ECO 650: Firms' Strategies and Markets
Vertical Relationships and Bargaining(II)

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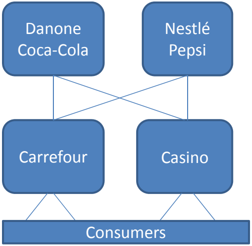
Buying power of retailers

A retailer is an intermediary: he buys products to suppliers and resells them to consumers.

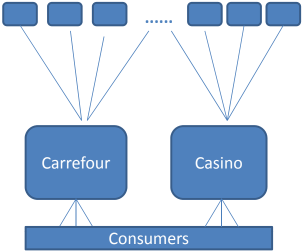
The high concentration on the retail market $\Rightarrow$ buying power towards suppliers: heterogenous balance of power!!

Big manufacturers
vs
Big retailers



*Famous national brands
*High concentration among manufacturers

Small producers
vs
Big retailers



*Small manufacturers
*Farmers (fruits and vegetables,meat,...)

Sources of buyer power

- Buyer size (larger discount?...)
- Gatekeeper positions (local monopoly on a market)
- Constrained capacity shelves space
- Outside options
  - Number of alternative suppliers vs alternative retailers. OECD (1998): "*Retailer A has buyer power over supplier B if a decision to delist B's product could cause A's profit to decline by 0.1% and B's to decline by 10%.*"
  - How differentiated ? Loyalty to the brand vs loyalty to the store; A survey by INSEE, 1997: When the favorite brand is not in its favorite store's shelves: 56% of consumers choose another brand, 24% will buy it later and 20% buy it in another store.
  - Private labels (since 70s): products sold under retailer's own brand

Consequences of Buyer Power: Potential Harms and Benefits

- Potential harms: Hold-up effect (reduction of inevtsements), Exit of small suppliers in situation of economic dependence (reduction of variety,...).
- Benefit: A monopolist may prefer dealing with several retailers, and thus favor competition, to obtain higher profits.

Methodological tool:Bargaining

- Bargaining: situation in which at least two players have a common interest to cooperate, but have conflicting interests over exactly how to co-operate.
- How to share a pie? Depends on:
  - The number of negotiators;
  - Each negotiator's "ability to negotiate", or "bargaining power";
  - Each negotiator's "outside option".
- "Bargaining theory with Applications", Muthoo (2004).

The Nash program (1950,1953)

- A bargaining problem with two players
- A vector $x = (x_1, x_2) \in \mathbb{R}^2$; x_i is the allocation of player i.
- A threat point $\underline{x} = (\underline{x}_1, \underline{x}_2) \in \mathbb{R}^2$;
- Players utility function $U_i(x)$.
- F is the set of feasible allocations;
  $F \bigcap \{(x_1, x_2) \in \mathbb{R}^2 : x_1 \geq \underline{x}_1, x_2 \geq \underline{x}_2\}$ is nonempty and bounded.

Theorem

The Nash Bargaining Solution x^* satisfies:

$$x^* \in \underset{x \in F}{argmax}(U_1(x_1) - U_1(\underline{x}_1))(U_2(x_2) - U_2(\underline{x}_2))$$

Five axioms

- Strong Pareto Optimality: the solution has to be realizable and Pareto optimal.
- Individual rationality: No player can have less than his outside option, otherwise he will not accept the "agreement".
- Invariance by an affine transformation: The result does not depend on the representation of (Von Neumann Morgenstern) utility functions.
- Independence of Irrelevant Alternatives: Eliminating alternatives that would not have been chosen, without changing the outside option, will not change the solution.
- Symmetry: Symmetric players receive symmetric payoffs.

Extension: The Nash bargaining solution with asymmetry

Assume that the players have different bargaining powers, say α and $1-\alpha$.

The Nash bargaining solution can be extended to that situation. It is the unique Pareto-optimal vector that satisfies:

$$x^* \in \underset{x \in F}{argmax} (U_1(x_1) - U_1(\underline{x}_1))^{\alpha}(U_2(x_2) - U_2(\underline{x}_2))^{1-\alpha}$$

Split-The-Difference-Rule

- Let V denote the cake to be shared such that $x_1 = V - x_2$,
- $U_i(x_i) = x_i$ (Risk neutral); $(\alpha, 1-\alpha)$ the bargaining powers.

The Nash bargaining solution (x_1^N, x_2^N) is:

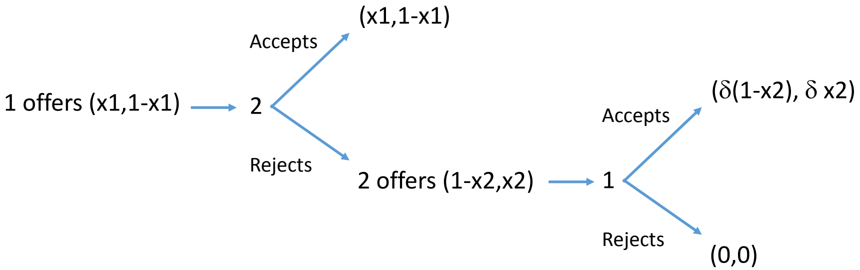
$$x_1^N = \underline{x}_1 + \alpha(V - \underline{x}_1 - \underline{x}_2)$$

$$x_2^N = \underline{x}_2 + (1-\alpha)(V - \underline{x}_1 - \underline{x}_2)$$

The Rubinstein (1982) bargaining model

- Two players, 1 and 2, have to reach an agreement on the partition of a pie of size 1.
- Each of them has to make in turn a proposal as to how it should be divided:
  - At each period, one offer is made;
  - They alternate making offers.
  - Player 1 makes the first offer.
- Finite number T of periods.
- There is a discount factor δ by period.

The Rubinstein (1982) game for $T = 2$



Resolution of the Rubinstein game

- Assume $T = 2$; in the second period, there is an equilibrium where 1 accepts any nonnegative offer by 2; 2 thus offers $(0, 1)$ (or $(\varepsilon, 1 - \varepsilon)$ to select equilibria); in period 1, 1 offers $(1 - \delta, \delta)$ and 2 accepts.
- Assume $T = 3$; in the third period, 1 makes the last offer and 2 accepts any nonnegative offer; 1 thus offers $(1, 0)$; in period 2, 2 offers $(\delta, 1 - \delta)$ and 1 accepts; in period 1, 1 offers $(1 - \delta(1 - \delta), \delta(1 - \delta))$ and 2 accepts.
- By iteration, there is an equilibrium where 1 offers in the first period $(x_1 = 1 - \delta + ... + (-1)^{T-1}\delta^{T-1}, 1 - x_1)$.

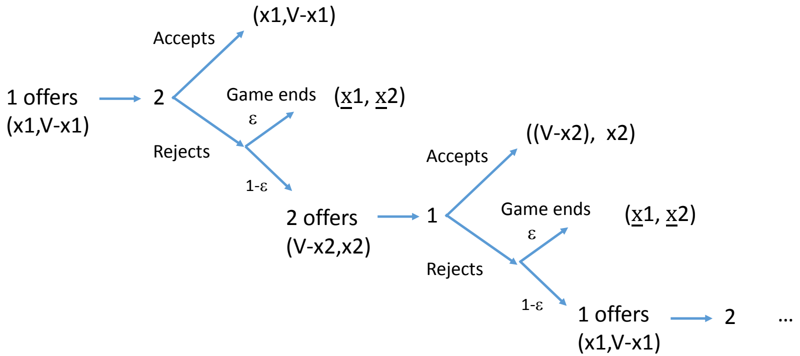
Solution of the Rubinstein game

- At the limit, when $T \to +\infty$, the sharing of the pie is $(x_1 = \frac{1}{1+\delta}, 1 - x_1)$;
- Impatience is the driving force that leads to an agreement, and it increases the power of the first player:
  - When the two players are infinitely patient, their situations become symmetric: when $T \to +\infty$ and $\delta = 1$, the sharing of the pie is $(\frac{1}{2}, \frac{1}{2})$;
  - When the two players are infinitely impatient, player 1 gets the whole pie: when $T \to +\infty$ and $\delta = 0$, the sharing of the pie is $(1, 0)$.

The Binmore-Rubinstein-Wolinsky (1986) bargaining model

- Two players 1 and 2 want to share a “pie" of value V
- Outside option: player i has a utility $\underline{x}_i$ if negotiation breaks, where $\underline{x}_1 + \underline{x}_2 < V$;
- Players alternate making the same offers 1 offers $(x_1, V - x_1)$ and 2 offers $(V - x_2, x_2)$;
- Infinite horizon; each time an offer is rejected, there is an exogenous risk of breakdown (end of the game) with a probability ε (no discounting).

Binmore-Rubinstein-Wolinsky (1986) game



Binmore-Rubinstein-Wolinsky (1986): results

- Any subgame perfect equilibrium involves player i indifferent between accepting or rejecting the offer of player j.

$$V - x_1^* = \epsilon \underline{x}_1 + (1-\epsilon) x_2^*$$

$$V - x_2^* = \epsilon \underline{x}_2 + (1-\epsilon) x_1^*$$

- The solution satisfies:

$$x_i^* = \underline{x}_i + \frac{1}{2-\epsilon}(V - \underline{x}_1 - \underline{x}_2)$$

- If both firms have the same bargaining power ($\epsilon \to 0, \alpha = 1/2$), in equilibrium, equal sharing of the surplus:
  $(\underline{x}_1 + \frac{V-\underline{x}_1-\underline{x}_2}{2}; \underline{x}_2 + \frac{V-\underline{x}_1-\underline{x}_2}{2})$.
  This is the symmetric Nash bargaining solution.
- If $\epsilon \to 1$, the player that plays first has all the power and the other player gets its disagreement payoff.

Applications

- Bargaining within buyer-seller relationship : The hold-up problem + Exercise 1.
- Bargaining power in a vertical chain with upstream competition : Strategic restriction of retailer's shelf space capacity
- Bargaining power in a vertical chain with downstream competition : creating a buying group

The hold-up Problem

Assumptions

Asset specificity: An investment brings more value when used by a particular buyer (matching, compatibility,...)

- An upstream seller S can produce a unit of good at cost $C(I)$.
- By investing I the unit cost decreases $C'(I) < 0$ but at a decreasing rate $C''(I) > 0$.
- We assume that the investment I is “specific":
  - The cost is $C(I)$ if S makes a deal with a “specific" buyer B.
  - The cost is $C(\lambda I)$ if S makes a deal with any other buyers with $\lambda \in [0, 1]$.
  - λ is the degree of specificity of the investment for B with a complete specificity when $\lambda = 0$ and no specificity when $\lambda = 1$.

Bargaining in a vertical chain

Assumptions

Incomplete contracts: Contracts cannot be written ex ante, i.e. before the investment decision is taken

- Irrespective of the buyer, an agreement between S and a buyer brings a value V.
- Formally we have a sequential stage game :
  1. An upstream seller S chooses its investment level I. Once the investment is realized, it is sunk.
  2. S bargains with B, following a Nash bargaining, over a contract T.

Bargaining stage

Following a Nash bargaining :

$$\underset{T}{Max}[V - T][T - C(I) - (V - C(\lambda I))]$$

is equivalent to the split-the-difference-rule:

$$V - T = T - C(I) - (V - C(\lambda I)) \Rightarrow T = V + \frac{C(I) - C(\lambda I)}{2}$$

In stage 2, the profit of the buyer is

$$\Pi_B = \frac{C(\lambda I) - C(I)}{2}.$$

Π_B increases if λ decreases, i.e. as the specificity of the investment increases.

The profit of the seller is

$$\Pi_S = V - (\frac{C(I) + C(\lambda I)}{2}) - I$$

decreases with the specificity of the investment.

Investment stage

The seller maximizes its profit with respect to I

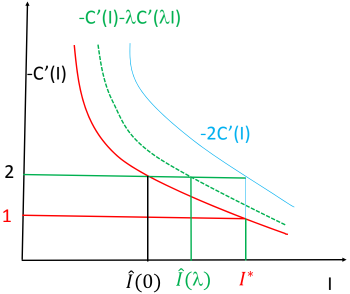
$$\underset{I}{Max}\, V - \left(\frac{C(I) + C(\lambda I)}{2}\right) - I$$

The FOC is:

$$-C'(I) - \lambda C'(\lambda I) = 2$$

The FOC of an integrated firm is:

$$-C'(I) = 1$$



Remember

- Investments in specific assets and incomplete contracts may generate hold-up, i.e expropriation of part of the rent of the investment by the partner, which triggers under-investment!
- The hold-up effect is stronger as the specificity of investment increases.
- Here specificity of investment by the producer is a source of buyer power!
- Vertical integration is a solution to hold-up.

Exercise 1: Bargaining power within a chain of monopolies

Assumptions:

- A manufacturer produces a good at a unit cost c.
- A retailer faces a demand $D(p) = 1 - p$.
- The game:
  1. The manufacturer and the retailer bargain over a two-part tariff contract (w, F);
  2. The retailer sets a final price p to consumers.

Questions:

1. Given the contract (w, F), determine the optimal price set by the retailer in stage 2. Determine the stage-2 equilibrium profits of firms $\pi_U(w) + F$ and $\pi_D(w) - F$.
2. Write down the Nash program and determine the optimal contract (w, F). Is it efficient?

Strategic shelf capacity's restriction

Assumptions:

- Two producers offering products differentiated in quality H and L with $H > L$
- We denote Π^X the maximum profit of a vertically integrated structure when the product sold is X and therefore have $\Pi^H > \Pi^L > 0$.
- Products are imperfect substitutes : $\Pi^H < \Pi^{HL} < \Pi^H + \Pi^L$
- A monopolist retailer D who can either open two slots or restrict its capacity to one single slot.

Research issue

Does D have an incentive to restrict its capacity to one slot?

Strategic shelf capacity's restriction

The timing of the game is the following:

1. D chooses the size of its shelves' (one or two slots).
   - i) D selects the product(s) accordingly (H or L for 1 slot and HL for 2 slots).
   - ii) If only one slot, manufacturers may offer slotting fees S to be selected. If D accepts a slotting fee, he must select the product.
2. The retailer bargains simultaneously with the selected supplier(s) over a fixed fee T (α denotes the retailer's buyer power).

We look for the optimal equilibrium assortment of the retailer.

We solve the game backward. Stage 2 bargaining is as follows.

Bargaining for HL Two negotiations takes place simultaneously, one between the pair $H - D$ and another between the pair $L - D$. The Nash program are as follows:

$$\max_{T_H}(\Pi^{HL} - T_H - T_L - (\Pi^L - T_L))^\alpha T_H^{(1-\alpha)}$$

$$\max_{T_L}(\Pi^{HL} - T_H - T_L - (\Pi^H - T_H))^\alpha T_L^{(1-\alpha)}$$

Firms obtain the following profits
$\pi_D^{HL} = (2\alpha - 1)\Pi^{HL} + (1-\alpha)(\Pi^H + \Pi^L)$, $\pi_H^{HL} = (1-\alpha)(\Pi^{HL} - \Pi^L)$,
$\pi_L^{HL} = (1-\alpha)(\Pi^{HL} - \Pi^H)$

Bargaining for X One negotiation takes place between the pair $X - D$. The Nash program are as follows:

$$\max_{T_X}(\Pi^X - T_X)^\alpha T_X^{(1-\alpha)}$$

Firms obtain the following profits $\pi_D^X = \alpha\Pi^X$, $\pi_X^X = (1-\alpha)\Pi^X$.

We solve stage 1 (i).

Comparing the profit of D in all cases, we obtain that $\pi_D^{HL} > \pi_D^H > \pi_D^L$ and therefore D always offers two slots and sells the two products.

(i) No capacity restriction

Without slotting fee, D has no incentive to restrict its capacity to one slot. He always offer the two goods and this is strictly profitable for two reasons:

- D chooses the structure that maximizes the industry profit.
- D can use one producer as a status-quo in its negotiation with the other.

We solve stage 1 (ii).

If D selects one slot A competition between the two producers takes place for the slot.

- At most H would be ready to offer $\bar{S}_H = \pi_H^H$;
- At most L is ready to offer $\bar{S}_L = \pi_L^L$.

Comparing these offers D would obtain $\pi_D^H + \bar{S}_H = \Pi^H > \pi_D^L + \bar{S}_L = \Pi^L$. Therefore H always wins the competition and offers S_H^* such that D is just indifferent between the two options.

In equilibrium H offers S_H^* such that: $S_H^* = \max\{\Pi^L - \pi_D^H, 0\}$. A positive slotting fee is paid by H to D when $\alpha < \frac{\Pi^L}{\Pi^H}$ and in that case the profit of D amounts to $\pi_D^H + \Pi^L - \pi_D^H = \Pi^L$.

(ii) Capacity restriction

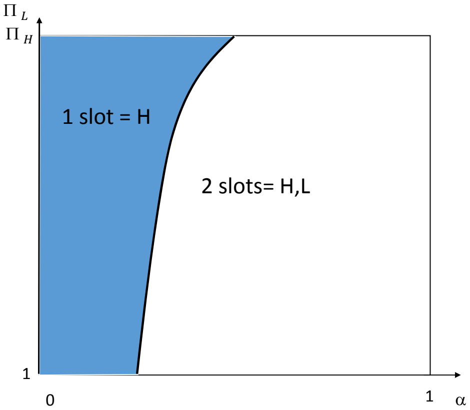
With slotting fees, D may have incentive to restrict its capacity to one slot when $\alpha < \frac{\Pi^{HL} - \Pi^H}{2\Pi^{HL} - \Pi^H - \Pi^L} \in [0, 1]$.

- By creating a competition for slots among suppliers D may obtain a larger share of a smaller pie.

Strategic capacity restriction

$\Pi_{HL} = 4$

$\Pi_H = 3$



Buying group

Assumptions:

- U offers a good at a unit cost 0.
- D_1 and D_2 are two downstream firms that compete à la Cournot.
- Demand is $P = 1 - q_1 - q_2$.
- The game is a follows:
  1. U and each D_i bargain over a linear tariff contract w_i.
  2. Wholesale prices are observed and each D_i chooses its quantity q_i.
- The Nash bargaining takes place simultaneously and secretly. We consider an asymmetric Nash bargaining framework with a parameter $(\alpha, 1-\alpha)$.

Profitability of a buying group?

A buying group consists in bargaining together and then compete on the downstream market.

Without buying group

- If the two firms have accepted their contract. Firm i chooses q_i to maximize $\max_{q_i}(1 - q_i - q_j - w_i)q_i$. Best reaction functions are:

$$q_i(q_j) = \frac{1 - q_j - w_i}{2}$$

for $i = 1, 2$ and in equilibrium we obtain the Cournot quantities $q_i^C(w_i, w_j) = \frac{1+w_j-2w_i}{3}$ for $i = 1, 2$. $\pi_i^C = \frac{(1+w_j-2w_i)^2}{9}$; $\pi_U^C = \sum_{i=1,2} w_i q_i^C(w_i, w_j)$

- If only one firm i has accepted the contract w_i, firm i chooses q_i to maximize $\max_{q_i}(1 - q_i - w_i)q_i$ with respect to q_i and therefore $q_i^M(w_i) = \frac{1-w_i}{2}$ and $\pi_i^M = \frac{(1-w_i)^2}{4}$; $\pi_U^M = w_i q_i^M(w_i)$

Bargaining stage

$$\max_{w_i} \pi_i^C(w_i, w_j)^{(1-\alpha)}(\pi_U^C(w_i, w_j) - \pi_U^M(w_j))^{\alpha}$$

$$\max_{w_i}(1-\alpha)ln(\pi_i^C(w_i, w_j)) + \alpha ln(\pi_U^C(w_i, w_j) - \pi_U^M(w_j))$$

Deriving, we obtain:

$$(1-\alpha)\frac{\frac{\partial \pi_i^C(w_i,w_j)}{\partial w_i}}{\pi_i^C(w_i, w_j)} + \alpha\frac{\frac{\partial \pi_U^C(w_i,w_j)}{\partial w_i}}{\pi_U^C(w_i, w_j) - \pi_U^M(w_j)} = 0 \qquad (1)$$

In equilibrium wholesale unit prices are $w_i = w_j = \frac{\alpha}{2}$. Thus equilibrium profits are $\pi_i^C = \frac{(8-7\alpha)^2}{36(4-3\alpha)^2}$ and $\pi_U^C = \frac{\alpha(8-7\alpha)}{6(4-3\alpha)^2}$.

With buying group

The bargaining succeeds either with both firms or none. The bargaining stage is thus rewritten as follows:

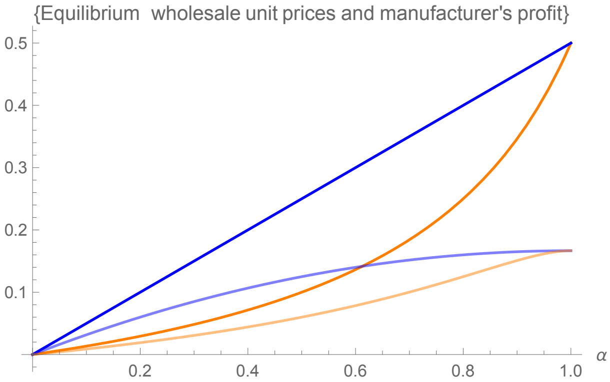
$$\max_{w_i} \pi_i^C(w_i, w_j)^{(1-\alpha)}(\pi_U^C(w_i, w_j))^{\alpha}$$

$$\max_{w_i} (1-\alpha) ln(\pi_i^C(w_i, w_j)) + \alpha ln(\pi_U^C(w_i, w_j))$$

Deriving, we obtain:

$$(1-\alpha)\frac{\frac{\partial \pi_i^C(w_i, w_j)}{\partial w_i}}{\pi_i^C(w_i, w_j)} + \alpha \frac{\frac{\partial \pi_U^C(w_i, w_j)}{\partial w_i}}{\pi_U^C(w_i, w_j)} = 0 \qquad (2)$$

Comparing (2) with (1) it is immediate that the equilibrium w decreases with the buying group. In equilibrium we find that wholesale unit prices are $w_i = w_j = \frac{\alpha}{2(4-3\alpha)}$. Thus equilibrium profits are $\pi_i^C = \frac{(2-\alpha)^2}{36}$ and $\pi_U^C = \frac{\alpha(2-\alpha)}{6}$.



Legend: Blue - No Buying Group; Orange- Buying Group. Bold: Wholesale prices.

Forming a Buying group enhances retailer's buyer power.

They obtain lower input prices and capture a larger share of profit to the detriment of the manufacturer.

Exercise 2: Buyer size and buyer power

Assumptions:

- A manufacturer U produces a good at a unit cost $C(Q)$, with $C'(Q) > 0$ and $C''(Q) > 0$.
- Two retailers D_1 and D_2 are active on **separate markets** and face an inverse demand $P(Q)$ with $P'(Q) < 0$.
- The two retailers must buy from the manufacturer to offer the product to consumers.
- We consider the following one-stage game: Each manufacturer-retailer pair bargain simultaneously over a quantity forcing contract (q, F);
- Use $P(Q) = 1 - Q$ and $C(Q) = \frac{Q^2}{2}$ for numerical application.
    1. Determine the optimal contracts (q_1, F_1) and (q_2, F_2). Compute the equilibrium profit of each firm
    2. D_1 and D_2 merge and the new entity bargain with U over a new contract (q, F). Determine the new equilibrium profits.
    3. Compare the profits obtained in (1) and (2) and comment.

Remember

- The relative outside options are key to determine the sharing of profits within the channel.
- Restricting the shelf capacity may be a way for a retailer to enhance competition among manufacturers and obtain a larger share of a smaller pie.
- Forming a buying group may be a way for retailers to obtain lower input prices from manufacturer (Caution: linear wholesale unit prices!)

References

- Binmore, Rubinstein and Wolinsky (1986), “The Nash Bargaining Solution in Economic Modelling", *RAND Journal of Economics*, 17, 2, p. 176-188.
- Hart, O. (1995). “Firms, contracts, and financial structure" Oxford & New York: *Oxford University Press*, Clarendon Press.
- Nash (1950), “The Bargaining Problem”, *Econometrica*, 18, 2;
- Rubinstein (1982), “Perfect equilibrium in a bargaining model”, *Econometrica*, 50, 1.
- Stole and Zwiebel, 1996, “Intra-firm bargaining under non-binding contracts”, *Review of Economic Studies*, 63, 375-410.