i, x_j) + c_j(x_i, x_j)}{3}.$$

- Stage 2 profits: $\pi_i(x_i, x_j) = \left(\frac{a-2c_i(\cdot)+c_j(\cdot)}{3}\right)^2 - x_i^2$.

Horizontal and Vertical Cooperation – Research and Development Agreements

- Optimality condition stage 1

$$\max_{x_i} \ \pi_i(x_i, x_j) = \left(\frac{a - c + (2-\beta)x_i - (1-2\beta)x_j}{3}\right)^2 - x_i^2.$$

- Gives best response function

$$x_i(x_j) = \frac{(2-\beta)(a - c + x_j(2\beta - 1))}{(5-\beta)(1+\beta)}.$$

- If $\beta > 0.5$, we have $\frac{\mathrm{d}x_1}{\mathrm{d}x_2} > 0$: research activity **strategic complements**.
- If $\beta < 0.5$, we have $\frac{\mathrm{d}x_1}{\mathrm{d}x_2} < 0$: research activity **strategic substitutes**.
- Equilibrium research activity:

$$x_i^* = \frac{(\beta - 2)(a - c)}{7 + (\beta - 1)\beta}.$$

- We have $\frac{\mathrm{d}x_i^*}{\mathrm{d}\beta} < 0$ for all $\beta \in [0, 1]$. The higher β the lower the research activity in equilibrium due to more severe free-riding

Horizontal and Vertical Cooperation – Research and Development Agreements

- Suppose that firms install RJV
- Firms continue to compete on product market, but maximize joint profits when choosing research activity x_i:

$$\max_{x_i, x_j} \pi_i(\cdot) + \pi_j(\cdot) =$$
$$\left(\frac{a - c + (2-\beta)x_i - (1-2\beta)x_j}{3}\right)^2 + \left(\frac{a - c + (2-\beta)x_j - (1-2\beta)x_i}{3}\right)^2 - \left(x_i^2 + x_j^2\right).$$

- We get equilibrium research activity with RJV

$$x_i^{\text{RJV}} = \frac{(a-c)(\beta+1)}{(2-\beta)(4+\beta)}.$$

- Comparison of x_i^* and x_i^{RJV} shows that effect of RJV on research activity is ambiguous
- Two effects:
  - RJV internalizes spillovers, thereby reducing incentives for free-riding and increasing research activity
  - RJV decreases "pressure" to innovate of competitors

- RJV increases research activity if $\beta > 0.5$.

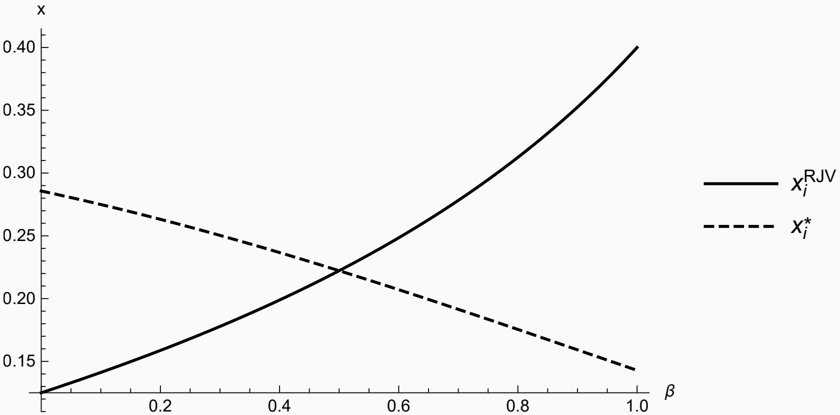

Figure 2: Research activity w/o RJV, x_i^*, and with RJV, x_i^{RJV}, with $a - c \equiv 1$.

Horizontal and Vertical Cooperation – Research and Development Agreements

- Suppose that firms can increase β to 1 in RJV (e.g., disclosure of research)
- Equilibrium research intensity then is $0.4(a-c)$ such that marginal costs are $c_i^{\text{RJV}} = \frac{9c-4a}{5}$
- Equilibrium output and price on stage 2 resp. reads $q_i^{\text{RJV}} = 0.6(a-c)$ and $p^{\text{RJV}} = 1.2c - 0.2a$
- Market price w/o RJV (exogenous $\delta \in [0,1]$) reads $p^* = a + \frac{6(a-c)}{2\beta+\beta^2-8}$, such that $p^* > p^{\text{RJV}}$.
- RJV increases consumer surplus and welfare

Horizontal and Vertical Cooperation – Further Examples

- Production/specialisation agreements (paras. 150 et seq. in 2011/C 11/01)
  - Production by one or more companies, separate joint venture
  - Horizontal or vertical
  - Realize gains from specialization
  - Might facilitate collusion or foreclosure
- Purchasing agreements (paras. 194 et seq., ibid.)
  - Purchase (intermediate) products jointly
  - Creation of buyer power, reduce input costs/increase quality, etc.
  - Horizontal or vertical
  - Might facilitate collusion or foreclosure
- Commercialisation/joint marketing activities (paras. 225 et seq., ibid.)
  - Joint retailing or marketing activities
  - Might facilitate collusion or foreclosure
- Agreements on standards (paras. 257 et seq., ibid.)
  - Establish standards for existing and future products, production processes, etc.
  - Only problematic if reduction in competition between different technologies

Horizontal and Vertical Cooperation – Purchasing Agreements and Buyer Power

- Firms can improve/establish buyer power by installing purchasing agreement
- Examples of buyer power
  - Listing fees
  - Slotting allowances
  - Advertising grants
  - Exclusivity clauses

Horizontal and Vertical Cooperation – Purchasing Agreements and Buyer Power

- Purchasing agreement: (downstream) firms become monopolistic buyer ⇒ monopsony (e.g., pp. 77–78 in Varian, 1981)
- Assumptions:
  - Homogeneous good supplied by multiple, price-taking downstream firms
  - Downstream firms purchase intermediate product at (wholesale) price w and sell good to final customers at (retail) price p. Demand reads $q(p) = a - p$.
  - Upstream firms are price-takers as well
  - Cost function upstream reads $c(q) = q^2$.
- Case 1: no buyer power
  - On downstream-level, we have $p = w$.
  - Supply of upstream firm

$$\max_q \ \pi_U = wq - q^2 \ \Rightarrow \ w = 2q.$$

  - In equilibrium, we have $p = 2q$ (retail price is equal to marginal cost upstream), such that $q_{\text{Case 1}} = \frac{a}{3}$.

Horizontal and Vertical Cooperation – Purchasing Agreements and Buyer Power

- Case 2: downstream firms establish purchasing agreement and behave as one monopsonistic buyer
  - Upstream, we still have $w = 2q$.
  - Downstream firms internalize increasing marginal cost/increase in wholesale prices such that

$$\max_q \ \pi_D = pq - \underbrace{2q^2}_{w(q)q} \ \Rightarrow \ p = \frac{q}{4}.$$

  - Equilibrium quantity decreases to $q_{\text{Case 2}} = \frac{a}{5}$
  - Monopsony decreases quantity/increases retail prices. Downstream profits increase from zero to $\frac{2a^2}{5}$.
- Here: buyer power reduces welfare
- Caveats
  1. Results are driven by assumption of increasing marginal cost
  2. Price-taking behavior upstream.

Horizontal and Vertical Cooperation – Purchasing Agreements and Buyer Power

- Bilateral monopoly
- Suppose that upstream marginal costs are a constant, c
- Efficient outcome obtains when retail price is equal to monopoly price $\frac{a}{2}$, with ensuing profits $\pi_M = \frac{a^2}{4}$
    - Bargaining over one indivisible unit (i.e., the monopoly quantity)
    - Fixed Fee T charged by upstream firm (e.g., part of two-part tariff; see future lectures and IO class!)
    - Disagreement profits upstream are c (e.g., sell to an outside market for price equals marginal costs)
    - Disagreement profits downstream are zero
- In equilibrium, $T \in [c, \pi_M]$
    - Any $T < c$ will lead to upstream firm breaking up negotiations as the firm would have to sell below marginal cost
    - Any $T > \pi_M$ will lead to downstream firm breaking up negotiations as the firm would make losses
- Upstream and downstream firm negotiate how to "split the pie"!

Horizontal and Vertical Cooperation – Slotting Allowances

- Model of slotting allowances of Shaffer (1991, RAND).
  - Perfectly competitive upstream producers of homogeneous good, constant marginal cost c
  - $\mathcal{N} = \{1, 2\}$ retailers downstream that sell good to final consumers, no further costs
  - Consumers perceive retailers as differentiated (e.g., location)
  - Demand of retailer $i \in \mathcal{N}$

$$q_i(p_i, p_j) = \frac{a - (1+\gamma)p_i + \gamma p_j}{2}.$$

  - If p_i increases by one unit, sales of i decrease by $1+\gamma$, whereas sales of j increase by γ. For $\gamma = 0$ ($\gamma \to \infty$) retailers are independent (perfect substitutes).
  - Timing
    1. Producers sets wholesale price w_i or two-part tariff (w_i, T_i) for each retailer i.
    2. Each retailer chooses from which producer to buy from
    3. retailers compete

Horizontal and Vertical Cooperation – Slotting Allowances

- Case 1: $T = 0$
  - Backwards induction: 3rd stage, competition between retailers for given w_i

$$\max_{p_i} \ \pi_i(p_i, p_j, w_i) = (p_i - w_i)\frac{a - (1+\gamma)p_i + \gamma p_j}{2} \ \forall \ i \in \{1, 2\}, i \neq j.$$

  - yields equilibrium retail prices

$$p_i(w_i, w_j) = \frac{a(2+3\gamma) + (1+\gamma)(2w_i(1+\gamma) + w_j\gamma)}{4 + 8\gamma + 3\gamma^2}.$$

  - 2nd and 1st stage, retailer i buys from producer such that

$$\max_{w_i} \ \{\pi_i(w_i, w_j) = (p_i(w_i, w_j) - w_i)q_i(p_i(w_i, w_j), p_j(w_i, w_j)) : (w_i - c)q_i(p_i(w_i, w_j), p_j(w_i, w_j)) = 0\}$$

  - Zero-profit condition (constraint) due to perfect competition upstream.
  - From Langrangean, we get $w_i = c$ for all i in equilibrium.
  - Retailer i's prices in equilibrium:

$$p_i^* = \frac{a + c(1+\gamma)}{2+\gamma}.$$

Horizontal and Vertical Cooperation – Slotting Allowances

- Case 2: Two-Part Tariffs ($T \neq 0$ possible).
  - Competition downstream as in Case 1:

$$\max_{p_i} = (p_i - w_i)q_i(p_i, p_j) \;\Rightarrow\; (p_i - w_i)\frac{\partial q_i}{\partial p_i} + q_i = 0 \;\Leftrightarrow\; q_i + p_i\frac{\partial q_i}{\partial p_i} = w_i\frac{\partial q_i}{\partial p_i}, \qquad (5)$$

  - such that

$$p_i(w_i, w_j) = \frac{a(2+3\gamma) + (1+\gamma)(2w_i(1+\gamma) + w_j\gamma)}{4 + 8\gamma + 3\gamma^2}.$$

  - Using (w_i, T_i), retailer i buys from producer such that

$$\max_{w_i, T_i} \Big\{\pi_i(\cdot) = (p_i(w_i, w_j) - w_i)q_i(p_i(w_i, w_j), p_j(w_i, w_j)) - T_i : (w_i - c)q_i(p_i(w_i, w_j), p_j(w_i, w_j)) + T_i = 0\Big\}.$$

  - Lagrangean:

$$\mathcal{L}(w_i, T_i, \lambda) = (p_i(w_i, w_j) - w_i)q_i(p_i(w_i, w_j), p_j(w_i, w_j)) - T_i + \lambda((w_i - c)q_i(p_i(w_i, w_j), p_j(w_i, w_j)) + T_i).$$

Horizontal and Vertical Cooperation – Slotting Allowances

- Case 2: Two-Part Tariffs ($T \neq 0$ possible).
  - From $\frac{\partial \mathcal{L}}{\partial T_i} = 0$, we have $\lambda = 1$.
  - Thus, $\frac{\partial \mathcal{L}}{\partial w_i} = 0$ is equivalent to

$$\left[(p_i - c)\frac{\partial q_i}{\partial p_i} + q_i(\cdot)\right]\frac{\partial p_i}{\partial w_i} + (p_i - c)\frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial w_i} = 0. \tag{6}$$

  - Substituting (5) into (6), we get

$$(w_i - c)\underbrace{\frac{\partial q_i}{\partial p_i}\frac{\partial p_i}{\partial w_i}}_{<0} + (p_i - c)\underbrace{\frac{\partial q_i}{\partial p_j}\frac{\partial p_j}{\partial w_i}}_{>0} = 0. \tag{7}$$

  - In equilibrium, we must have $w_i > c$ and $T_i < 0$, for (7) to be satisfied:
    - If $w_i = c$, second term in (7) has to be zero as well. However, the term is positive. Hence, $w_i \neq c$.
    - If $w_i < c$, first term in (7) is positive, such that second term must be negative. This requires that $p_i < c$, which is only possible for $T_i < 0$. Otherwise, retailer would incur losses. However, for $w_i < c$ and $T_i < 0$, we have losses upstream. Thus, we must have $w_i > c$.
    - For $w_i > c$, we must have $T_i < 0$ since otherwise there would be profits upstream.

Horizontal and Vertical Cooperation – Slotting Allowances

- Case 2: Two-Part Tariffs ($T \neq 0$ possible).
  - Computation (fyi):
    - For $\lambda = 1$, we have

$$\frac{\partial \mathcal{L}}{\partial w_1} = \frac{(\gamma+1)\left(\gamma^2(a(3\gamma+2)+\gamma(\gamma+1)w_2)+c(\gamma+2)(3\gamma+2)(\gamma(\gamma+4)+2)-4(\gamma+1)^2(\gamma(\gamma+4)+2)w_1\right.}{2(\gamma+2)^2(3\gamma+2)^2} \overset{!}{=} 0.$$

    - Symmetry $w_1 = w_2$ implies

$$w_i^{2PT} = \frac{a\gamma^2 + c(2+\gamma)(2+\gamma(4+\gamma))}{(1+\gamma)(4+\gamma(6+\gamma))}.$$

    - This implies

$$p_i^{2PT} = \frac{2a(1+\gamma)+c(2+\gamma(4+\gamma))}{4+\gamma(6+\gamma)}.$$

    - Equilibrium demand reads

$$q_i^{2PT} = \frac{(a-c)(2+\gamma(4+\gamma))}{8+2\gamma(6+\gamma)}.$$

    - Using zero-profit condition, we get $T_i < 0$ such that:

$$(w_i^{2PT}-c)q_i^{2PT} + T_i = 0 \;\Leftrightarrow\; T_i^{2PT} = -\frac{(a-c)^2\gamma^2(2+\gamma(4+\gamma))}{2(1+\gamma)(4+\gamma(6+\gamma))^2} < 0.$$

Horizontal and Vertical Cooperation – Slotting Allowances

- Compared to linear prices, two-part tariffs lead to
  - Increasing wholesale prices w
  - Producers paying slotting allowances (technically, $T < 0$ is paid by retailers)
  - Profit $(w_i - c)q_i > 0$ upstream is extracted with fixed fee/slotting allowance
  - Retail prices increase ($p_i^{2PT} > p_i^*$, cf Proposition 8 in Shaffer (1991)).