Markups, Markdowns, and Bargaining in a Vertical Supply Chain

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What is the welfare effect of buyer power?

Two contradictory views:

- **countervailing power theory** (Galbraith, 1952):
  - Rebates received by downstream firms are passed through to consumers.

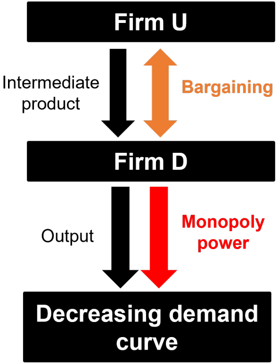
    ⇒ **Buyer power improves welfare.**
  - Common feature in the vertical relationship literature.
- **monopsony power theory** (Robinson, 1933):
  - Input prices fixed below the competitive level lead to output reduction.

    ⇒ **Buyer power harms welfare.**
  - Long tradition in the labor literature.

This paper:

- **bridges both theories in a unified bargaining framework,**
- **delivers new insights for welfare, policy, and empirics.**

What We Do



- Take the canonical model of bargaining in vertical relationships.

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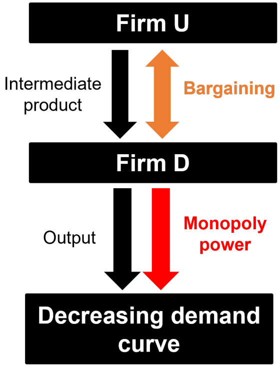

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- Allow monopsony power to emerge by **relaxing two assumptions**:

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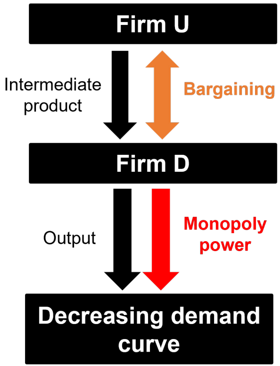

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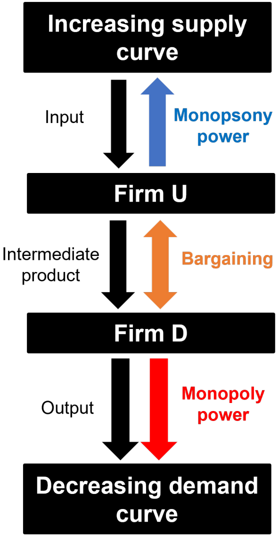

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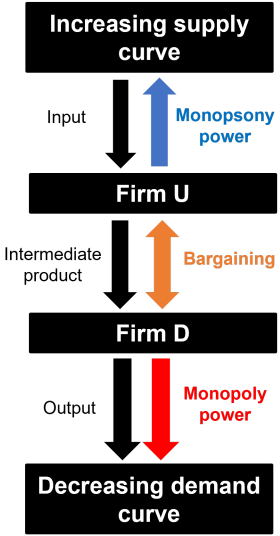

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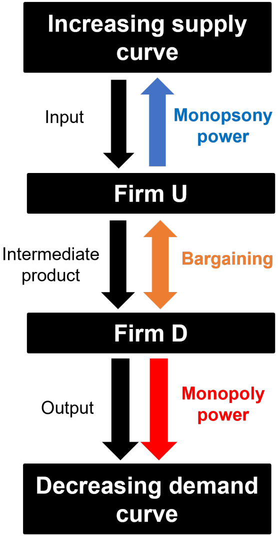

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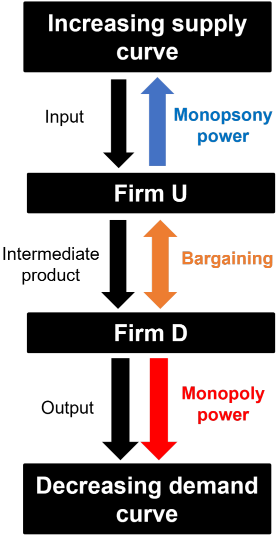

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- Revisit *double marginalization*: sources, implications, and remedies.

What We Find

A **vertically-integrated firm** with **monopsony** and **monopoly** power exerts a **markdown** and **markup**.

A **vertical relationship** which bargains over a linear tariff:

- **reproduces vertical integration if and only if bargaining is efficiently balanced**,
  - i.e., when the seller's Nash-bargaining weight $\alpha = \alpha_I$ with $\alpha_I \in (0, 1)$,
  - where $\alpha_I \downarrow$ with the input supply elasticity and $\uparrow$ with the output demand elasticity.
- **generates an additional inefficency otherwise, due to:**
  - **double markupization when the seller is too powerful** $(\alpha > \alpha_I)$,
    - *welfare increases with buyer power, countervailing the seller's monopoly power*;
  - **double markdownization when the buyer is too powerful** $(\alpha < \alpha_I)$,
    - *welfare increases with seller power, countervailing the buyer's monopsony power*.

Extending the analysis:

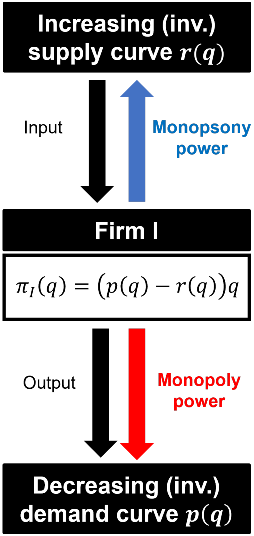
- similar results hold with **two-part tariffs if frictions impede fixed fee extraction**,
- an optimal upstream price floor **depends on the distribution of bargaining power** in the chain,
  - suppresses double markdownization, **turning buyer monopsony into countervailing power**.

A unified model of monopoly, monopsony, and countervailing power.

(Cournot, 1838; Robinson, 1933; Fellner, 1947; Spengler, 1950; Galbraith, 1952)

1. **Endogenizing the right-to-manage, i.e., who sets the quantity in bargaining over a price,**
   - via a timing with (1) price bargaining, and (2) *voluntary exchange* implying a *short-side rule*,
   - solving a long-standing issue in bilateral monopoly models (Atkin et al., 2024; Toxvaerd, 2024).
2. **Allowing countervailing (welfare-improving) or distortive seller and buyer power to emerge,** (Loertscher and Marx, 2022, 2025; Demirer and Rubens, 2025)
   - showing *double marginalization* may result from *excessive seller or buyer power*,
   - differing from bargaining models with *constant marginal cost* or *exogenous right-to-manage*, (Lee et al., 2021; Alviarez et al., 2023; Wong, 2023; Azkarate-Askasua and Zerecero, 2024; Treuren, 2025)
   - relevant for *bargaining* settings with *increasing marginal cost*. (Morlacco, 2019; Boehm and Pandalai-Nayar, 2022; Yeh et al., 2022; Kroft et al., 2023; Rubens, 2023)
3. **Offering general markup/markdown definitions and expressions for bargaining frameworks.**
4. **Delivering implications for policy, pass-through, and empirical work,**
   - e.g., optimal price floor design depends on the distribution of bargaining power in the chain.

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:

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

We also assume, for simplicity:

- one-to-one production technology,
- no cost besides the input price.

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:

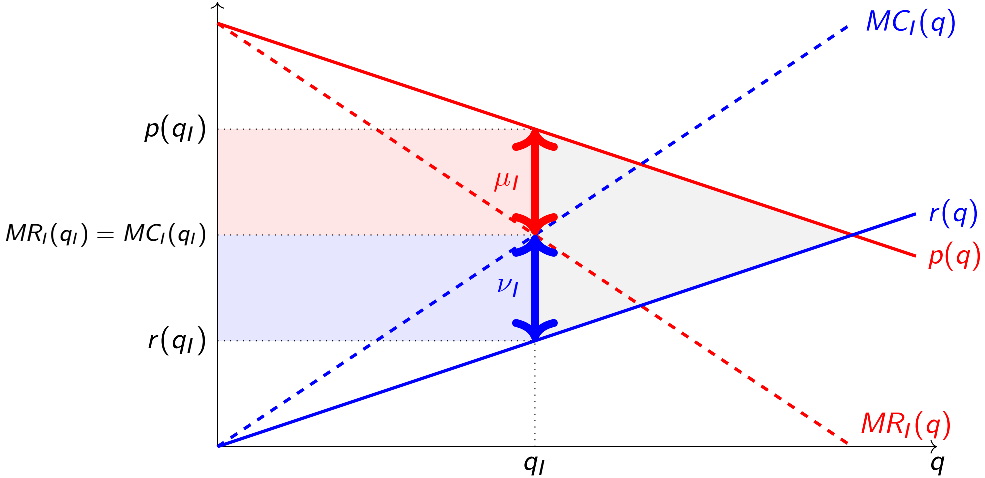
$$\underbrace{p(q_I)\left(1 - \varepsilon_p^{-1}(q_I)\right)}_{MR_I(q_I)} = \underbrace{r(q_I)\left(1 + \varepsilon_r^{-1}(q_I)\right)}_{MC_I(q_I)}.$$

In equilibrium, firm I exerts:

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

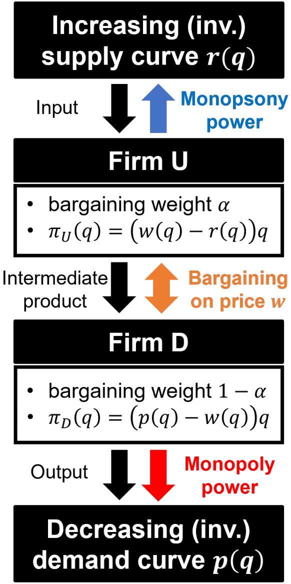
Definitions

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



Both distort the quantity downward, the input price downward, and the output price upward. Definitions

The Supply Chain



Timing

- **Stage 1:** firms U and D bargain over a linear wholesale price w.
- **Stage 2:**
  - U and D simultaneously announce the quantities q_U and q_D they are willing to trade.
  - *Exchange is voluntary*, implying that the quantity traded is the minimum of q_U and q_D.

Remarks:

- we restrict attention to **linear prices** (for now),
- **voluntary exchange** means no firm can force the other to trade more than it wants to:
  - standard/implicit in Walrasian and non-Walrasian (i.e., rationing) models (Bénassy, 1993),
    - ★ e.g., the canonical model of vertical relationship with constant upstream marginal cost,
  - equivalent to D (resp. U) uniterally setting the consumer price p (resp. input price r).
- we adopt a **subgame perfect equilibrium concept** $\rightarrow$ we solve backward.

▸ Timing ▸ Linear price ▸ Microfoundation ▸ Alternative Stage 2

[Stage 2] Given w, firms announce quantities under voluntary exchange.

- U's optimal quantity to trade is given by:

$$\tilde{q}_U(w) \in \underset{q_U}{\text{argmax}}\ \pi_U \equiv (w - r(q_U))q_U \iff w = MC_U(\tilde{q}_U(w)).$$

- D's optimal quantity to trade, is given by:

$$\tilde{q}_D(w) \in \underset{q_D}{\text{argmax}}\ \pi_D \equiv (p(q_D) - w)q_D \iff MR_D(\tilde{q}_D(w)) = w.$$

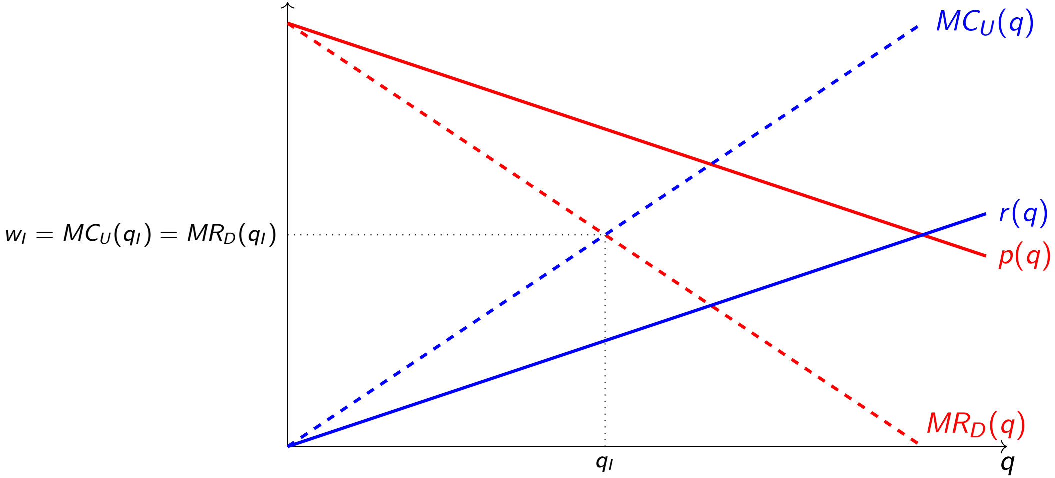
Lemma

There exists a unique subgame equilibrium in dominant strategies such that U announces $\tilde{q}_U(w)$, D announces $\tilde{q}_D(w)$, and the quantity traded is $q(w) = \min\{\tilde{q}_U(w), \tilde{q}_D(w)\} \leq q_I$.

⚙ "Inverting" $q(w)$ yields a wholesale-price quantity schedule obeying a **short-side rule**.

▸ Proof ▸ More ▸ Alternative Stage 2

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



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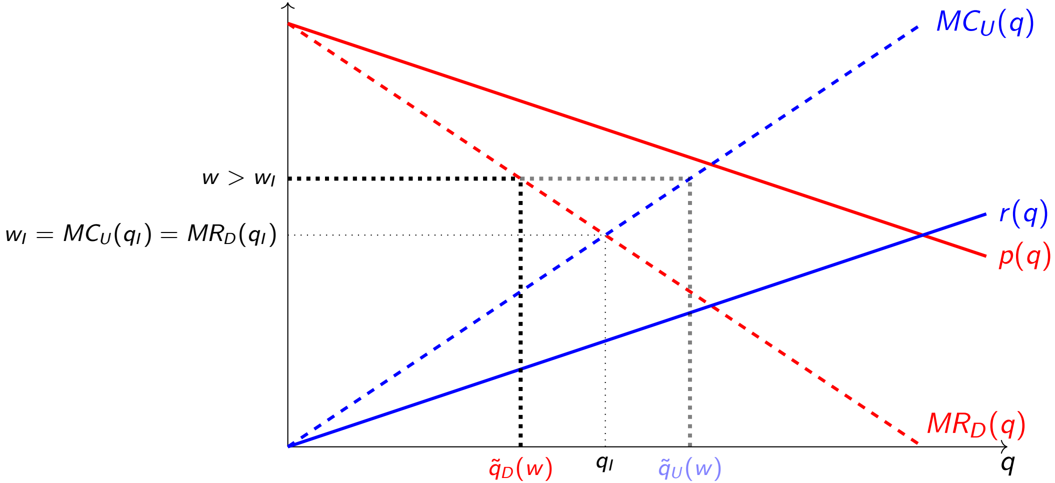

For a high price ($w > w_I$), D is willing to demand less ($\tilde{q}_D(w)$) than U is willing to supply ($\tilde{q}_U(w)$).

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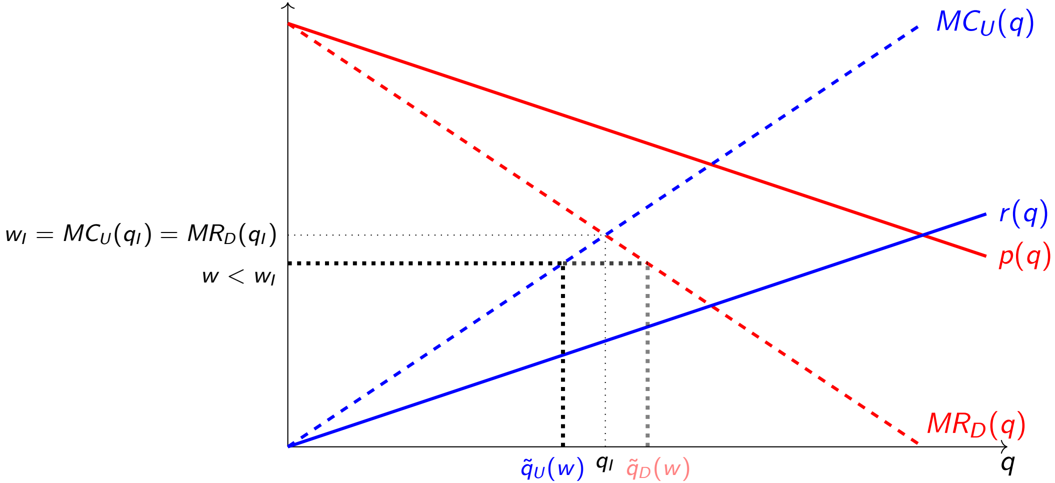
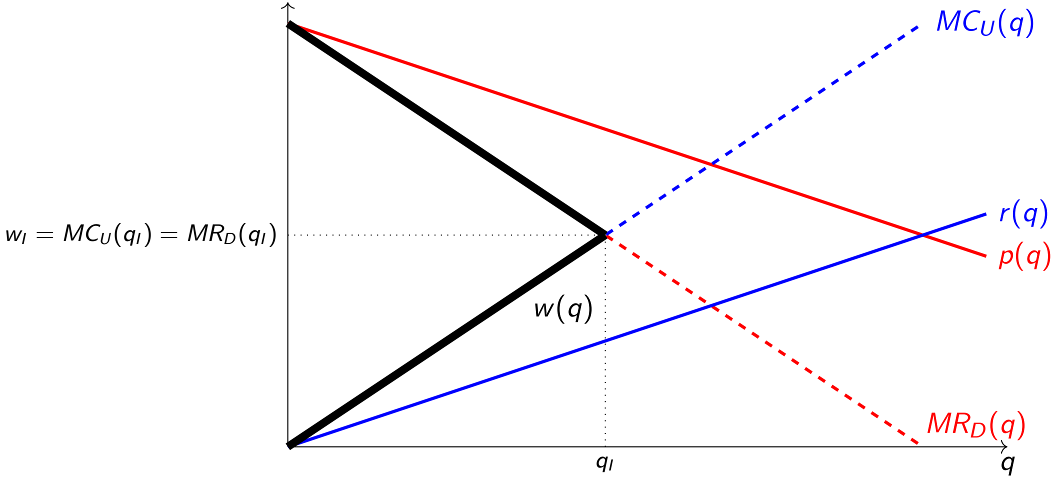


For a low price ($w < w_I$), U is willing to supply less ($\tilde{q}_U(w)$) than D is willing to demand ($\tilde{q}_D(w)$).

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



The short-side rule determines the wholesale price-quantity schedule, thus implying that $q(w) \leq q_I$ for any w.

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

The Nash program is given by:

$$\max_{w} \pi_U(q)^{\alpha} \pi_D(q)^{(1-\alpha)} \quad \text{s.t} \quad w(q) = \begin{cases} MC_U(q) \text{ if } w \leq w_I, \\ MR_D(q) \text{ otherwise.} \end{cases}$$

The FOC (equivalently written w.r.t q) yields:

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

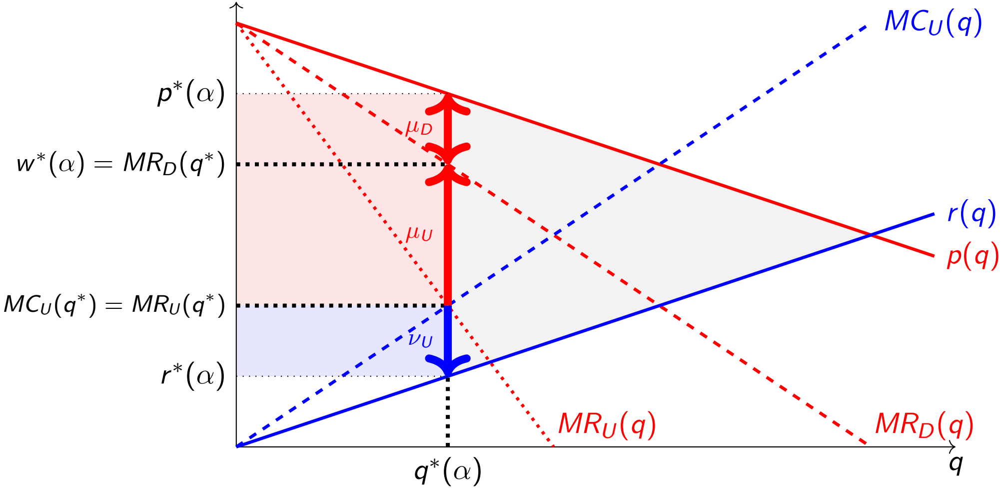
The FOC depends on α directly and through firm anticipations of the schedule $\boldsymbol{w(q)}$, with:

$$\frac{\partial w(q)q}{\partial q} = \begin{cases} \frac{\partial MC_U(q)q}{\partial q} \equiv MC_D(q) \text{ if } w < w_I, \\ \frac{\partial MR_D(q)q}{\partial q} \equiv MR_U(q) \text{ if } w > w_I. \end{cases}$$

→ We now treat cases from $\alpha = 1$ to $\alpha = 0$, i.e., **with increasingly high buyer power from** D.

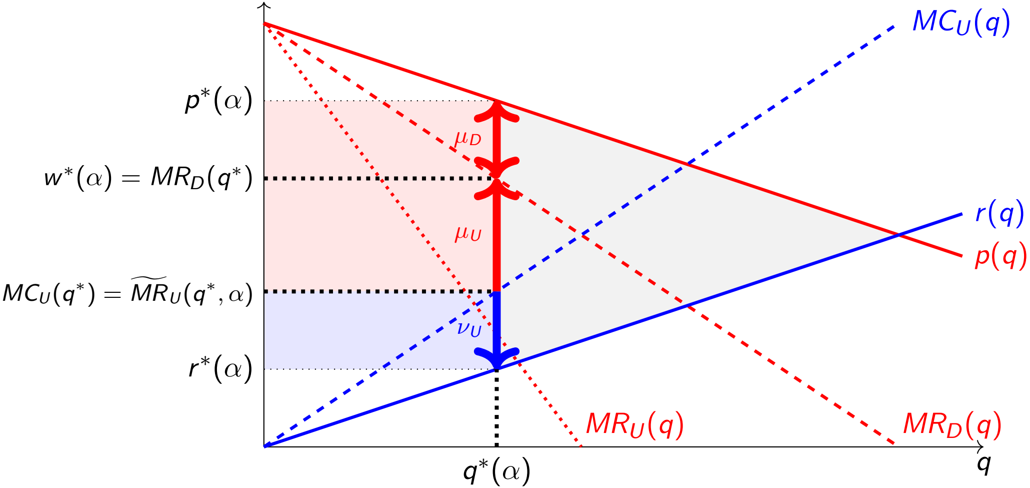
▸ Non-coop microfoundation ▸ SOC

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



Extreme double markupization à la Cournot (1838)-Spengler (1950). Maths

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



Double markupization decreases as D gains countervailing buyer power. ▸ Maths ▸ Definitions

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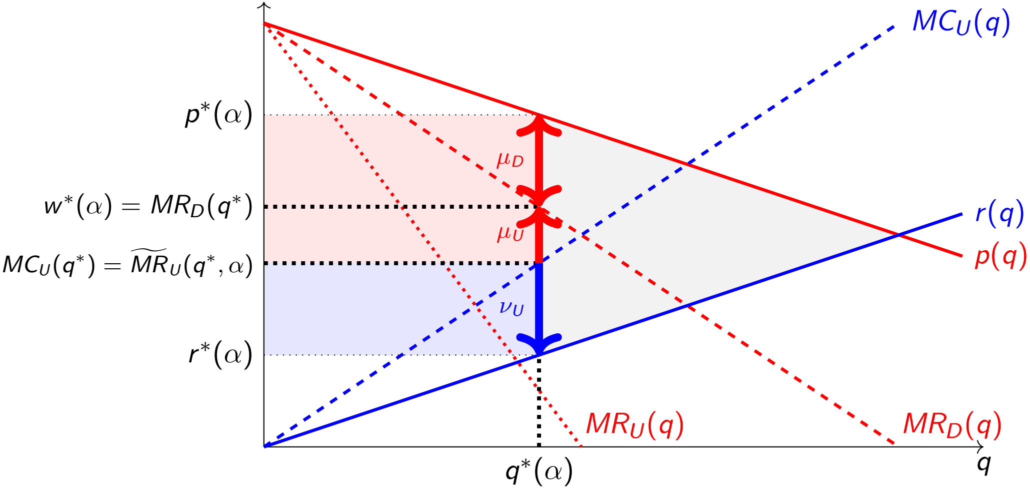
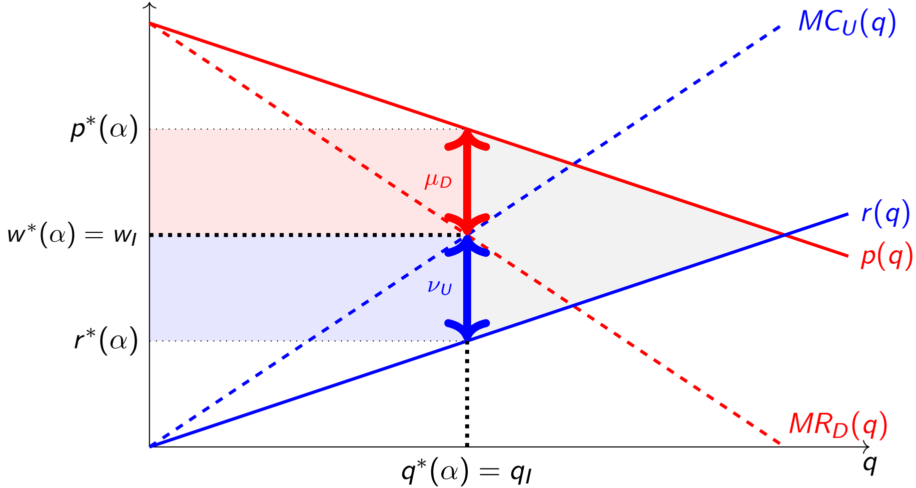


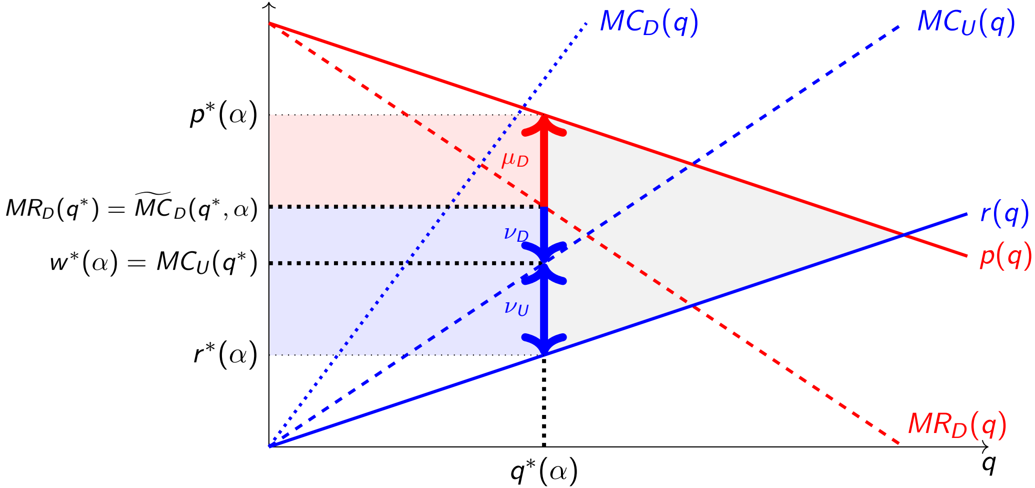
Double markupization decreases as *D* gains countervailing buyer power. ▸ Maths ▸ Definitions

When $\alpha = \alpha_I \equiv \frac{\pi^U(q_I)}{\pi^U(q_I)+\pi^D(q_I)} = \frac{\varepsilon_p(q_I)-1}{\varepsilon_p(q_I)+\varepsilon_r(q_I)}$, bargaining is (bilaterally) efficient.



U's seller power and D's buyer power fully countervail each other, reproducing vertical integration. More

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



Double markdownization *arises as U loses countervailing seller power.* Maths Definitions

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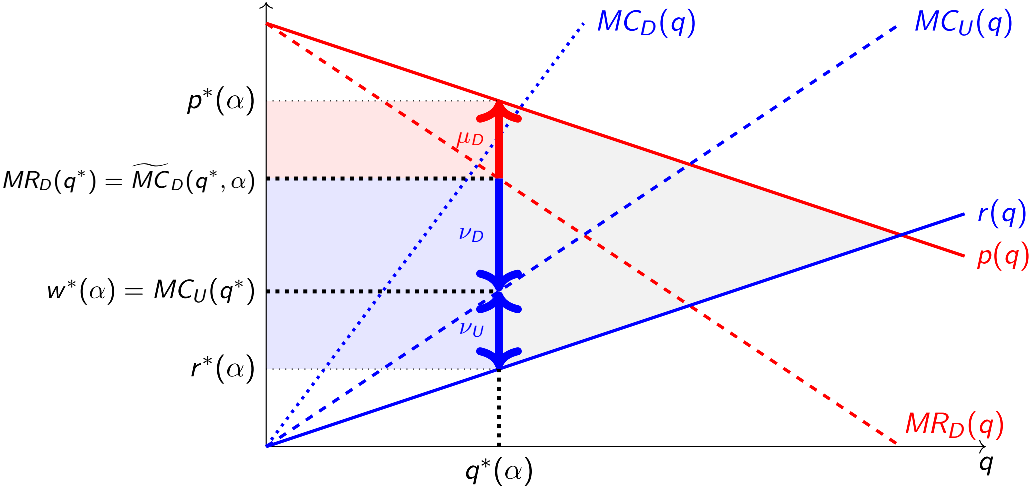
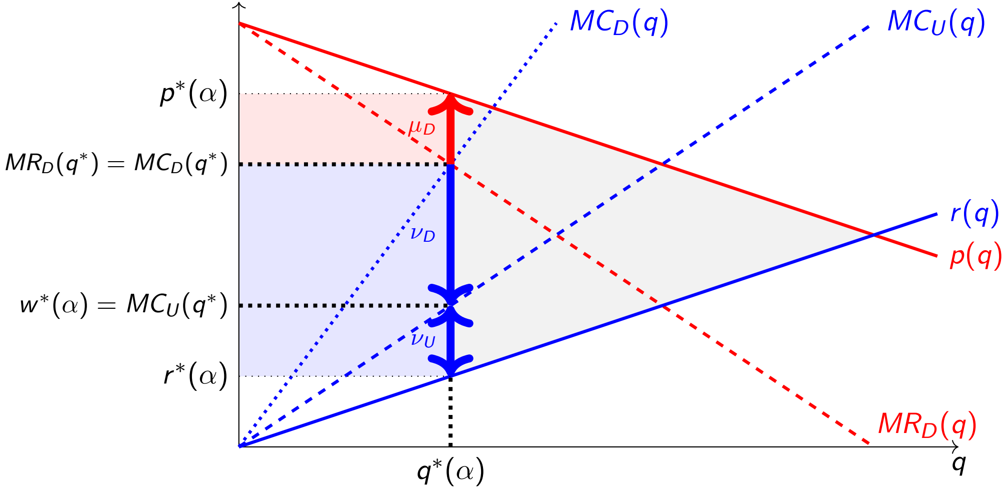


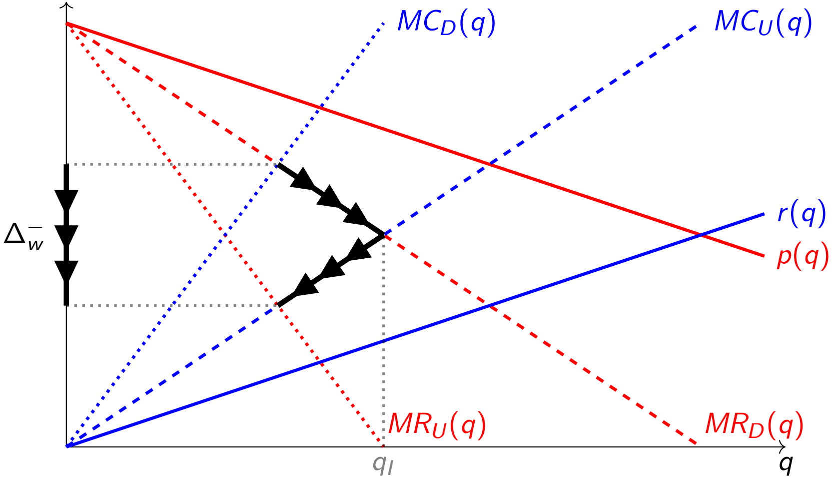
Double markdownization increases as U loses countervailing seller power. Maths Definitions

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



Extreme double markdownization as U has no countervailing seller power. ▸ Maths

Overall, increasing buyer power ($\downarrow \alpha$) has a non-monotonic welfare effect.



The weak side endogeneously obtains the right-to-manage, keeping welfare and bilateral efficiency aligned.

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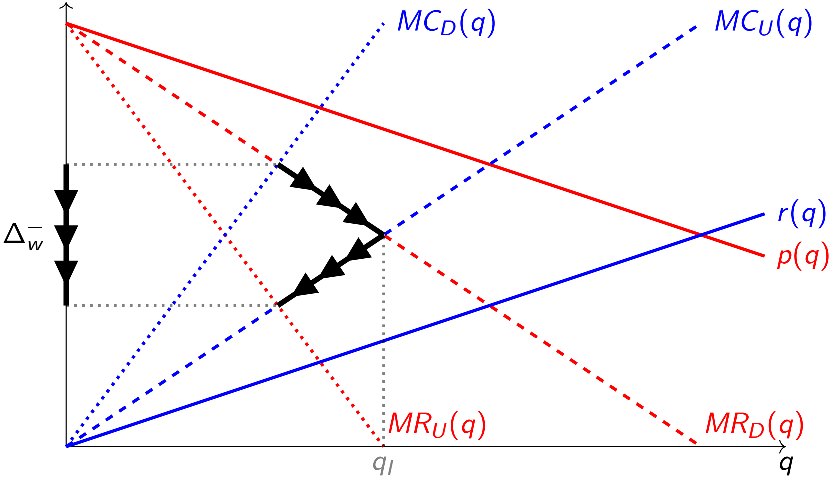

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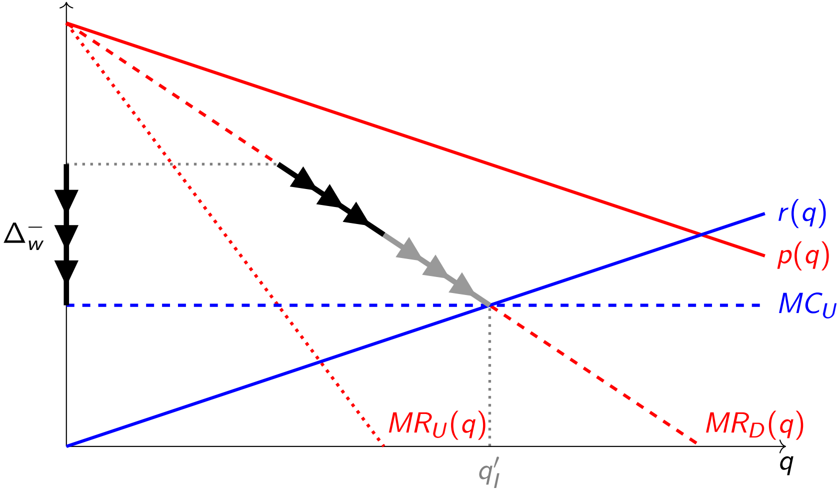

...countervailing if U had constant MC_U, implying that D would always be willing to trade less than U at w^*.

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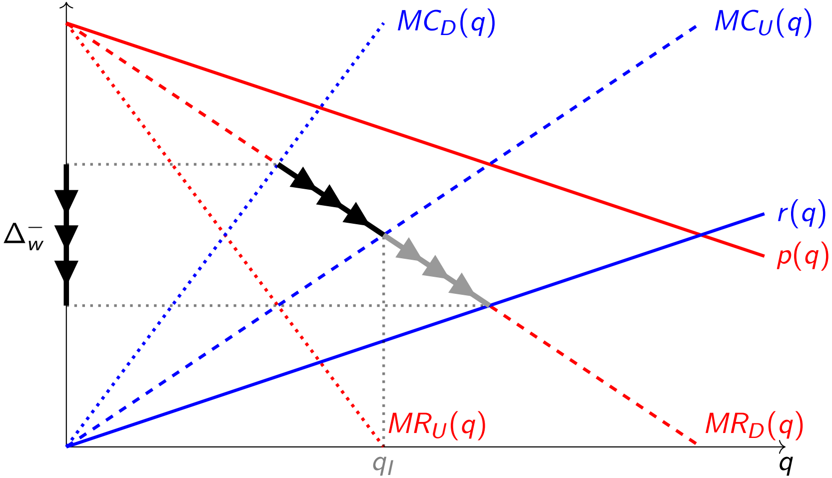

...countervailing if D exogenously had the RTM, setting $q^* > q_I > \tilde{q}_U$ *at* $w^* < MC_U(q^*)$ *when* $\alpha < \alpha_I$.

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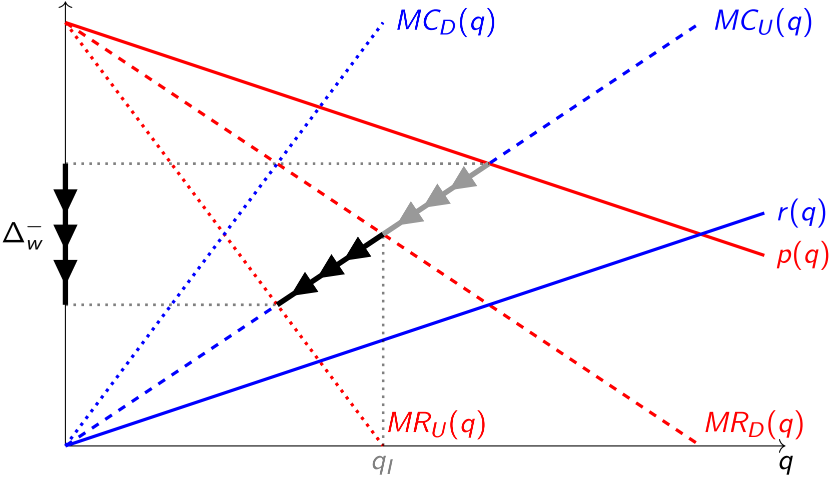


...distortive if U exogenously had the RTM, setting $q^* > q_I > \tilde{q}_D$ at $w^* > MR_D(q^*)$ when $\alpha > \alpha_I$.

Welfare Effects of Buyer and Seller Power

When U is powerful ($\alpha > \alpha_I$), an increase in D's bargaining power ($\downarrow \alpha$) *countervails* U's seller power:

- **U's markup μ_U** and the supply chain margin $\mathcal{M} = \nu_U \times \boldsymbol{\mu_U} \times \mu_D$ decrease,

When D is powerful ($\alpha < \alpha_I$), an increase in U's bargaining power ($\uparrow \alpha$) *countervails* D's buyer power:

- **D's markdown ν_D** and the supply chain margin $\mathcal{M} = \nu_U \times \boldsymbol{\nu_D} \times \mu_D$ decrease,

$\Rightarrow$ **As $\alpha \to \alpha_I$, welfare increases, and all players gain, except the firm losing bargaining power.**

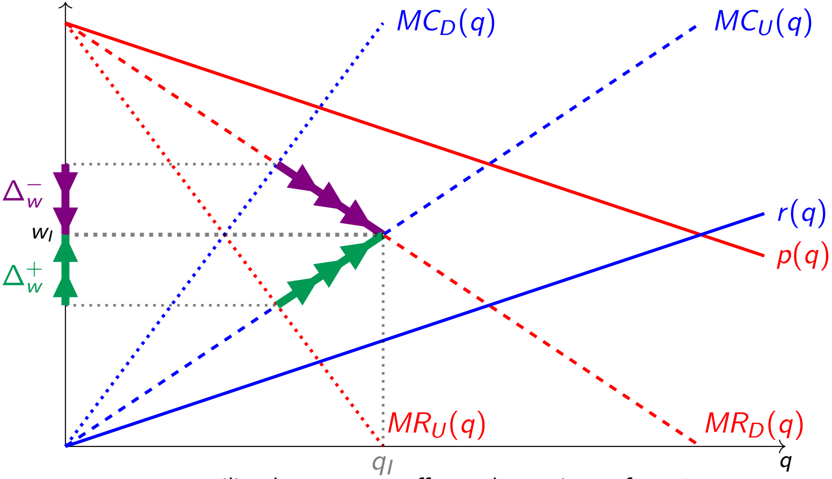
When $\alpha = \alpha_I \equiv \frac{\pi^U(q_I)}{\pi^U(q_I)+\pi^D(q_I)} = \frac{\varepsilon_p(q_I)-1}{\varepsilon_p(q_I)+\varepsilon_r(q_I)}$, welfare is maximized as:

- U's seller power and D's buyer power *fully countervail each other*, i.e., $\mu_U = \nu_D = 1$,
  - as they equally concede in equilibrium, i.e., $\beta_U(q_I, \alpha) = \beta_D(q_I, \alpha) = 1$,
- the chain replicates vertical integration: $q = q_I$ and $\mathcal{M} = \nu_U \times \mu_D = M_I$.

NB: effects on ν_U and μ_D depend on supply and demand sub/super-convexity but remain second-order.

More

Countervailing Buyer and Seller Power



countervailing buyer power effects, decreasing α from 1 to α_I
countervailing seller power effects, increasing α from 0 to α_I

How to interpret α_I?

The short-side rule implies that q_I is reached iff the bargaining leads to w_I such that:

$$\underbrace{\tilde{q}_D(w_I) = \tilde{q}_U(w_I) = q_I}_{\text{Stage 2}} \iff \underbrace{MR_D(\tilde{q}_D(w_I)) = MC_U(\tilde{q}_U(w_I))}_{\text{Stage 1}}.$$

Both players' incentives to trade must thus be aligned. It is the case iff $\alpha = \alpha_I$, with:

$$\alpha_I \equiv \underbrace{\frac{\pi^U(q_I)}{\pi^U(q_I) + \pi^D(q_I)}}_{U's \text{ share of joint profit}} = \underbrace{\frac{\varepsilon_p(q_I) - 1}{\varepsilon_p(q_I) + \varepsilon_r(q_I)}}_{\uparrow \text{ in } \varepsilon_p \text{ and } \downarrow \text{ in } \varepsilon_r}.$$

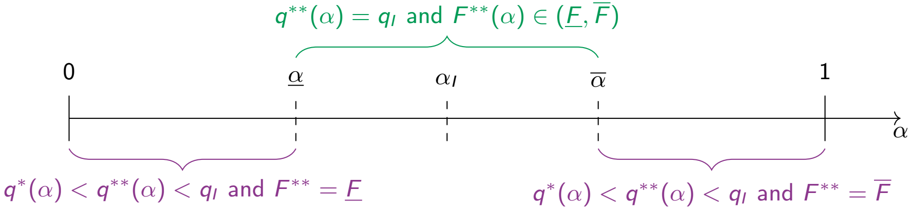
The costlier it is to incentivize a player to trade q_I, the larger its share of joint profit must be.

- low ε_r rel. to ε_p $\leftrightarrow$ *relatively* high incentives for U to exert monopsony power $\leftrightarrow$ high α_I,
- low ε_p rel. to ε_r $\leftrightarrow$ *relatively* high incentives for D to exert monopoly power $\leftrightarrow$ low α_I,

Back

Extension: Bargaining on a Two-Part Tariff (w, F) with Frictions

Without friction, two-part tariffs kill double-marginalization. Yet, with frictions, e.g., with $\underline{F} \leq F \leq \overline{F}$, we get:



Double marginalization persists under unbalanced bargaining, as the weak side liquidity constraint binds.

Microfoundations and alternative frictions:

- upfront payment of F + imperfect financial markets (Nocke and Thanassoulis, 2014),
- ex-post payment of F + uncertainty (e.g., about demand),

The fixed fee F becomes a relatively less efficient tool when the bargaining gets unbalanced.

Price Floor

We consider the introduction of a price floor $\underline{r}$ in the upstream market,

- e.g., minimum wage in a labor market or price floor in a raw agricultural product market.

A price floor flattens supply and marginal cost curves on the binding part, so that:

$$\underline{r}(q) = \underline{MC_U}(q) = \underline{MC_D}(q) = \underline{r} \text{ for } q \leq \underline{q}$$

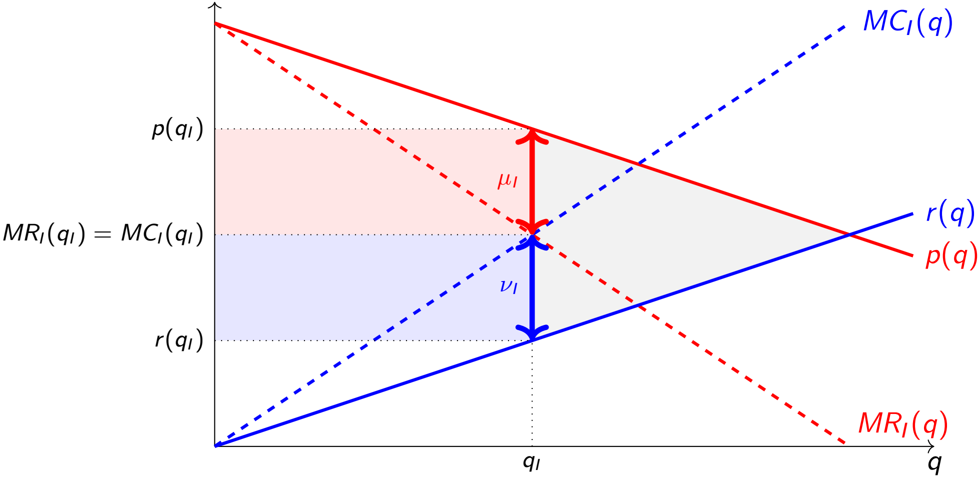
while $r(q)$, $MC_U(q)$, and $MC_D(q)$ remain unchanged for $q > \underline{q}$, where $\underline{q} \equiv r^{-1}(\underline{r})$.

Under a price floor, the demand side always pins down quantity: $w(q) = MR_D(q)$.

In what follows, we look for the optimal price floor in different cases, starting with benchmarks:

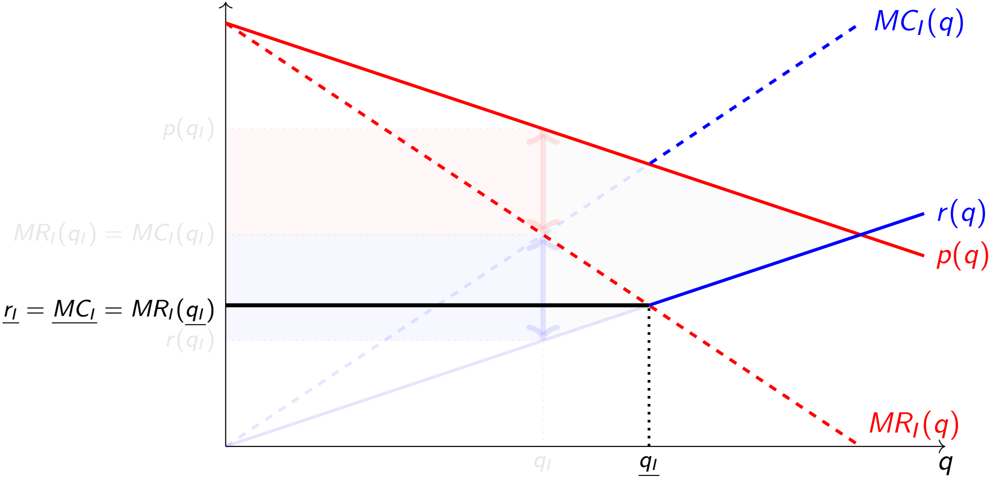
1. vertical integration,
2. take-it-or-leave-it offers.

Optimal Price Floor Under Vertical Integration



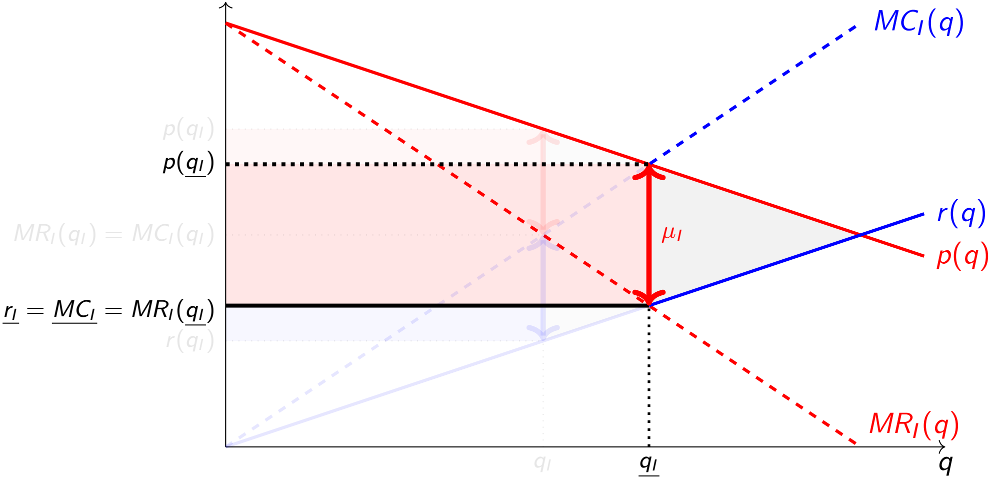
We start from the vertical integration case where I exerts a markup and a markdown.

Optimal Price Floor Under Vertical Integration



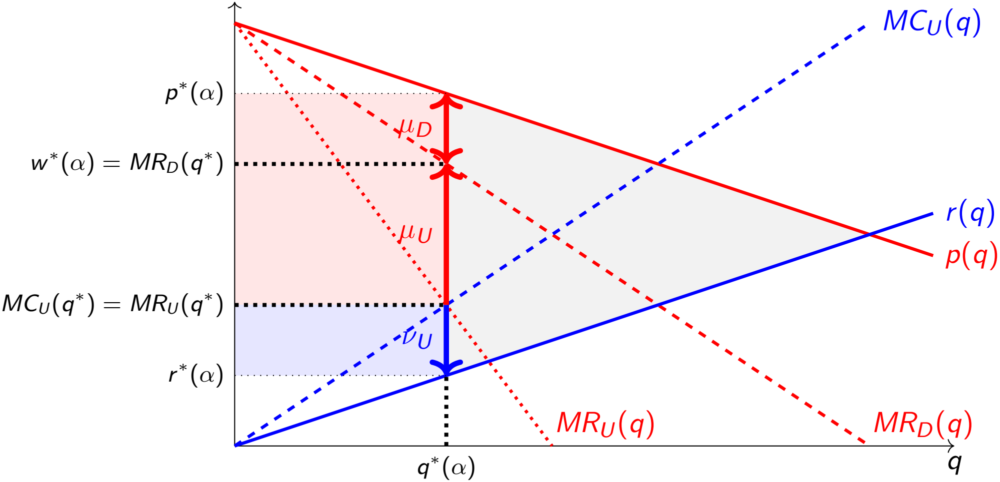
The optimal price floor, such that $r(\underline{q_I}) = MR_I(\underline{q_I})$, redefines the supply curve and MC_I.

Optimal Price Floor Under Vertical Integration



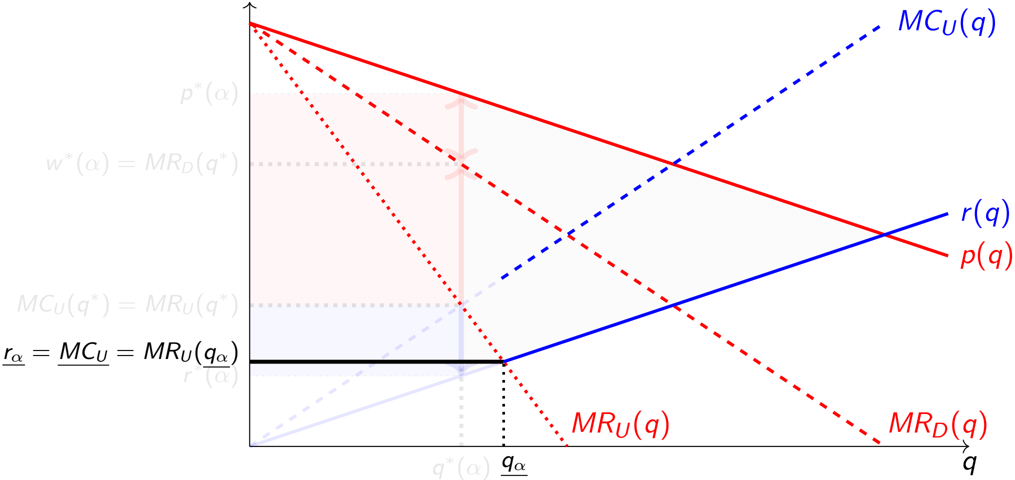
As it flattens supply and MC_I, the price floor eliminates the markdown, but not the markup.

Optimal Price Floor under a Take-it-or-Leave-it Offer from U $(\alpha = 1)$



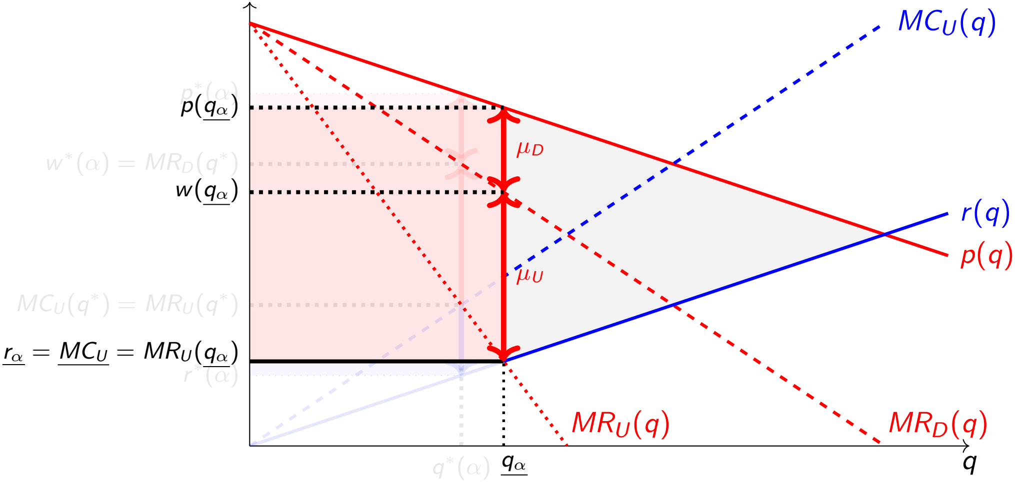
We start from extreme double markupization.

Optimal Price Floor under a Take-it-or-Leave-it Offer from U $(\alpha = 1)$



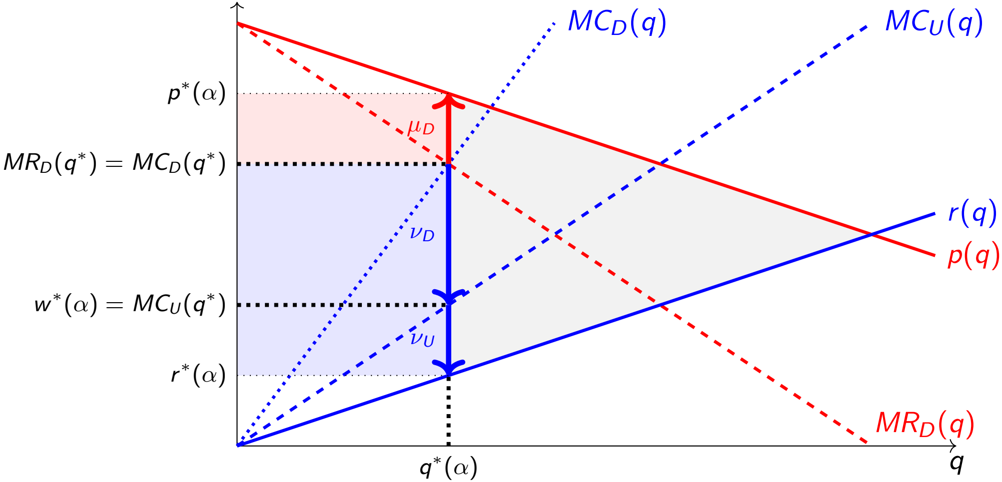
The optimal price floor, such that $\underline{r_\alpha} = r(\underline{q_\alpha}) = MR_U(\underline{q_\alpha})$*, redefines the supply curve and* MC_U*.*

Optimal Price Floor under a Take-it-or-Leave-it Offer from U $(\alpha = 1)$



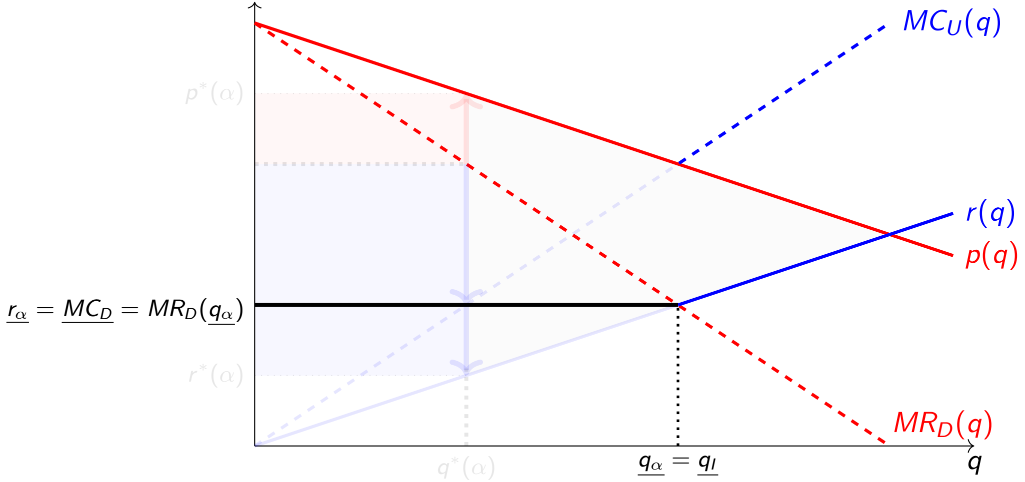
As it flattens supply and MC_U, the price floor eliminates the markdown, but not markups.

Optimal Price Floor under a Take-it-or-Leave-it Offer from D $(\alpha = 0)$



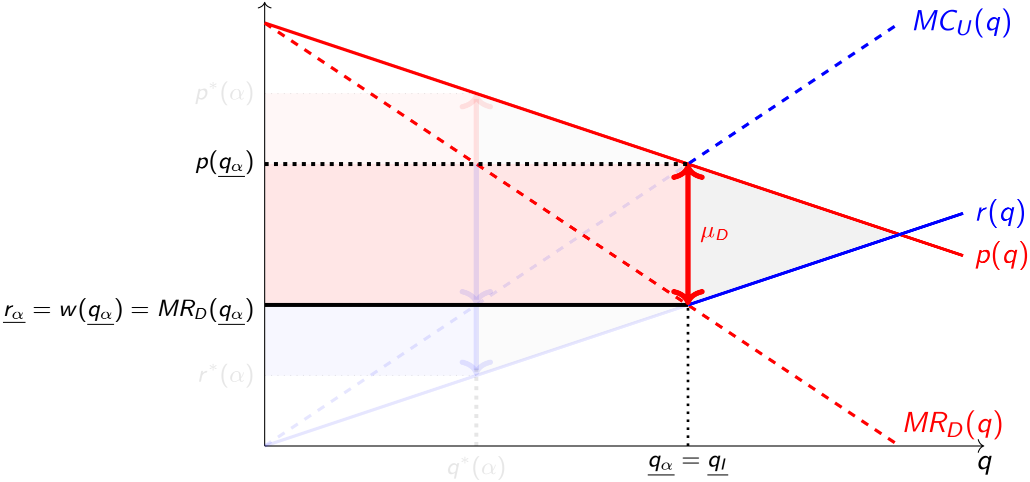
We start from extreme double markdownization.

Optimal Price Floor under a Take-it-or-Leave-it Offer from D $(\alpha = 0)$



The optimal price floor, such that $r(\underline{q_\alpha}) = MR_U(\underline{q_\alpha})$, redefines the supply curve, MC_U, and MC_D.

Optimal Price Floor under a Take-it-or-Leave-it Offer from D $(\alpha = 0)$



As it flattens supply and MC_U, the price floor eliminates both markdowns, but not the markup.

Overall, the optimal price floor depends on α, and increases welfare.

When $\alpha = 0$, the optimal price floor is $\underline{r_0} = r(\underline{q_0})$, with $\underline{q_0}$ such that $MR_D(\underline{q_0}) = r(\underline{q_0})$.
When $\alpha = 1$, the optimal price floor is $\underline{r_1} = r(\underline{q_1})$, with $\underline{q_1}$ such that $MR_U(\underline{q_1}) = r(\underline{q_1})$.

More generally, for any α, the optimal price floor is $\underline{r_\alpha} = r(\underline{q_\alpha})$, with $\underline{q_\alpha}$ such that:

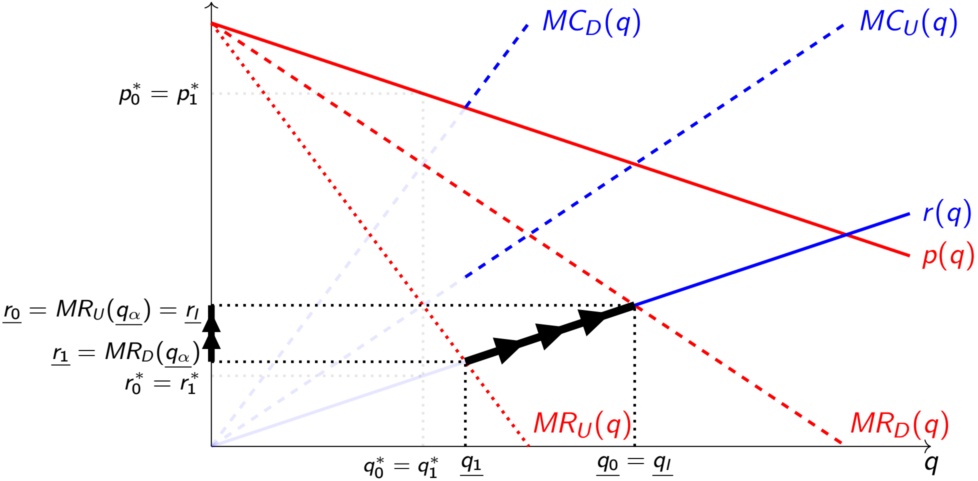
$$\widetilde{MR}_U(\underline{q_\alpha}, \alpha) = r(\underline{q_\alpha}),$$

where (remember that) $\widetilde{MR}_U(q, \alpha) \equiv \beta_D(q, \alpha) MR_D(q) + (1 - \beta_D(q, \alpha)) MR_U(q)$. Graph

We obtain that the *optimal* price floor:

- **always increases (total) welfare**,
- **always benefits input suppliers (e.g., workers, farmers) and consumers**, and hurts U,
- **benefits** D **when** U **is powerful** ($\alpha \geq \alpha_I$) but **may hurt it otherwise**,
  - as we go from double markdownization to double markupization.

The optimal price floor and its welfare effects increase with D's buyer power.



Under the optimal price floor, welfare is maximized when $\alpha = 0$, restoring the canonical result!

The optimal policy depends on the type of double marginalization prevailing.

Overall, a **price floor is especially powerful under double markdownization**, where it:

- **transforms D's monopsony power into countervailing buyer power**,
- is an interesting tool to complement pro-buyer-power antitrust decisions,
  - e.g., clearance of retailer purchasing alliances.

Optimal policy design requires knowing which type of double marginalization prevails, as:

- if actual double markdownization is mistaken for double markupization,
  - **too low price floor → suboptimal, yet positive, welfare effects**;
- if actual double markupization is mistaken for double markdownization,
  - **too high price floor → suboptimal, possibly negative, welfare effects**.

Conclusion (1/3) - This Paper

This paper offers **a unified model of monopoly, monopsony, and countervailing power**, by:

- **endogenizing the right-to-manage**, i.e, who sets the quantity in a vertical relationship,
  - via a standard sequential timing with *voluntary exchange*, implying a *short-side rule*,
  - whereby a firm endogenously loses the right-to-manage when becoming too powerful;
- showing a vertical chain:
  - **reaches the vertical integration outcome if bargaining is efficiently balanced**
    - if $\alpha = \alpha_I$, with $\alpha_I \in (0,1)$, $\downarrow$ with input supply elasticity and $\uparrow$ with output demand elasticity,
  - **generates, otherwise, an additional inefficiency:**
    - **double markupization if excessive seller power**, giving rise to *countervailing buyer power*,
    - **double markdownization if excessive buyer power**, giving rise to *countervailing seller power*;
- **offering general markup/markdown definitions and expressions for bargaining frameworks.**

Whether double markup or double markdown prevails matters for policy design, e.g., price floor.

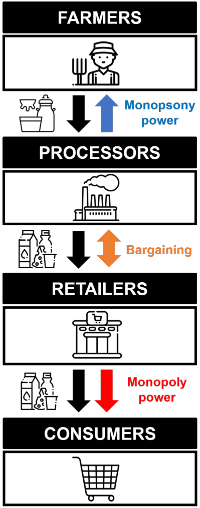
Conclusion (2/3) - Take-Aways for Empirical Work

1. **Need for flexibility in modeling marginal cost functions** in structural bargaining work:
   - commonly assumed constant upstream (Lee et al., 2021),
   - conditioning the nature of bilateral distortions and welfare effects of buyer and seller power.
2. **The bilateral inefficiency** (markup μ_U or markdown ν_D) **depends on**:
   - **who has the right-to-manage**
     - see Atkin et al. (2024) for an identification using Argentinian import restrictions,
   - **bargaining power, and supply and demand elasticities,**
     - see Demirer and Rubens (2025) for an estimation in the Texas coal value chain.
3. **Pass-throughs depend on demand & supply elasticities & curvatures + bargaining power.**

Relevance: **supply chains with bargaining and increasing marginal cost**, e.g., in which D bargains:

- with unions/cooperatives representing heterogeneous workers/firms,
- with a firm U which has decreasing returns to scale or monopsony power in its input market(s),
  - e.g., labor or raw agricultural product market.

Conclusion (3/3): Next Paper - *Markups and Markdowns from Farm to Fork*



From Avignon and Guigue (2022), we know that French dairy processors:

- **exert both markdowns and markups with large heterogeneity (firm-product-year)**,
- **adjust markdowns & markups to shocks** (commodity prices, farm costs), suggesting:
  - non-constant milk supply elasticity and processor-retailer bargaining,
  - that farmer subsidies are diverted due to processor monopsony power.

Goal: extend the model (competition) + use production and demand approaches to assess:

- the **role of bargaining** with retailers,
- the **passthrough of subsidies and upstream shocks to consumers**,
- recent **policies aiming at rebalancing value-added sharing**.

Thank you!

Markup & Markdown Definitions (which do not directly rely on MC or MR)

Our definitions aim to capture that **markups and/or markdowns (>1) arise under two conditions:**

(i) firms behave strategically to extract surplus from **imperfectly elastic demand and/or supply**,

(ii) surplus extraction occurs (at least partially) through the **use of a linear tariff**.

The markup of firm i is defined as $\mu_i \equiv \frac{x_i}{\hat{x}_i}$, where:

- x_i is the price at which firm i sells its marginal unit of output,
- $\hat{x}_i$ is the minimum price required for this unit to be sold, holding firm i's inframarginal revenue constant.

The markdown of firm i is defined as $\nu_i \equiv \frac{\hat{z}_i}{z_i}$, where:

- z_i is the price at which firm i buys its marginal unit of input,
- $\hat{z}_i$ is the maximum price required for this unit to be purchased, holding firm i's inframarginal cost constant.

Under bargaining, U's marginal revenue and D's marginal cost become ill-defined/irrelevant, but we show that:

$$\mu_U = \frac{w(q^*)}{MC_U(q^*)} \quad , \quad \nu_U = \frac{MC_U(q^*)}{r(q^*)} \quad , \quad \mu_D = \frac{p(q^*)}{MR_D(q^*)} \quad \text{and} \quad \nu_D = \frac{MR_D(q^*)}{w(q^*)}.$$

Vertical Integration
Double Markup
Double Markdown

Timing

A large literature assumes wholesale and retail prices are determined **simultaneously**:

- an assumption typically made to simplify "Nash-in-Nash" bargaining model estimation, (Crawford and Yurukoglu, 2012; Ho and Lee, 2017; Noton and Elberg, 2018; Sheu and Taragin, 2021)
- reasonable in the presence of retail price stickiness,
- questioning equilibrium existence in take-it-or-leave-it cases.

Instead, **we assume a sequential timing**, aligned with:

- bargaining involving contracting and price/wage stickiness (in an uncertain world)
- empirical findings that retail prices immediately respond to changes in wholesale prices (Goldberg and Hellerstein, 2013; Nakamura and Zerom, 2010)
- our future empirical application to the French dairy value chain, where:
  - processors and retailers yearly negotiate on wholesale prices,
  - raw milk and retail prices adjust at a higher frequency.

Back

Why do we assume linear tariffs, or bargaining on price only?

1. **Standard assumption in the (broadly-defined) double marginalization literature**, including:
   - a vast IO literature:
     see, e.g., Tirole (1988); Rey and Vergé (2008); Lee et al. (2021) for textbook and reviews.
   - **recent trade/macro work on aggregate distortions** in input-output networks
     Baqaee (2018); Baqaee and Farhi (2020); Dhyne et al. (2022); Arkolakis et al. (2023)...
   - recent bargaining models in trade or labor (maintaining exogenous right-to-manage):
     (Lee et al., 2021; Alviarez et al., 2023; Wong, 2023; Azkarate-Askasua and Zerecero, 2024; Treuren, 2025)
2. **Empirical evidence of:**
   - **linear tariffs** (Mortimer, 2008; Crawford and Yurukoglu, 2012; Grennan, 2013; Gowrisankaran et al., 2015; Smith and Thanassoulis, 2015; Ho and Lee, 2017; Noton and Elberg, 2018; Cussen and Montero, 2024),
   - **double marginalization** (Luco and Marshall, 2020; Molina, 2025).
3. Our **results remain under non-linear tariff and frictions impeding fixed fee extraction**,
   - incomplete contracts/markets.

Back

Non-cooperative Microfoundation

- Stage 1 (Rey and Vergé, 2020):
  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 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: unchanged.

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* $w^{**} = w^*$.

NB: same equilibrium under alternative Stage 2 where D (resp. U) unilaterally sets p (resp. r).

▸ More (Alternative Stage 2) ▸ Back (Timing)

Unilateral Pricing as an Alternative to Voluntary Exchange

(a) Simultaneous Pricing: D sets the consumer price p and U sets the input price r, simultaneously. Given the input quantity that U can procure, D purchases from U to meet consumer demand.

Intuitions:

1. Under imperfectly elastic supply and demand:
   - r determines the maximum quantity U can procure from input suppliers,
   - p determines the maximum quantity D will purchase from U.
2. D (resp. U) internalizes that the max. quantity it can trade with U (D) is constrained by r (p).
3. Given w, each firm sets its profit-maximizing price while anticipating that of the other.
4. The unique Pareto-dominant Nash equilibrium coincides with that of the baseline model.

(b) Sequential Pricing: One firm chooses its profit-maximizing price before the other, e.g.:

2.1 Given w, U chooses the input price r.

2.2 Given w and r, D sets the consumer price p.

The unique equilibrium coincides with that of the baseline model. Back (Timing) Back (Stage 2)

Proof: Unique Subgame Perfect Equilibrium in Dominant Strategies

Announcing the profit-maximizing quantity, resp. $\tilde{q}_U$ and $\tilde{q}_D$, is a (weakly) dominant strategy for U and D.

Indeed, assume that U anticipates that D will announce a quantity q_D^a (symmetric reasoning for D):

- such that $q_D^a \leq \tilde{q}_U(w)$. Then:
  - announcing $\tilde{q}_U(w)$ is as good as announcing any other quantity larger or equal to q_D^a given that only q_D^a will then be traded (short-side rule).
  - announcing a lower quantity than q_D^a is strictly dominated as the quantity traded would then be even further away from the optimal quantity $\tilde{q}_U(w)$ (short-side rule).
- such that $\tilde{q}_U(w) < q_D^a$. Then announcing $\tilde{q}_U(w)$ is the best strategy for U as the quantity traded in that case maximizes U's profit.

$\Rightarrow$ each firm announces the quantity that maximizes its profit.

Because a (weakly) dominant strategy is the best response to *any* strategy the other firm might play (including the one chosen in equilibrium), the strategy profile $(\tilde{q}_U(w), \tilde{q}_D(w))$ constitutes a Nash equilibrium.

Back

Multiple Equilibria in Dominated Strategies

Given voluntary exchange, there exists a multiplicity of Nash equilibria in (weakly) dominated strategies, e.g.:

- if U believes that D will announce $\hat{q} < \tilde{q}_D$ (resp D if it believes that U will announce $\hat{q} < \tilde{q}_U$),
- also announcing $\hat{q}$, is one best response for U (resp D), although a weakly dominated strategy.

$\Rightarrow$ any strategy profile $(\hat{q},\hat{q})$ with $\hat{q} < \min\{\tilde{q}_U(w),\tilde{q}_D(w)\}$ is a Nash equilibrium of the announcement game.

However, such equilibria are destroyed by the trembling-hand criteria (or similarly cheap talk):

- both U and D are better off announcing $\check{q} > \hat{q}$ whenever the other firm trembles upward.

In addition:

- when $\tilde{q}_U(w) < \tilde{q}_D(w)$, announcing any quantity in the interval $[\tilde{q}_U(w), \tilde{q}_D(w)]$ is a best response for D,
- when $\tilde{q}_D(w) < \tilde{q}_U(w)$, announcing any quantity in the interval $[\tilde{q}_D(w), \tilde{q}_U(w)]$ is a best response for U.

$\Rightarrow$ leading to asymmetric announcements yielding the same equilibrium outcome as described in the Lemma.

Finally, the Pareto dominance criterion also selects the equilibria leading to the same outcome as in the Lemma.

Back

Proof: Wholesale Price-Quantity Schedule

As MR_D is decreasing and MC_U is increasing:

1. there is a unique quantity $q = q_I$ such that $MR_D(q_I) = MC_U(q_I)$,
2. in stage 2, there is a unique $w = w_I$ such that

$$w_I = MR_D(\tilde{q}_D(w_I)) = MC_U(\tilde{q}_U(w_I)) = MR_D(q_I) = MC_U(q_I),$$

3. for $w < w_I$, $\tilde{q}_D(w) > \tilde{q}_U(w)$, and for $w > w_I$, $\tilde{q}_D(w) < \tilde{q}_U(w)$.

The resolution of stage 2 leads to $q(w) = \min\{\tilde{q}_U(w), \tilde{q}_D(w)\}$, and thus:

$$q(w) = \begin{cases} \tilde{q}_U(w) \text{ for } w \leq w_I, \\ \tilde{q}_D(w \text{ for } w \leq w_I. \end{cases}$$

For $w \leq w_I$, we thus have:

$$q = \tilde{q}_U = MC_U^{-1}(w) \Rightarrow MC_U(q) = w.$$

and for $w \geq w_I$:

$$q = \tilde{q}_D = MR_D^{-1}(w) \Rightarrow MR_D(q) = w.$$

Back (Maths) Back (Graph)

Assumptions - Second-Order Condition of the Nash-Bargaining Problem

We assume that D's marginal revenue and U's marginal cost satisfy:

i) $\varepsilon_{MR_D} > 1$, guaranteeing that $MR_U(q) > 0$ and the FOC can be satisfied $\forall \alpha \in [0, 1]$,
   - equivalent to $\varepsilon_p > 3 - \sigma_p$, i.e., supermodular consumer demand (Mrázová and Neary, 2017),

ii) $\sigma_{MR_D} < 2$, guaranteeing that the SOC is satisfied when $w = MR_D(q)$,

iii) $\sigma_{MC_U} > -2$, guaranteeing that the SOC is satisfied when $w = MC_U(q)$.

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:

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

U obtains a markup, governed by a standard Lerner index:

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

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

Back

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

U and D anticipate $\tilde{q}_D(w) < \tilde{q}_U(w)$, i.e., $w(q) = MR_D(q)$. The rearranged Nash-program FOC yields:

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

U obtains a markup

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

mitigated by D's countervailing buyer power

$$\beta_D(q^*,\alpha) \equiv \underbrace{\frac{1-\alpha}{\alpha}}_{D\text{'s relative bargaining ability}} \times \underbrace{\frac{\pi_U(q^*)}{\pi_D(q^*)}}_{U\text{'s relative GFT}} = \underbrace{-\frac{\pi'_U(q^*)}{\pi'_D(q^*)}}_{U\text{'s relative concession costs}} \in (0,1)$$

which decreases in α, with $\beta_D(q^*,1) = 0$, and $\beta_D(q^*,\alpha_I) = 1$.

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

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

U and D anticipate $\tilde{q}_U(w) < \tilde{q}_D(w)$, i.e., $w(q) = MC_U(q)$. The rearranged Nash-program FOC yields:

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

D obtains a markdown

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

mitigated by U's countervailing seller power

$$\beta_U(q^*,\alpha) \equiv \underbrace{\frac{\alpha}{1-\alpha}}_{U\text{'s relative bargaining ability}} \times \underbrace{\frac{\pi_D(q^*)}{\pi_U(q^*)}}_{D\text{'s relative GFT}} = \underbrace{-\frac{\pi'_D(q^*)}{\pi'_U(q^*)}}_{D\text{'s relative concession costs}} \in (0,1)$$

which increases in α, with $\beta_U(q,0) = 0$, and $\beta_U(q,\alpha_I) = 1$.

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

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:

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

D obtains a markdown, governed by a standard Lerner index:

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

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

Back

Distributional and Second-Order Effects of Buyer and Seller Power

Distributional welfare effects: when $\alpha \to \alpha_I$,

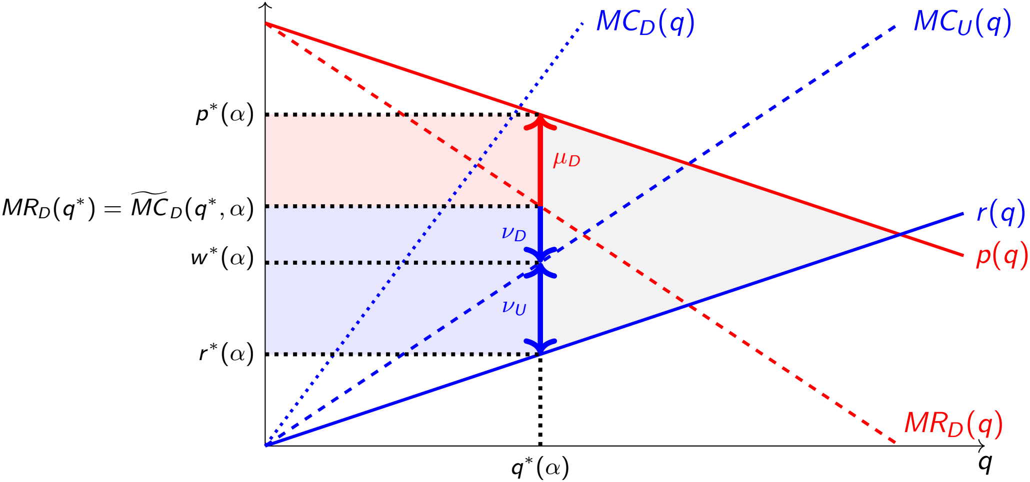
- and U is powerful ($\alpha_I < \alpha \leq 1$), an increase in D's bargaining power ($\downarrow \alpha$)
  - raises consumers' and input suppliers' surpluses,
  - raises D's profit, but decreases U's profit.
- and D is powerful ($0 \leq \alpha < \alpha_I$), an increase in U's bargaining power $\uparrow \alpha$)
  - raises consumers' and input suppliers' surpluses,
  - raises U's profit, but decreases D's profit.

Second-order effects: when $\alpha \to \alpha_I$, the positive welfare effects are:

- smaller when demand and supply functions are subconvex,
  - as D's markup μ_D and U's markdown ν_U both increase with q.
- larger when demand and supply functions are superconvex, since:
  - as D's markup μ_D and U's markdown ν_U both decrease with q.

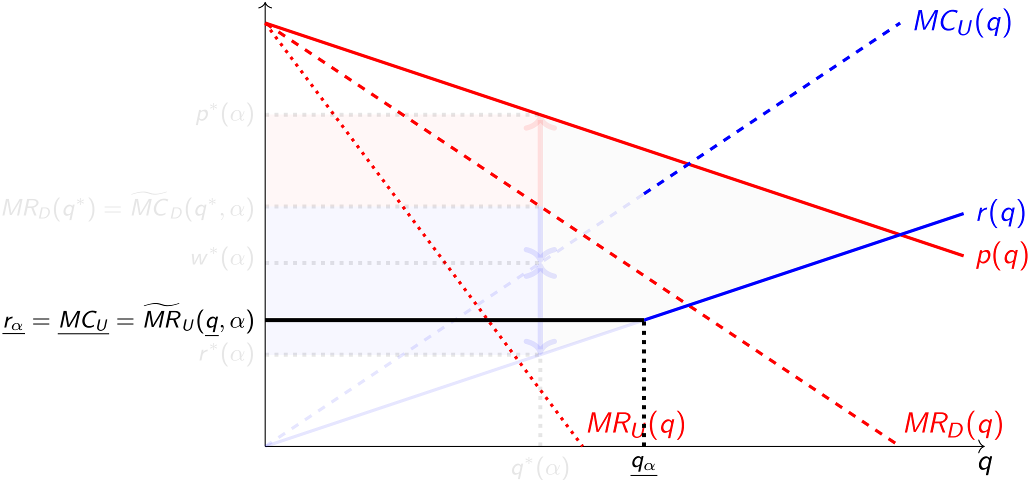
Back

Price Floor under Double Markdown ($0 < \alpha < \alpha_I$)



We start from intermediate double markdownization. Back

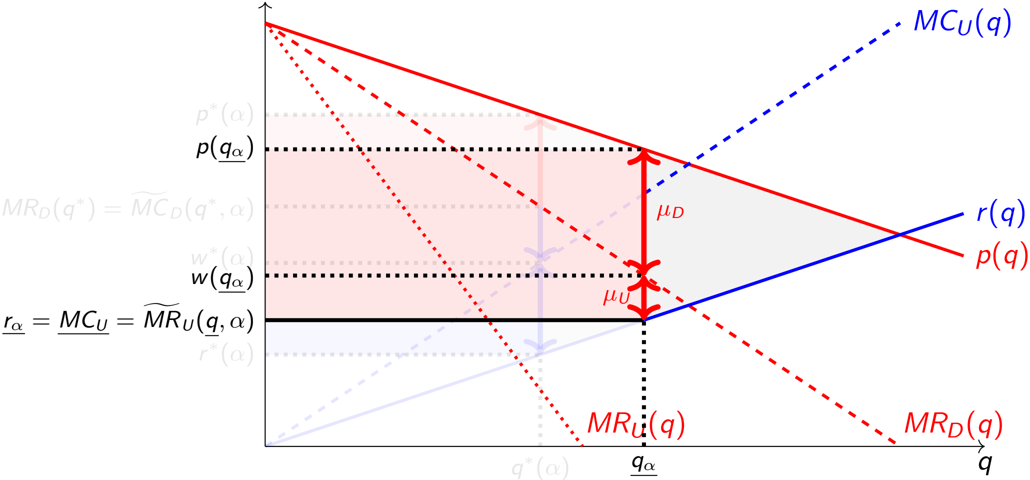
Price Floor under Double Markdown ($0 < \alpha < \alpha_I$)



The optimal price floor, such that $r(\underline{q_\alpha}) = \widetilde{MR}_U(\underline{q}, \alpha)$, *redefines supply,* MC_U, *and* MC_D.

Back

Price Floor under Double Markdown ($0 < \alpha < \alpha_I$)



Flattening supply and MC_U, the price floor eliminates double markdown, but creates double markup.

Back

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