Markups, Markdowns, and Bargaining in a Vertical Supply Chain

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What is the welfare effect of buyer power?

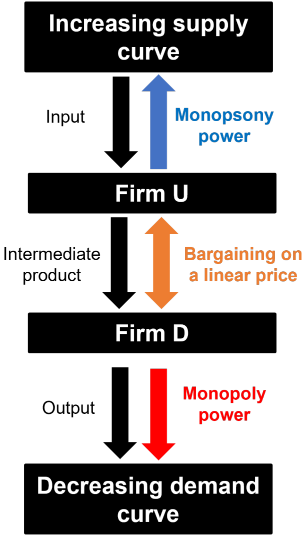
Two contradicting views:

- **countervailing power theory** (Galbraith, 1952):
  - Rebates obtained by downstream firms are transmitted to consumers.

    $\Rightarrow$ **Buyer power improves welfare.**
  - Common feature in the vertical relationship literature.
- **monopsony power theory** (Robinson, 1933):
  - Input prices fixed below the competitive level lead to output reduction.

    $\Rightarrow$ **Buyer power harms welfare.**
  - Long tradition in the labor literature.

What we Do



- Take the canonical model of bargaining in vertical relationships.
- Authorize monopsony power, by **relaxing two assumptions**:
  - constant marginal cost for U,
  - exchanged quantity always set by D.
- Allowing us to:
  - clarify the *nature* of market power emerging in bargaining,
  - explore welfare, profit-sharing, and policy implications.

Preview of Results

A **vertically-integrated** firm with **monopsony** and **monopoly** power generates inefficiency by imposing a **markdown** and a **markup**.

A **vertical relationship** with linear pricing (generally) generates **double marginalization** causing additional inefficiency:

- perfectly balanced bargaining power ($\alpha = \alpha_I$), replicates the vertical integration outcome,
  - with $\alpha_I \in (0, 1)$ contingent on supply and demand primitives,
  - decreasing with input supply elasticity and increasing with consumer demand elasticity.
- too powerful supplier ($\alpha > \alpha_I$), causes inefficiency due to **double markupization**,
  - *monopoly power* prevails and *countervailing buyer power forces* arise,
  - **welfare increases with buyer power** (decreases with α);
- too powerful buyer ($\alpha < \alpha_I$), causes inefficiency due to **double markdownization**,
  - *monopsony power* prevails and *countervailing seller power forces* arise,
  - **welfare decreases with buyer power** (increases with α);

Contributions

1. **Endogeneizing the right-to-manage (RTM)**, i.e. who sets the quantity, in a bargaining
   - applying short-side-rule and subgame perfect equilibrium concepts,
   - offering a non-cooperative solution to an unsolved issue in the bilateral monopoly literature. (Fellner, 1947; Toxvaerd, 2024; Houba, 2024; Demirer and Rubens, 2025)
2. **Showing that balancing bargaining power improves welfare**,
   - in settings with monopsony power and/or increasing marginal costs (MC), (Amodio et al., 2024; Avignon and Guigue, 2022; Boehm and Pandalai-Nayar, 2022; Morlacco, 2019; Rubens, 2023; Yeh et al., 2022; Zavala, 2022)
   - intuitive idea yet contradicting bargaining models with constant MC and/or exogenous RTM. (Lee et al., 2021; Alviarez et al., 2023; Azkarate-Askasua and Zerecero, 2022; Mukherjee and Sinha, 2024; Wong, 2023)
3. **Providing markup and markdown definitions compatible with bargaining frameworks,**
   - without directly relying on marginal revenue and marginal cost.
   - deriving markup and markdown expressions for a continuous allocation of bargaining power.

1 Definitions

2 Benchmark

3 Setting

4 Resolution

5 Equilibrium

6 Conclusion

Markup and Markdown Definitions.

Markup μ_i: surplus firm i obtains from selling the marginal output unit, i.e. wedge between the price x_i at which firm i sells the marginal output unit and the minimum price $\hat{x}_i$ at which this marginal unit would be supplied:

$$\mu_i \equiv \frac{x_i}{\hat{x}_i}.$$

Markdown ν_i: surplus firm i obtains from buying the marginal input unit, i.e. wedge between the maximum price $\hat{z}_i$ at which the marginal input unit would be bought and the price z_i at which firm i buys this marginal unit:

$$\nu \equiv \frac{\hat{z}_i}{z_i}.$$

For *bargaining* equilibria, the buyer's MC and seller's MR are not defined, but we show that:

$$\mu_i = \frac{x_i(q^*)}{MC_i(q^*)} \textbf{ and } \nu_i = \frac{MC_i(q^*)}{z_i(q^*)} \quad \textbf{or} \quad \mu_i = \frac{x_i(q^*)}{MR_i(q^*)} \textbf{ and } \nu_i = \frac{MR_i(q^*)}{z_i(q^*)}.$$

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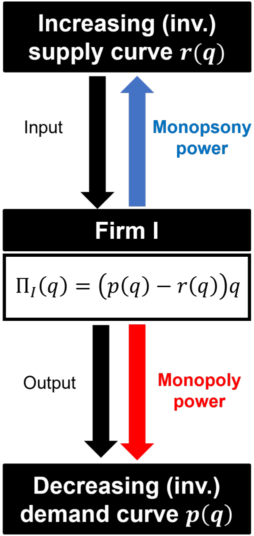
Let's start with a useful benchmark: vertical integration.



With standard assumptions on supply and demand henceforth:

i) $r'(q) \geq 0$ and $\sigma_r(q) > -2$;

ii) $p'(q) < 0$, $\varepsilon_p(q) \geq 1$, and $\sigma_p(q) < 2$.

iii) $p(0) > r(0)$ and $lim_{q \to \infty} p(q) = 0$

where for any function f:

- $\epsilon_f(q) \equiv \frac{f(q)}{q|f'(q)|}$ is the elasticity of $f(.)$,
- $\sigma_f(q) \equiv \frac{qf''(q)}{|f'(q)|}$ is a measure of convexity of $f(.)$.

In equilibrium, the firm exerts a markup and a markdown.

The maximization program of firm I is given by:

$$\max_q \Pi_I = (p(q) - r(q))q,$$

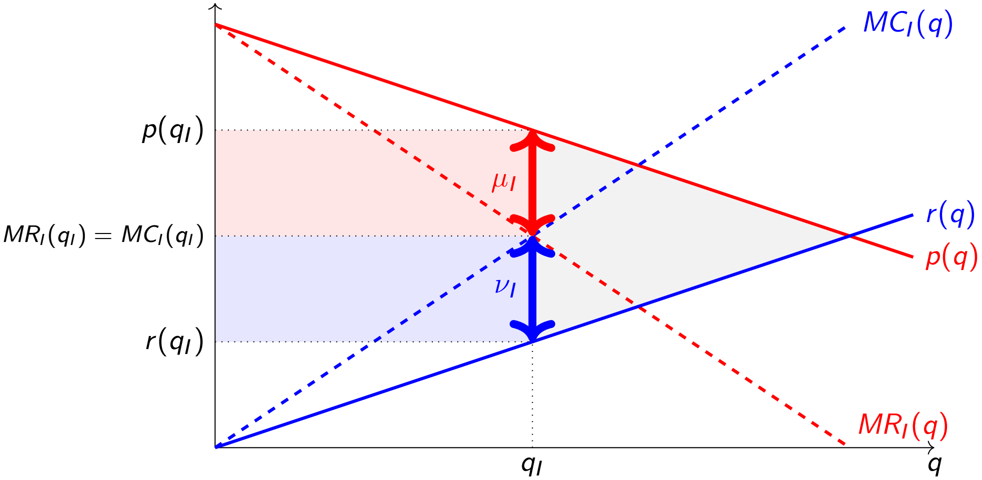
yielding the FOC:

$$\underbrace{p(q_I)\left(1 - \varepsilon_p^{-1}(q_I)\right)}_{MR_I(q_I)} = \underbrace{r(q_I)\left(1 + \varepsilon_r^{-1}(q_I)\right)}_{MC_I(q_I)}.$$

In equilibrium, we have firm's I:

1. markup $\mu_I \equiv \frac{p(q_I)}{MC(q_I)} = \frac{1}{1-\varepsilon_p^{-1}(q_I)}$,
2. markdown $\nu_I \equiv \frac{MR(q_I)}{r(q_I)} = 1 + \varepsilon_r^{-1}(q_I)$,
3. (total) margin $M_I \equiv \frac{p(q_I)}{r(q_I)} = \nu_I \times \mu_I = \frac{1+\varepsilon_r^{-1}(q_I)}{1-\varepsilon_p^{-1}(q_I)}$.

The markup and the markdown harm welfare, consumers, and suppliers.



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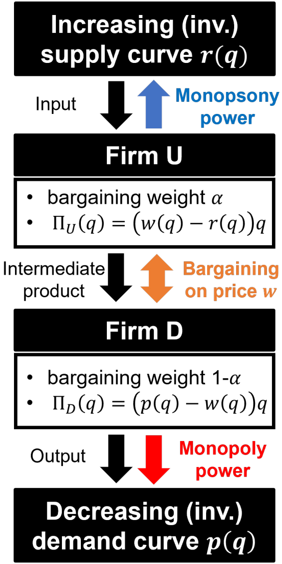
The Supply Chain



Timing

- **Stage 1:** firms U and D bargain over a linear wholesale price w.
- **Stage 2:** given w, U optimally sets its quantity q_U and D optimally sets its quantity q_D.

In equilibrium, the short-side rule applies:

$$q(w) = \min\{q_U(w), q_D(w)\},$$

and input and output prices are $r(q)$ and $p(q)$.

Note that:

- we restrict attention to linear prices,
- we adopt a subgame perfection equilibrium concept $\rightarrow$ we solve backward.

[Stage 2] Firms maximize profits given w under the short-side rule.

- Given w, D's program is:

$$\max_{q_D} \Pi_D = (p(q_D) - w)q_D \quad \text{subject to} \quad q_D \leq q_U(w)$$

  - The FOC yields $MR_D(\tilde{q}_D(w)) = w$ *for an interior solution* $\tilde{q}_D(w)$.

- Given w, U's program is:

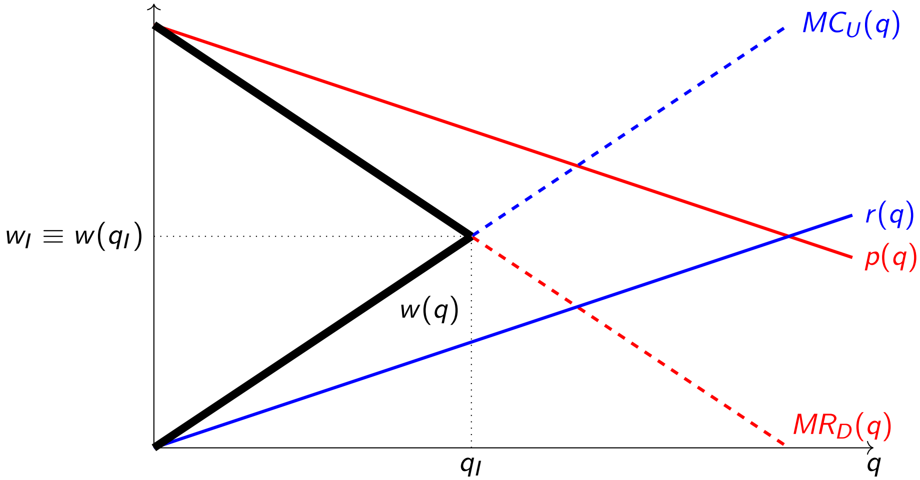
$$\max_{q_U} \Pi_U = (w - r(q_U))q_U \quad \text{subject to} \quad q_U \leq q_D(w)$$

  - The FOC yields $w = MC_U(\tilde{q}_U(w))$ *for an interior solution* $\tilde{q}_U(w)$.

- Applying the short-side rule delivers the wholesale price-quantity schedule:

$$q(w) = \min\{\tilde{q}_D(w), \tilde{q}_U(w)\} \iff w(q) = \begin{cases} MC_U(q) & \text{if } w \leq w_I, \\ MR_D(q) & \text{otherwise.} \end{cases}$$

[Stage 2] The short-side determines the wholesale price-quantity schedule.



For a high (low) price w, D is ready to demand less (more) than U is ready to supply.

[Stage 1] U and D Nash-bargain over w, internalizing the schedule $w(q)$.

The Nash-program is given by:

$$\max_{w} \Pi_U(q)^{\alpha}\Pi_D(q)^{(1-\alpha)} \quad \text{s.t} \quad w(q) = \begin{cases} MC_U(q) \text{ if } w \leq w_I \\ MR_D(q) \text{ if } w \geq w_I \end{cases}$$

The FOC yields:

$$\boldsymbol{\alpha} \underbrace{\left[\frac{\boldsymbol{\partial w(q)q}}{\boldsymbol{\partial q}} - MC_U(q)\right]}_{\frac{\partial \Pi_U(q)}{\partial q}} \Pi_D(q) + (1-\boldsymbol{\alpha}) \underbrace{\left[MR_D(q) - \frac{\boldsymbol{\partial w(q)q}}{\boldsymbol{\partial q}}\right]}_{\frac{\partial \Pi_D(q)}{\partial q}} \Pi_U(q) = 0$$

The equilibrium depends on $\boldsymbol{\alpha}$ directly and via firm anticipations of the schedule $\boldsymbol{w(q)}$.

Microfoundation

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2 Benchmark

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When $\alpha = \alpha_I$, the bargaining power allocation is efficient.

We denote α_I the value of α such that the Nash-bargaining yields the integrated-firm outcome.

For this α_I, the Nash-program FOC thus has to yield:

$$MR_D(q_I) \quad = \quad MC_U(q_I),$$

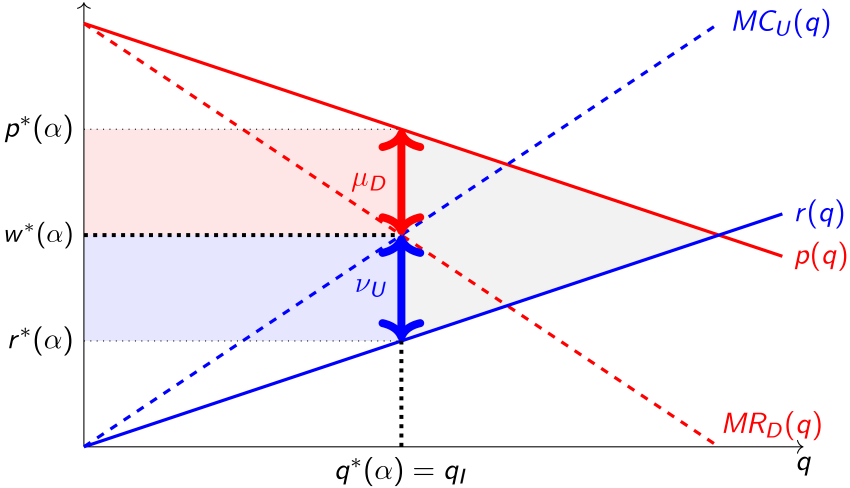
which implies that:

$$\alpha_I \equiv \frac{\Pi^U(q_I)}{\Pi^U(q_I) + \Pi^D(q_I)} = \frac{(\varepsilon_p(q_I) - 1)}{(\varepsilon_p(q_I) + \varepsilon_r(q_I))},$$

with $0 < \alpha_I < 1$. Authorizing constant MC_U or MR_D, we have:

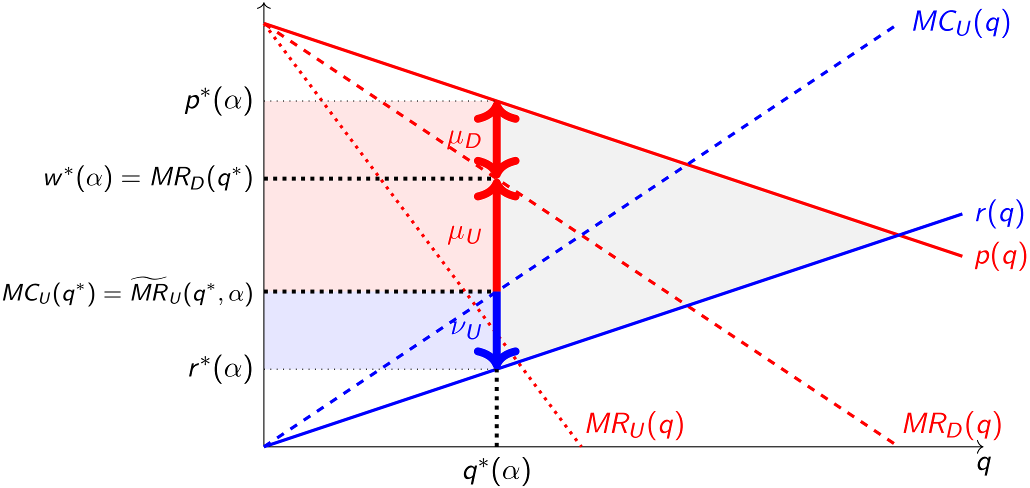
$$\alpha_I = \begin{cases} 0 & \text{if } MC_U(q) \text{ is constant in } q \text{ (\textbf{"pure countervailing power case"}),} \\ 1 & \text{if } MR_D(q) \text{ is constant in } q \text{ (\textbf{"pure monopsony power case"}).} \end{cases}$$

When $\alpha = \alpha_I$, the bargaining power allocation is efficient.



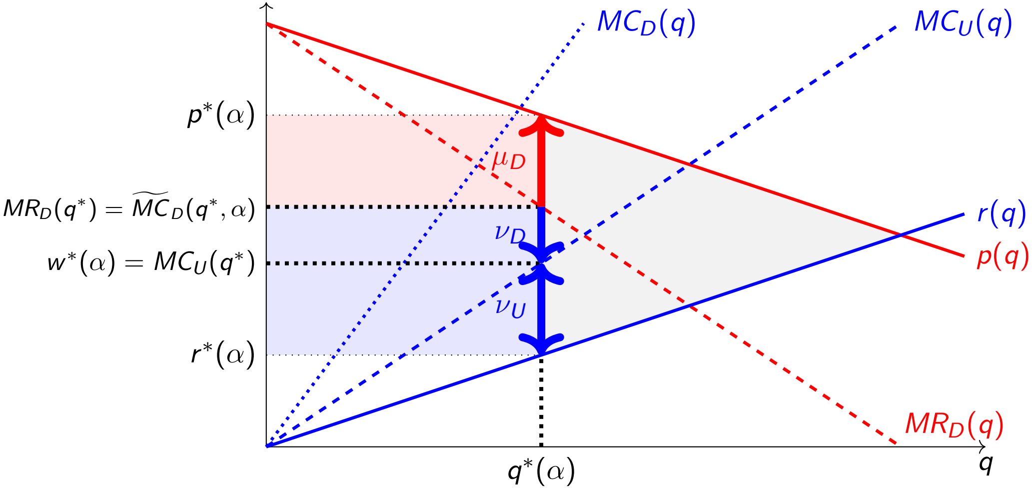
Each firm's bargaining power *fully countervails* the other's market power.

When $\alpha_l < \alpha < 1$, U is too powerful.



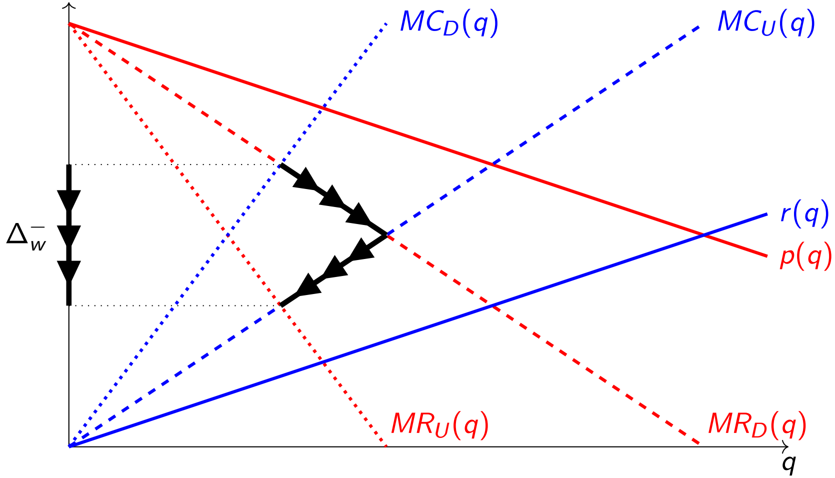
Double markupization arises and D exerts countervailing buyer power. ▸ Maths ▸ More

When $0 < \alpha < \alpha_I$, D is too powerful.



Double markdownization arises and U exerts countervailing seller power. ▸ Maths ▸ More

Increasing buyer power (decreasing α) has a non-monotonic welfare effect.



Weak side endogeneously gets RTM $\rightarrow$ keeps welfare and bilateral efficiency aligned! ▸ More

Extending to Competition Policy Issues

In a supply chain characterized by both monopoly and monopsony power:

- The interests of final consumers and competitive suppliers (workers, farmers, etc.) are aligned:
  - Changes in price ($\Delta^{-}p$), revenue ($\Delta^{+}r$), and quantity ($\Delta^{+}q$) occur together.
    - ★ The French government's decision to increase the "minimum resale price" in food retail negatively impacts both farmers and consumers.
  - Implementing a price floor on agricultural can be beneficial for both farmers and consumers.
- The reduction (or increase) of wholesale prices negotiated by the retailer has uncertain consequences for both farmers and consumers:
  - It is necessary to determine whether the vertical relationship is characterized by double markup or double markdown.

Conclusion

Under linear pricing, a vertical chain:

- **reaches the vertical integration outcome when bargaining is balanced**
  - i.e. when $\alpha = \alpha_I$, with $0 < \alpha_I < 1$ for any increasing MC_U and decreasing MR_D,
- generates, in general, an additional inefficiency:
  - **double markupization** if U is too powerful $\rightarrow$ total welfare increases with buyer power,
  - **double markdownization** if D is too powerful $\rightarrow$ total welfare decreases with buyer power,

Our framework with **endogenous right-to-manage**:

- implies a too-powerful firm concedes RTM in equilibrium,
- **keeps bilateral efficiency and welfare concerns aligned**.

More to come:

- pass-through and policy intervention analysis,
- upstream/downstream competition and empirical application.

Thank you!

General Markup and Markdown Definitions.

Markup μ_i: surplus firm i obtains from selling the marginal output unit, i.e. wedge between the price x_i at which firm i sells the marginal output unit and the minimum price $\hat{x}_i$ at which this marginal unit would be supplied:

$$\mu_i \equiv \frac{x_i}{\hat{x}_i}.$$

Markdown ν_i: surplus firm i obtains from buying the marginal input unit, i.e. wedge between the maximum price $\hat{z}_i$ at which the marginal input unit would be bought and the price z_i at which firm i buys this marginal unit:

$$\nu \equiv \frac{\hat{z}_i}{z_i}.$$

The equilibrium expressions of μ_i and ν_i are contingent on firm's i environment, i.e. all factors determining i's behavior: supply and demand primitives, market structure (vertical chain/integration), conduct.
For *unilateral price setting* equilibria:

$$\mu_i = \frac{p(q^*)}{MC_i(q^*)} = \frac{p(q^*)}{MR_i(q^*)} \text{ and } \nu_i \equiv \frac{MR_i(q^*)}{r(q^*)} = \frac{MC_i(q^*)}{r(q^*)}.$$

For *bargaining* equilibria, the buyer's MC and seller's MR are not defined, but we show that:

$$\mu_i = \frac{p(q^*)}{MC_i(q^*)} \text{ and } \nu_i = \frac{MC_i(q^*)}{r(q^*)} \quad \text{or} \quad \mu_i = \frac{p(q^*)}{MR_i(q^*)} \text{ and } \nu_i = \frac{MR_i(q^*)}{r(q^*)}.$$

Back

Microfoundation à la Rey and Vergé (2020)

U and D play the following game:

- Stage 1: Wholesale negotiation.
  1.1 U makes a take-it-or-leave-it (TIOLI) offer to D, which either accepts or rejects.
  1.2 If D rejects the offer, Nature selects selects U with probability ϕ and D with probability $1 - \phi$ to make an ultimate TIOLI offer.
  1.3 The selected firm makes the ultimate TIOLI offer to its counterpart, which accepts or rejects.
- Stage 2: Quantity setting.

Proposition

For any Nash-bargaining solution $w^* \in [\underline{w}, \overline{w}]$ there exists a unique $\phi \in [0, 1]$ such that the non-cooperative game solution $w^{**} = w^*$.

Back

When $\alpha = 1$, U makes a take-it-or-leave-it offer to D.

U anticipates $w(q) = MR_D(q)$. Its program, equivalent to the Nash program (as $\alpha = 1$), is:

$$\max_q \Pi_U(q) = w(q)q - r(q)q \quad \text{subject to} \quad w(q) = MR_D(q)$$

The FOC yields:

$$\underbrace{w(q^*)\left(1 - \varepsilon_{MR_D}^{-1}(q^*)\right)}_{MR_U(q^*)} = \underbrace{r(q^*)\left(1 + \varepsilon_r^{-1}(q^*)\right)}_{MC_U(q^*)}.$$

We can define in particular:

$$\mu_U \equiv \frac{w(q^*)}{MC_U(q^*)} = \frac{\varepsilon_{MR_D}}{\varepsilon_{MR_D} - 1} = \frac{\varepsilon_p - 1}{\varepsilon_p + \sigma_p - 3},$$

as well as $\nu_U \equiv \frac{MC_U(q^*)}{r(q^*)} = \frac{\varepsilon_r + 1}{\varepsilon_r}$, $\nu_D \equiv \frac{MR_D(q^*)}{w(q^*)} = 1$, and $\mu_D \equiv \frac{p(q^*)}{w(q^*)} = \frac{p(q^*)}{MR_D(q^*)} = \frac{\varepsilon_p}{\varepsilon_p - 1}$.

Back

When $\alpha_l < \alpha < 1$, U is too powerful.

The (rearranged) Nash-program FOC yields the equilibrium quantity q^*:

$$MC_U(q^*) = \underbrace{\beta_D(q^*, \alpha) MR_D(q^*) + (1 - \beta_D(q^*, \alpha)) MR_U(q^*)}_{\widetilde{MR}_U(q^*, \alpha)},$$

where $\beta_D(q, \alpha) \equiv \frac{1-\alpha}{\alpha} \frac{\Pi_U(q)}{\Pi_D(q)}$, decreases in α, with $\beta_D(q, 1) = 0$ and $\beta_D(q, \alpha_l) = 1$. Rewriting again:

$$\underbrace{r(q^*)(1 + \varepsilon_r^{-1}(q^*))}_{MC_U(q^*)} = \underbrace{\left(1 - \varepsilon_{MR_D}^{-1}(q^*)(1 - \beta_D(q^*, \alpha))\right) w(q^*)}_{\widetilde{MR}_U(q^*, \alpha)}.$$

We can define in particular:

$$\mu_U \equiv \frac{w(q^*)}{MC_U(q^*)} = \frac{\varepsilon_{MR_D}}{\varepsilon_{MR_D} - (1 - \beta_D(q^*, \alpha))} = \frac{\alpha \varepsilon_{MR_D}(\varepsilon_r + 1) + (1 - \alpha)(\varepsilon_p - 1)\varepsilon_r}{(\varepsilon_r + 1)(\alpha(\varepsilon_{MR_D} - 1) + (1 - \alpha)(\varepsilon_p - 1))}$$

as well as $\nu_U \equiv \frac{MC_U(q^*)}{r(q^*)} = \frac{\varepsilon_r + 1}{\varepsilon_r}$, $\nu_D \equiv \frac{MR_D(q^*)}{w(q^*)} = 1$, and $\mu_D \equiv \frac{p(q^*)}{MR_D(q^*)} = \frac{\varepsilon_p}{\varepsilon_p - 1}$. Back

When $\alpha = \alpha_I$, bargaining is efficient.

We start with a specific case that proves to be a useful baseline.

α_I is the value of α such that the Nash-bargaining yields the integrated-firm outcome.

For this α_I, the Nash-program FOC thus has to yield:

$$MR_D(q_I) \quad = \quad MC_U(q_I),$$

which implies that:

$$\alpha_I \equiv \frac{\Pi^U(q_I)}{\Pi^U(q_I) + \Pi^D(q_I)} = \frac{(\varepsilon_p(q_I) - 1)}{(\varepsilon_p(q_I) + \varepsilon_r(q_I))},$$

with $0 < \alpha_I < 1$. Authorizing constant MC_U or MR_D, we have:

$$\alpha_I = \begin{cases} 0 & \text{if } MC_U(q) \text{ is constant in } q \textbf{ ("pure countervailing power case")}, \\ 1 & \text{if } MR_D(q) \text{ is constant in } q \textbf{ ("pure monopsony power case")}. \end{cases}$$

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When $0 < \alpha < \alpha_I$, D is too powerful.

The (rearranged) Nash-program FOC yields the equilibrium quantity q^*:

$$MR_D(q^*) = \underbrace{\beta_U(q,\alpha)MC_U(q^*) + (1-\beta_U(q,\alpha))MC_D(q^*)}_{\widetilde{MC}_D(q^*,\alpha)},$$

where $\beta_U(q,\alpha) \equiv \frac{\alpha}{1-\alpha}\frac{\Pi_D(q)}{\Pi_U(q)}$ decreases in α with $\beta_U(q,0) = 0$ and $\beta_U(q,\alpha_I) = 1$. Rewriting again:

$$\underbrace{p(q^*)\left(1-\varepsilon_p^{-1}(q^*)\right)}_{MR_D(q^*)} = \underbrace{\left(1+\varepsilon_{MC_U}^{-1}(q^*)(1-\beta_U(q^*))\right)w(q^*)}_{\widetilde{MC}_D(q^*,\alpha)}.$$

We can define in particular:

$$\nu_D \equiv \frac{MR_D(q^*)}{w(q^*)} = \frac{MR_D(q^*)}{MC_U(q^*)} = \frac{\varepsilon_{MC_U} + (1-\beta_U(q^*,\alpha))}{\varepsilon_{MC_U}} = \frac{(\varepsilon_p - 1)(\alpha(\varepsilon_r+1) + (1-\alpha)(\varepsilon_{MC_U}+1))}{\alpha\varepsilon_p(\varepsilon_r+1) + (1-\alpha)(\varepsilon_{MC_U})(\varepsilon_p-1)},$$

as well as $\nu_U \equiv \frac{MC_U(q^*)}{r(q^*)} = \frac{\epsilon_r+1}{\epsilon_r}$, $\mu_U \equiv \frac{w(q^*)}{MC_U(q^*)} = 1$, and $\mu_D \equiv \frac{p(q^*)}{w(q^*)} = \frac{p(q^*)}{MR_D(q^*)} = \frac{\varepsilon_p}{\varepsilon_p - 1}$. Back

When $\alpha = 0$, D makes a take-it-or-leave-it offer to U.

D anticipates $w(q) = MC_U(q)$. Its program, equivalent to the Nash program (as $\alpha = 0$), is:

$$\max_q \Pi_D(q) = p(q)q - w(q)q \quad \text{subject to} \quad w(q) = MC_U(q)$$

The FOC yields:

$$\underbrace{p(q^*)\left(1 - \varepsilon_p^{-1}(q^*)\right)}_{MR_D(q^*)} = \underbrace{w(q^*)\left(1 + \varepsilon_{MC_U}^{-1}(q^*)\right)}_{MC_D(q^*)}.$$

We can define in particular:

$$\nu_D \equiv \frac{MR_D(q^*)}{w(q^*)} = \frac{\varepsilon_{MC_U} + 1}{\varepsilon_{MC_U}} = \frac{\sigma_r + \varepsilon_r + 3}{\varepsilon_r + 1},$$

as well as $\nu_U \equiv \frac{MC_U(q^*)}{r(q^*)} = \frac{\epsilon_r + 1}{\epsilon_r}$, $\mu_U \equiv \frac{w(q^*)}{MC_U(q^*)} = 1$, and $\mu_D \equiv \frac{p(q^*)}{w(q^*)} = \frac{p(q^*)}{MR_D(q^*)} = \frac{\varepsilon_p}{\varepsilon_p - 1}$.

Back

Welfare effects when U is powerful

Corollary

When U is powerful ($\alpha_I < \alpha \leq 1$), a change in α affects markups, markdowns, and margins in the value chain in the following way:

(i) *$\mathcal{M}$, the value-chain margin, increases in α.*

(ii) *M_U and μ_U, respectively the margin and the markup of U, increase in α,*

(iii) *under demand and supply subconvexity, which ensures that $\frac{\partial \varepsilon_f}{\partial q} < 0, \forall f \in \{p, r\}$,*

- *ν_U, the markdown of U, decreases in α,*
- *M_D, the margin of D (here equal to its markup μ_D), decreases in α.*

Results in (iii) are reversed under demand and supply super-convexity $\left(\frac{\partial \varepsilon_f}{\partial q} > 0, \forall f \in \{p, r\}\right)$, and canceled under C.E.S demand and supply $\left(\frac{\partial \varepsilon_f}{\partial q} = 0, \forall f \in \{p, r\}\right)$.

Back

Welfare effects when D is powerful

Corollary

When D is powerful ($0 \leq \alpha < \alpha_I$), a change in α affects markups, markdowns, and margins in the value chain in the following way:

(i) *$\mathcal{M}$, the value-chain margin, decreases in α,*

(ii) *M_D and ν_D, respectively the margin and the markdown of D, decrease in α,*

(iii) *under demand and supply subconvexity, which ensures that $\frac{\partial \varepsilon_f}{\partial q} < 0, \forall f \in \{p, r\}$,*

- *M_U, the margin of U (here equal to its markdown ν_U), increases in α,*
- *μ_D, the markup of D, increases in α.*

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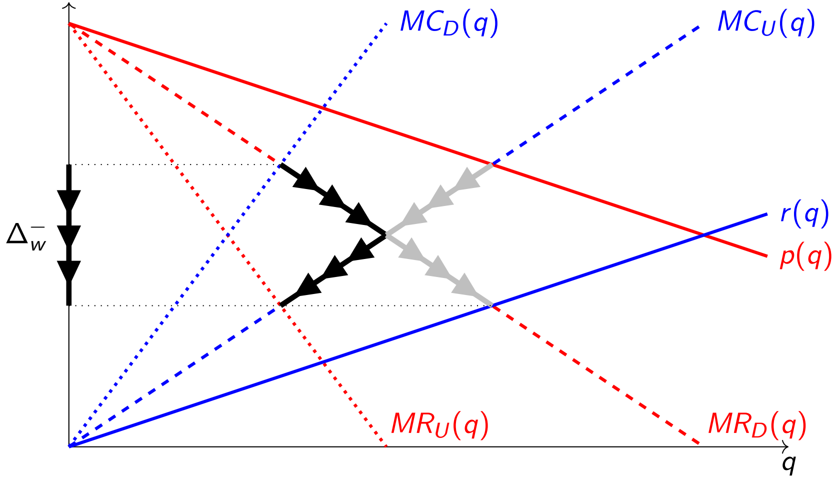
Back

When D (U) *exogenously* holds RTM, welfare is max. when $\alpha = 0$ ($\alpha = 1$).



In such cases, $w < MC$ ($w > MR$) and welfare and bilateral efficiency are misaligned! Back

Recap

The equilibrium $\{q_\alpha, r_\alpha, w_\alpha, p_\alpha\}$ is defined in three parts depending on the value of α relatively to a threshold $\alpha_I = \frac{\Pi_U(q_I)}{\Pi_U(q_I)+\Pi_D(q_I)}$.

1. When $\alpha = \alpha_I$,
   (i) $q_{\alpha_I} = q_I$, $r_{\alpha_I} = r_I$, $w_{\alpha_I} = w_I$, and $p_{\alpha_I} = p_I$;
   (ii) $\nu_U > 1$, $\mu_U = \nu_D = 1$, $\mu_D > 1$,
   (iii) **same total welfare as in the vertically-integrated case**.
2. When $\alpha_I < \alpha \leq 1$,
   (i) $q_\alpha < q_I$, $r_\alpha < r_I$, $w_\alpha > w_I$, and $p_\alpha > p_I$,
   (ii) $\nu_U > 1$, $\mu_U > 1$, $\nu_D = 1$, $\mu_D > 1$,
   (iii) $\frac{\partial q_\alpha}{\partial \alpha} < 0$, $\frac{\partial r_\alpha}{\partial \alpha} < 0$, $\frac{\partial w_\alpha}{\partial \alpha} > 0$, and $\frac{\partial p_\alpha}{\partial \alpha} > 0$,
   (iv) **total welfare is decreasing in α**.
3. When $0 \leq \alpha < \alpha_I$,
   (i) $q_\alpha < q_I$, $r_\alpha < r_I$, $w_\alpha < w_I$, and $p_\alpha > p_I$,
   (ii) $\nu_U > 1$, $\mu_U = 1$, $\nu_D > 1$, $\mu_D > 1$,
   (iii) $\frac{\partial q_\alpha}{\partial \alpha} > 0$, $\frac{\partial r_\alpha}{\partial \alpha} > 0$, $\frac{\partial w_\alpha}{\partial \alpha} > 0$, and $\frac{\partial p_\alpha}{\partial \alpha} < 0$,
   (iv) **total welfare is increasing in α**.

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