Decentralized or Centralized Control of Online Service Platforms: Who Should Set Prices?

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Note: For the convenience of discussion, the No. of figures and tables in this slide are consistent with those in the original paper.

Introduction

The Evolving Landscape of Online Service Platforms

- Online service platforms have revolutionized various sectors: ride-sharing (Uber), food delivery (DoorDash), freelance labor (TaskRabbit), and more.
- **Efficient matching and pricing** are crucial for the success of these platforms, determining their competitiveness and market appeal.
- The **study aims to** explore optimal pricing control structures, investigating the conditions favoring centralized versus decentralized pricing strategies.

Market and Regulatory Dynamics

- **Regulatory debates**:
  - It (e.g., worker classification as independent contractors vs. employees) significantly impact platforms' pricing freedom and control.
  - Examples include California's AB5 law and UK court rulings affecting ride-sharing platforms like Uber and Lyft.
- **Technology Shocks:** Blockchain enables disintermediated markets, altering control over pricing.

Platform Challenges and Ideal Mechanism

- **Chanllenges:**
  - **Server Heterogeneity:** Independent agents with varied costs and the inability to influence overall platform outcomes significantly.
  - **Consumer Choice:** Influenced by both the platform's overall attractiveness and individual server pricing.
- **Centralized vs. Decentralized Pricing:** Affects server participation and platform attractiveness. Centralized pricing may hinder participation due to the inability to accommodate individual server costs.
- **Ideal Mechanism:** The proposed mechanism leverages quantity of service as a proxy for server costs, adapting discounts or surcharges to balance server competition and cost variance.
- **Aim:** To combine the advantages of centralized and decentralized pricing, ensuring fair, efficient pricing that aligns with both server and consumer interests.

Related Research and Key Insights: Literature Review

1. Supply Chain Management

- **Ownership and Contracts:** Examines the dynamics between suppliers and retailers, focusing on the challenges of pricing control and coordination.
- **Double Marginalization:** A phenomenon where each entity in the supply chain adds their own markup, leading to higher prices than if the supply chain were vertically integrated.
- **Pricing Control:** While direct control of retail prices is risky and usually avoided due to legal implications, platforms offer a new avenue for exerting such control effectively.

2. Platform Management

- **Market Dynamics:** Platforms operate similarly to supply chains but allow for a unique set of pricing controls and dynamics due to the vast number of independent agents involved.
- **Agent Preferences:** Unlike traditional retail settings, agents (or servers) on platforms may benefit from competitors lowering their prices, as this can increase the overall attractiveness of the platform and, consequently, demand for all.

3. Decentralized Markets and Distributed Ledger Technology

- **Innovation in Market Design:** Exploration of how blockchain and similar technologies enable markets without centralized control, presenting new challenges and opportunities for pricing strategies.
- **Research Focus:** Studies have largely concentrated on fixed prices, revenue maximization, and the matching process, with less attention to how decentralized pricing can be effectively managed to benefit all parties involved.

Implications for Platform Economics

- The intersection of these areas highlights the complexity of managing online platforms, especially regarding pricing strategies and their impact on market attractiveness, competition, and regulatory compliance.
- The study aims to contribute to this discourse by addressing the effects of decentralized pricing, particularly in contexts where legal frameworks influence the classification of workers and necessitate certain pricing models.
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Model Overview

- **Objective:** Model the interactions between customers and servers on a platform, focusing on how pricing affects demand.

Key Components

1. **Server Cost Diversity $F(c)$:** Servers have varying costs to provide services, modeled with a uniformly distributed cost function.
2. **Price p:**
   - **Platform Price $\overline{p}$:** The platform's average price, influencing overall demand.
   - **Server Price $p(c)$:** Individual server prices, affecting server competitiveness.

$$\bar{p} = \frac{\int_0^{\hat{c}} q(c)p(c)\,dc}{\int_0^{\hat{c}} q(c)\,dc} \tag{1}$$

3. **Demand $q(c)$:**
   - **Demand for a Server $q(c)$:** Defined as $q(c) = 1 - \beta\overline{p} + \gamma(\overline{p} - p(c))$, balancing between the overall platform's price attractiveness and the server's competitiveness.
   - **Two main factors:**
     - **Average Platform Price $\overline{p}$:** Influences platform attractiveness. Lower average prices attract more demand, while higher prices may drive consumers to alternative solutions.
     - **Individual Server Price $p(c)$:** Affects a server's competitive position. Servers with prices lower than the average attract more customers.

Sensitivity Parameters

- **β (Beta):** Measures how sensitive the platform's demand is to its average price, indicating the level of external competition.
- **γ (Gamma):** Represents the impact of internal competition, showing how much demand shifts among servers based on price differences.

Platform Attractiveness vs. Server Competition

A server's perspective on pricing is influenced by two key parameters:

- **β (platform attractiveness effect)**
- **γ (server competition effect)**

Balance Analysis

- The balance between platform attractiveness and server competition is influenced by parameters β and γ.
- When **β < γ**, server competition is paramount; servers desire higher prices from competitors.
- When **γ < β**, the overall platform's attractiveness takes precedence; servers benefit from competitors' lower prices.

Decision-Making and Market Equilibrium

- **How Decisions Are Made:**
  - Platforms decide on centralized or decentralized pricing, along with fee collection methods.
  - Servers maximize profit based on private costs and the set pricing structure.
  - In centralized pricing, servers choose market participation; in decentralized, servers also set prices.
- **Achieving Balance:** An equilibrium, or balance, is found when servers' expectations about the platform's performance match the real outcomes. Essentially, servers make pricing decisions that they believe will maximize their profits, and the market stabilizes when these expectations are met.

Platform's Role and Profit Strategy

- **Platform's Choices:** The platform has two main choices: directly setting service prices or allowing servers to set their own prices. Additionally, it decides on how to charge servers, whether through a percentage of their sales, a fixed fee, or a mix.
- **Maximizing Profits:** The platform's goal is to increase its earnings, which can involve adjusting the fee structure or pricing strategy based on the market dynamics and server behavior.

Private Information and Shared Knowledge

- **What Everyone Knows:** Most information, like the general cost for servers to provide services and the pricing structure of the platform, is openly known to all parties.
- **Private Details:** Individual server costs are the exception and are known only to each server. This private information plays a critical role in how servers decide their pricing.

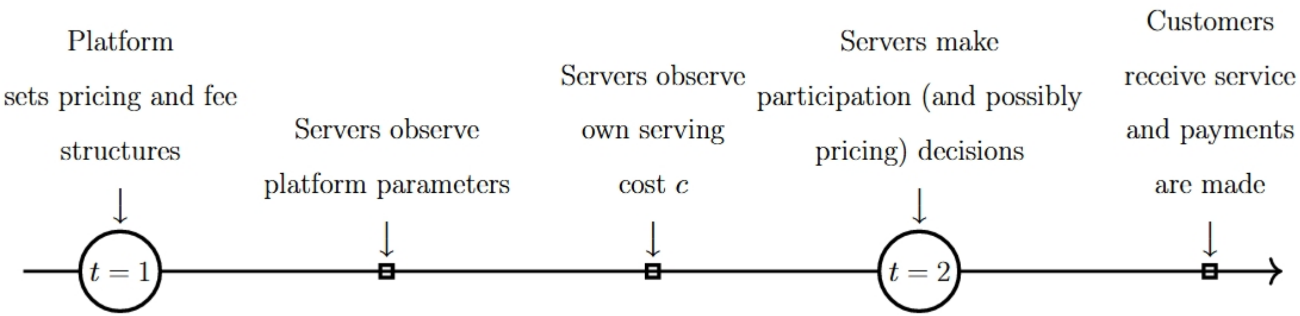


Figure 1: Sequence of events

Pricing Policies Under Commission Contracts

Centralized Platform Pricing

- **Control:** The platform sets a uniform price for all transactions.
- **Industry Example:** Common in ride-sharing services.
- **Server Decision:** Limited to opting in or out of the market based on the set price.
- **Impact:** Platform uses fee structures to influence server participation and thus, total supply.

Decentralized Server Pricing

- **Control:** Servers set their own prices, as seen in room-sharing or freelance platforms.
- **Decision Factors:** Server pricing is influenced by competitive dynamics and the platform's fee structure.
- **Market Effect:** Allows for a wider range of prices, potentially expanding total market supply but risking higher average prices.

Commission Contract

- **Structure:** Servers pay a percentage **φ** of their revenue as commission to the platform.
- **Revenue Share:** Commonly around 25% in ride-sharing.
- **Server Profit:** Calculated as a function of demand, price set, and commission rate.

$$\pi(c) = q(c)((1 - \phi)p(c) - c) \qquad (2)$$

- **Platform Profit:**

$$\Pi = \phi \int_0^{\hat{c}} q(c)p(c)dc = \phi\overline{p} \int_0^{\hat{c}} q(c)dc$$

Centralized Platform Policy: Proposition 1

Platform's optimization problem:

$$\max_{p,\phi} \Pi^P = \phi p \int_0^{\hat{c}} (1 - \beta \overline{p}) dc$$

$$s.t. \quad \hat{c} = (1 - \phi)\overline{p}$$

Proposition 1.

With a commission contract and centralized platform pricing, for the platform there exists a unique optimal price and commission rate.

- The first column in **Table 1** summarizes the equilibrium market characteristics under platform pricing.
- Proposition 1 identifies the platform's optimal decision and the equilibrium market characteristic under centralized platform pricing.

Decentralized Platform Policy: Proposition 2

Server c's pricing problem:

$$\max_{p(c)} \pi(c) = (1 - \beta\bar{p} + \gamma(\bar{p} - p(c)))((1-\phi)p(c) - c)$$

Platform's optimization problem:

$$max_{\phi} \quad \Pi^S = \phi p \int_0^{\hat{c}(\phi)} (1 - \beta\overline{p} + \gamma(\overline{p} - p(c)))dc$$

$$s.t. \qquad (1)$$

$$p(c) = \frac{1}{2\gamma}\left(1 + (\gamma - \beta)\bar{p} + \frac{c\gamma}{1-\phi}\right)(3)$$

$$\hat{c} = \hat{c}(\phi) = \frac{(1-\phi)(1+(\gamma-\beta)\bar{p})}{\gamma}(4)$$

Proposition 2.

With a commission contract and decentralized server pricing, for any commission rate there exists a unique price equilibrium among the servers. There exists a unique optimal commission rate for the platform.

- Equilibrium market characteristics of the optimal server pricing policy are included in **Table 1, Column 2**.
- Proposition 2 identifies the platform's optimal decision under decentralized server pricing.

	Platform pricing	Server pricing	Optimal mechanism
Platform's profit, Π	$\frac{1}{27\beta^2}$	$\frac{9}{8}\left(\frac{\gamma}{(2\beta+\gamma)^3}\right)$	$\frac{1}{24\beta^2}$
Servers' total profit	$\frac{1}{54\beta^2}$	$\frac{9}{16}\left(\frac{\gamma}{(2\beta+\gamma)^3}\right)$	$\frac{1}{48\beta^2}$
Mass of server entry, $\hat{c}$	$\frac{1}{3\beta}$	$\frac{3}{2(2\beta+\gamma)}$	$\frac{1}{2\beta}$
Average market price, $\overline{p}$	$\frac{2}{3\beta}$	$\frac{2}{2\beta+\gamma}$	$\frac{2}{3\beta}$
Server prices, $p(c)$	$\frac{2}{3\beta}$	$\frac{3}{2(2\beta+\gamma)}+c$	$\frac{2}{3\beta}-\frac{1}{6\gamma}+\frac{\beta}{\gamma}c$
Commission rate (ϕ) or fee (f)	$\frac{1}{2}$	$\frac{1}{2}$	$a_0+a_1c+a_2c^2$
Total quantity served, Q	$\frac{1}{9\beta}$	$\frac{9}{8}\left(\frac{\gamma}{(2\beta+\gamma)^2}\right)$	$\frac{1}{8\beta}$

Table 1: Equilibrium market characteristics under the three pricing policies.

Centralized vs. Decentralized Pricing

- **Centralized Pricing**:
  - **Full Platform Control**: Direct influence on platform attractiveness.
  - **Elimination of Server Competition**: No price competition among servers.
  - **Supply Limitation**: Inability to accommodate diverse server costs may restrict participation.
  - **Demand Impact**: Lack of competition may not drive prices down, possibly diminishing demand.
- **Decentralized Pricing**:
  - **Server Pricing Independence**: Servers set prices based on their costs.
  - **Expansion of Market Supply**: Inclusive of high-cost servers, expanding market participation.
  - **Potential for Increased Revenue**: All servers, irrespective of cost, contribute to platform revenue.
  - **Rise in Average Market Price**: Individual pricing strategies may lead to a higher overall price, affecting demand.
  - **Uniform Commission Rate**: Platform’s limited ability to differentiate incentives between server groups.

Balancing Centralized and Decentralized Pricing

- **No Dominant Pricing Model**:
  - Neither centralized nor decentralized pricing universally outperforms the other.
  - The effectiveness of pricing models is contingent on specific market conditions.
- **Optimal Server Pricing Condition**:
  - Server pricing is superior when the platform attractiveness effect (β) equals the server competition effect (γ).
  - In this scenario, server pricing yields a 12.5% higher revenue for the platform than centralized pricing.
- **Local Monopolies**:
  - Equal β and γ parameters create conditions where servers act as local monopolies.
  - Servers are indifferent to competitors' prices, eliminating direct competition.
- **Advantages of Server Pricing**:
  - Servers can set prices that reflect their individual costs and maximize their profits.
  - The platform leverages server pricing to achieve better revenue outcomes than a one-price-fits-all approach.

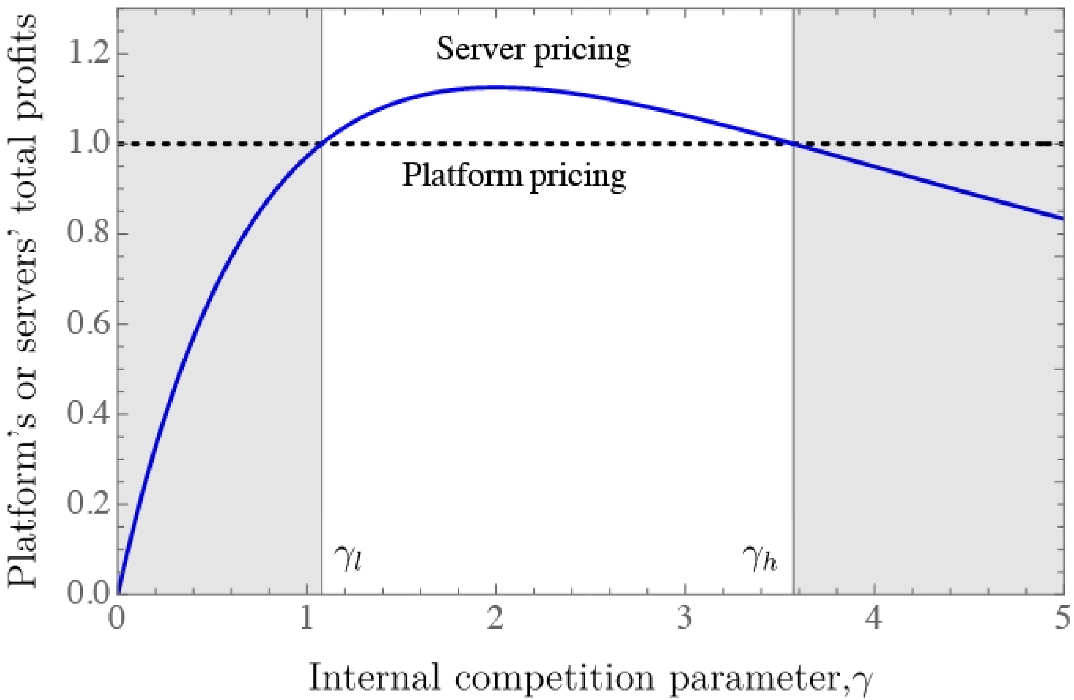


Figure 2: The platform's and servers' total profits under server pricing (solid line), as a fraction of their profits under platform pricing (scaled to 1).

* Shaded area: Platform pricing is preferred. White area: Server pricing is preferred.

Proposition 3.

The platform's earnings with server pricing are highest when $\gamma = \beta$. There exists $\gamma_l < \beta$ and $\beta < \gamma_h$ such that the platform prefers server pricing when $\gamma_l < \gamma < \gamma_h$, and otherwise platform pricing is preferred.

- **Platform revenue drops** when the balance between γ (server competition effect) and β (platform attractiveness effect) is disrupted.
- **When γ < β (Platform Attractiveness Dominates)**:
  - Market average price, p, remains higher than the platform's ideal price.
  - Servers wish for a collective price reduction but lack influence over the market average price.
- **When β < γ (Server Competition Dominates)**:
  - Servers lower prices to capture more market share, leading to reduced average market prices.
  - High demand is met, but platform revenue suffers due to overly aggressive price cuts.
- **Extreme Deviations in γ**:
  - If γ is too weak ($\gamma < \gamma_l$) or too strong ($\gamma_h < \gamma$), centralized pricing becomes the optimal strategy to prevent extreme price scenarios.
  - Centralized control stabilizes pricing at the cost of flexibility in reflecting servers' individual costs.

Comparison of Pricing Strategies

- **Optimal Pricing:** Determined by the platform's ability to balance supply and demand through fee structures.
- **Market Equilibrium:** Achieved when the pricing strategy aligns with server costs and market demand expectations.
- **Revenue Impact:** Platform's revenue is maximized when internal competition (γ) equals external competition (β), leveraging the benefits of decentralized pricing without sacrificing control.

Strategic Implications

- **Flexibility vs. Control:** Centralized pricing offers control at the cost of flexibility, while decentralized pricing offers flexibility at the risk of reduced control over market prices.
- **Optimal Commission Rate:** Exists uniquely for each pricing policy, affecting market participation and platform profit.
- **Economic Outcomes:** Neither pricing strategy universally outperforms the other; the choice depends on market conditions, specifically the balance between γ and β.

Platform's Optimal Contract Strategy

- Understanding the Platform's Optimal Fee Structure
- **Background:** Commission contracts are standard but lack flexibility. The platform can seek a mechanism that adjusts to server costs and market conditions effectively.
- **The Revelation Principle(Myerson, 1981):** The search for an optimal mechanism can be restricted to the set of truth-inducing mechanisms.
- **Truth-Inducing Menus:** Offer servers a set of choices linking reported costs to specific prices, quantities, and fees, designed to ensure servers are no worse off than their best outside option.

$p(c)$: the price the platform assigns to server c

$f(c)$: the fee collected

Then:

(1) A server's earning with cost c that reports costs $\tilde{c}$:

$$\pi(c, \tilde{c}) = (1 - \beta\bar{p} + \gamma\,(\bar{p} - p(\tilde{c})))\,(p(\tilde{c}) - c) - f(\tilde{c})$$

(2) The platform's optimal mechanism design problem:

$$\begin{aligned} \max_{p(c), f(c), \hat{c}} \quad & \Pi = \int_0^{\hat{c}} f(c)\,dc \\ \text{s.t.} \quad & \pi(c, c) \geq \pi(c, \tilde{c}), \quad \forall c \in (0, \hat{c}), \quad \forall \tilde{c} \in (0, \hat{c}) \\ & \pi(c, c) \geq 0, \quad \forall c \in (0, \hat{c}), \\ & Eq.(1) \end{aligned}$$

Proposition 4. - Optimizing Platform Revenue

The following mechanism maximizes the platform's revenue: $p(c) = \frac{2}{3}\beta - \frac{1}{6}\gamma + \frac{\beta}{\gamma}c$, $f(c) = a_0 + a_1 c + a_2 c^2$, highlighting how server prices adjust based on costs.

- Equilibrium market characteristics of the optimal contract are displayed in **Table 1, Column 3**.
- **Outcome:** Allows the platform to maximize revenue by fine-tuning prices and fees in response to server cost structures, ensuring responsiveness to both market-wide and individual competitive dynamics.

Server Pricing Summary

- **Linear Price Increase:** Server prices increase linearly with costs in optimal mechanisms and decentralized server pricing.
- **Decentralized Pricing Rate:** In decentralized control, price-to-cost increase rate ($\frac{\partial p(c)}{\partial c}$) is fixed at 1, unaffected by market characteristics.
- **Optimal Mechanism Sensitivity:** The optimal mechanism adjusts the price responsiveness ($\frac{\partial p(c)}{\partial c} = \frac{\beta}{\gamma}$) to server costs based on market parameters.
  - **Greater Platform Attractiveness (γ < β):** Optimal prices more sensitive to server costs. Decentralized control may result in too high average prices.
  - **Dominant Internal Competition (β < γ):** Optimal mechanism dampens price competition, leading to less cost-responsive pricing.
- **Fee Structure in Optimal Mechanism:**
  - Servers pay fees quadratic in their costs, diverging from simple revenue cost-share models found in commission contracts.

From Theory to Practice: Quantity-Based Discounts/Surcharges

- **Transition:** Moving from optimal but impractical mechanisms to a more feasible strategy using quantity-based fees.
- **Gap:** Such structure has been shown to help the efficiency of decentralized supply chains (e.g. Monahan 1984, Weng 1995, Corbett and De Groote 2000), however, their use for price coordination has not been studied in the context of service platforms.
- **Mechanism Details:** Servers adjust their service levels based on demand, guided by a fee structure that encourages optimal service provision without direct cost reporting.

Let:

$$\frac{f(c)}{q(c)} = q(c)\left(\frac{1}{2\beta} - \frac{1}{\gamma}\right) + \left(\frac{1}{6\beta} + \frac{1}{3\gamma}\right) \quad (5)$$

Suppose the platform announces the fee structure in Equation (5), but otherwise lets the servers choose their prices. Then:

(1) Server c faces the problem:

$$\max_{p(c)} \quad \pi(c) = q(c)(p(c) - c) - q(c)\left(\frac{f(c)}{q(c)}\right)$$

(2) Given an expected average price p, the servers' optimal price satisfies:

$$p(c) = \frac{2\beta(3\gamma c - 6\gamma\bar{p} - 2) + 6\beta^2\bar{p} + \gamma(6\gamma\bar{p} + 7)}{6\gamma^2} (6)$$

(3) The highest cost participant is indifferent between participating and not participating: $\pi(\hat{c}) = 0 (7)$

So, the platform earns:

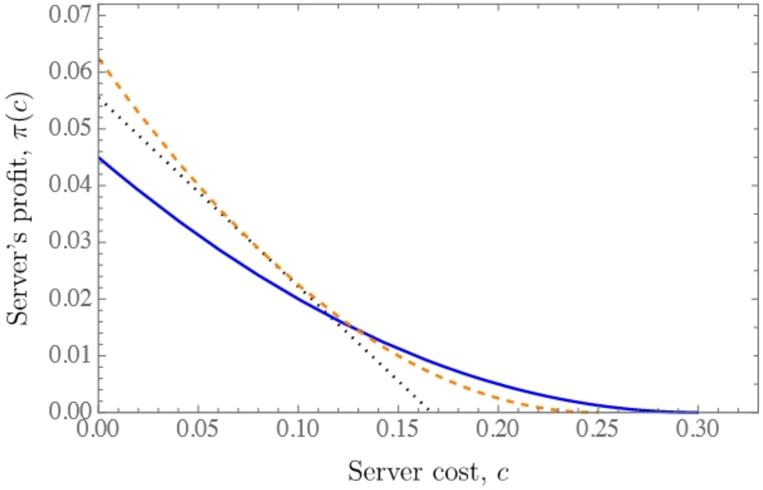
$$\Pi^Q = \int_0^{\hat{c}} q(c)\left(\frac{f(c)}{q(c)}\right) = \int_0^{\hat{c}} q(c)\left(q(c)\left(\frac{1}{2\beta} - \frac{1}{\gamma}\right) + \left(\frac{1}{6\beta} + \frac{1}{3\gamma}\right)\right) dc$$

Proposition 5.

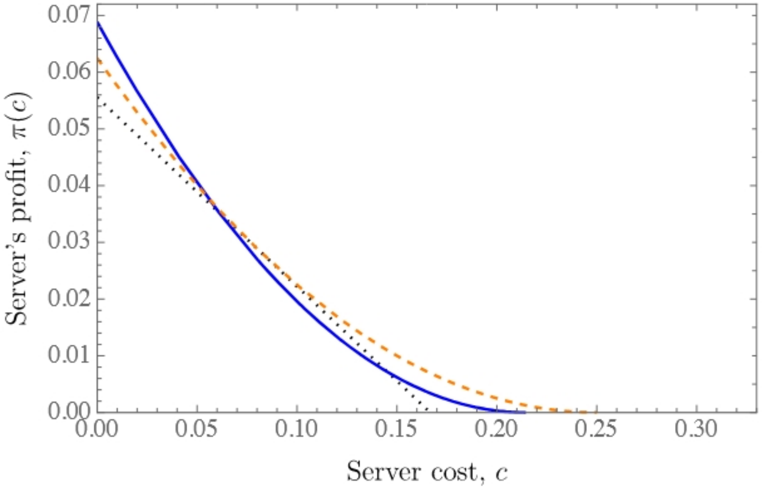
With the **fee structure (5)** there exists a unique equilibrium to the servers' decentral- ized pricing game and this equilibrium replicates all performance metrics of the optimal mechanism, including the platform's profit.

- **Meaning of Proposition 5:** Platform can replicate the optimal mechanism using decentralized pricing and a quantity-based fee.
- **Strong Server Competition ($2\beta < \gamma$):**
  - Implementation of a quantity surcharge policy.
  - Aimed at reducing excessive server competition which could lower platform revenue.
  - Discourages low-cost servers from high quantity exploitation.
  - **Apple's App Store Example:** Implemented a policy penalizing high volume sellers with higher commission rates.

- **High Platform Attractiveness ($\gamma < 2\beta$):**
  - Utilization of a simple quantity discount policy.
  - The fee per unit decreases as the number of units served increases.
  - Encourages low-cost servers to serve more, lowering market prices, enhancing platform appeal.
  - **Ride-Sharing Platforms:** Quantity discounts observed; typically thought to encourage server retention.
- **Quantity-Based Discounts/Surcharges Model's Implication:**
  - Quantity discounts regulate competition among servers without the need for recruitment costs.
  - Serves as a regulatory tool for service platforms, moderating server competition.



(a) Servers' profits, $\pi(c)$, with respect to server cost, c, for $\gamma = 1$, $\beta = 2$.



(b) Servers profit's, $\pi(c)$, with respect to server cost, c, for $\gamma = 3$, $\beta = 2$.

Figure 3: Servers' profits under the three pricing policies: platform pricing (dotted), server pricing (solid) and quantity discount model (dashed).

Corollary 1 - Impact on Server Welfare and Consumer Benefits

Total server profit is higher with quantity pricing than both platform or server pricing.

Compare to platform pricing:

- **Server Welfare:** Quantity pricing increases the total value generated, disproportionately benefiting servers by encouraging more service provision.
- **Consumer Benefits:** Leads to increased supply and potentially lower prices, enhancing consumer welfare.
- **Overall Impact:** Balances platform profitability with improvements in server welfare and consumer satisfaction, contributing to a healthier, more dynamic market.

Compare to server pricing:

- **Platform Attractiveness ($\gamma < \beta$):** Server pricing leads to higher prices; Quantity Pricing are more favorable for consumers, reducing prices.

- **Server Competition ($\beta < \gamma$):** Server pricing has lower prices in non-extreme scenarios ($\beta < \gamma < 4\beta$); Quantity pricing benefits platforms and servers, so consumers may face higher prices.

Discussion: Several Extensions

Discussion 1: Disintermediation and Blockchain Smart Contracts

Maximizing Total System Value

- **Disintermediation via Smart Contracts:** Removes the platform, potentially increasing total value by shifting control to servers.
- **Optimal Disintermediated Mechanism:**
  - **Price Setting:** Servers set their own prices, maximizing profits.
  - **Subsidy System:** Servers contribute to or receive subsidies, ensuring a balanced flow.

Proposition 6.

Without a central platform earning a profit, the servers' profits can be maximized in equilibrium when a server with cost c selects price $p(c) = \frac{2}{3\beta} - \frac{1}{6\gamma} + \frac{\beta}{2\gamma}$, and the server contributes a subsidy $f(c)$ to the system, where $f(c) = \frac{1}{12}\left(\frac{1}{\beta} - \frac{1}{\gamma}\right) + \frac{1}{3}\left(\frac{\beta}{\gamma} - 1\right)c + \left(\frac{\beta(\gamma-\beta)}{4\gamma}\right)c^2$. If $f(c)$ is negative, then the server receives a subsidy. There is a zero net flow of subsidy transfers.

Implications of Disintermediated Pricing

- **Incentive Compatible:** Servers won't deviate from the set mechanism.
- **Potential for Increased Profits:** Servers keep more earnings, potentially increasing participation and customer satisfaction.

Challenges and Alternatives

- **Implementation Hurdles:** Complex subsidy system, sensitive to market conditions.
- **Simpler Alternative:**
  - Servers set prices and retain revenue, using blockchain **only** for transaction integrity.
  - "**Disintermediated server pricing**": equivalent to the decentralized server pricing setting from Section 4.2, but with commission $\phi = 0 (8)$
  - **Unique Price Equilibrium:** Achieved under Equations (1), (3), (4) and (8) .

Best Case Scenario”:

We show that even under this best-case assumption, blockchain may not always prevail as the preferred mode of adoption.

Proposition 7.

With disintermediated server pricing (i.e., no platform, servers set their prices and retain all earnings), there exists a unique price equilibrium among the servers. There exists $\gamma_l < \beta$ and $\beta < \gamma_h$ such that the total server profits under disintermediated server pricing is higher than quantity pricing when $\gamma_l < \gamma < \gamma_h$, and lower otherwise.

* Note: Best case scenario is hard to be satisfied because decentralized platforms rely on alternative monetization mechanisms that may proxy for commission fees, such as stake retention in Initial Coin Offerings (Gan et al. 2021a,b), and a tokenized economy (Cong et al. 2020, Tsoukalas and Falk 2020).

Increased System Value with Disintermediation

- **Total Profit Increase:** Optimal disintermediated mechanism boosts system profits by 33.3%.
- **Benefits to Servers:** Higher retained earnings encourage server participation.
- **Advantages for Customers:** Maintains market prices while serving a higher quantity.

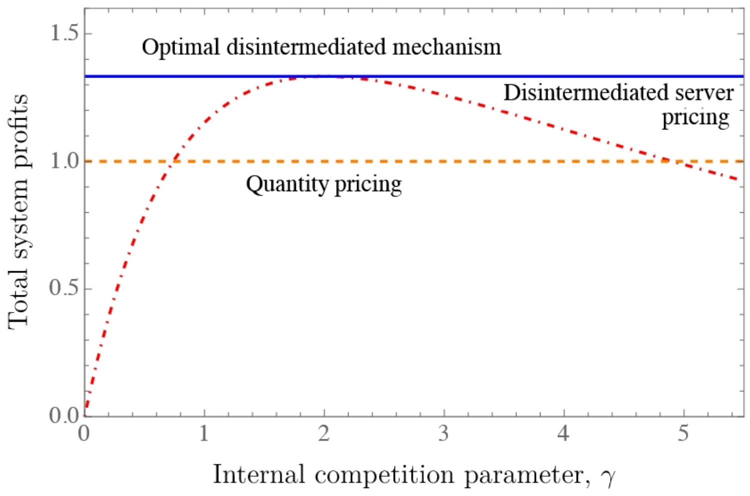


Figure 4: Total system profits with respect to the internal competition parameter, γ, for β = 2 under , disintermediated server pricing (dot-dashed line) and disintermediated optimal mechanism (solid line), as a fraction of quantity pricing (scaled to 1).

Limitations and Considerations

- **Implementation Challenges:** Best outcomes limited to cases with intermediate server competition levels.
- **Platform Alternatives:** Platforms can align with server objectives, providing added value not considered in the disintermediation model.

Balancing Profit and Pricing Control

- **Profit Maximization vs. Coordination:** Platform's profit-seeking can lead to value destruction, more than coordination benefits.
- **Disintermediation Feasibility:** Centralized platforms may still be preferable in markets with different server objectives or added value.

Conclusion

- **Optimal Contracts:** Increase value but may be complex to implement.
- **Server-Controlled Pricing:** Simpler, increases value by removing platform distortions, but with less control over competition.
- **Impact on System Value:** Disintermediation can either raise or lower system value depending on the degree of server competition.

Discussion 2: Variation in Server Costs

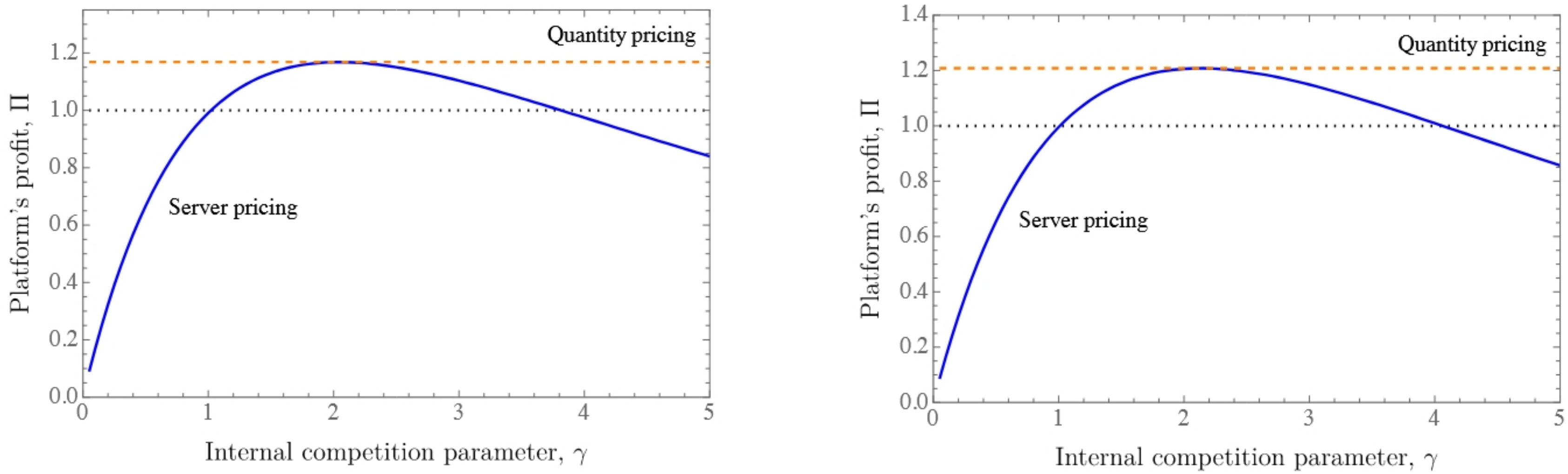
Analytical and Numerical Evaluation:

- **Uniform Distribution Basis:** Allows for an analytically derived linear optimal quantity pricing.
- **Extension to Beta Distribution:** Symmetric Beta distribution ($\alpha 1 = \alpha 2 = \alpha$) used for numerical evaluation.
- **Parameter Set:** 250 scenarios with γ ranging from 0.1 to 5, β fixed at 2, and α from 2 to 5.
- **Performance:** Linear mechanism nearly matches optimal, yielding 99.9% of the optimal profit on average, never dropping below 99%.

Impact of Cost Variance:

- **Figures 5a and 5b Insights:** Explore platform profits for high ($\alpha = 2$) and low ($\alpha = 5$) cost variance in the market.
- **Preference for Server Pricing:** Optimal in scenarios with intermediate server competition, regardless of cost variance.

Efficiency of Linear Mechanism: Demonstrates robust performance across varying levels of cost variance and server competition.



(a) Platform's relative profit under server pricing for $\alpha = 2$, $\beta = 2$.

(b) Platform's profit under server pricing for $\alpha = 5$, $\beta = 2$.

Figure 5: The platform's relative profit for α = 2, β = 2 (left) and α = 5, β = 2 (right). Legend: server pricing (solid line) and optimal mechanism (dashed line), as a fraction of platform pricing (scaled to 1).

Discussion 3: Throughput Maximization

Growth-Oriented Platform Strategies

- **Early Life-Cycle Focus:** Platforms may emphasize growth over immediate profitability.
- **Throughput Maximization:** Aligns with strategies in existing models (e.g., Ahmadinejad et al., Castro et al., Yan et al.).

Impact of Server Competition

- **Consistency in Findings:** Even when prioritizing quantity, the adverse effects of excessive server competition persist.

Strategic Alignment: Growth through quantity maximization does not significantly diverge from profit goals.
Appendix Reference: For detailed analysis, see Appendix on page 48.

Discussion 4: Correlation Between Server Cost and Customer Value

Service Homogeneity vs. Heterogeneity

- **Homogeneous Service Model:** Applicable to ride-sharing where server preferences are non-value-adding (e.g., time or location).
- **Heterogeneous Service Model:** Relevant to home rental or freelance labor where higher costs can correlate with higher service quality.

Model Extension for Heterogeneity

- **Demand Function Adjustment:** Includes a term that scales with server costs, affecting the demand function as: $q(c) = 1 + \alpha c - \beta p + \gamma(p - p(c))$.
- The other characteristics of the setting follow **decentralized server pricing** in Section 4.2

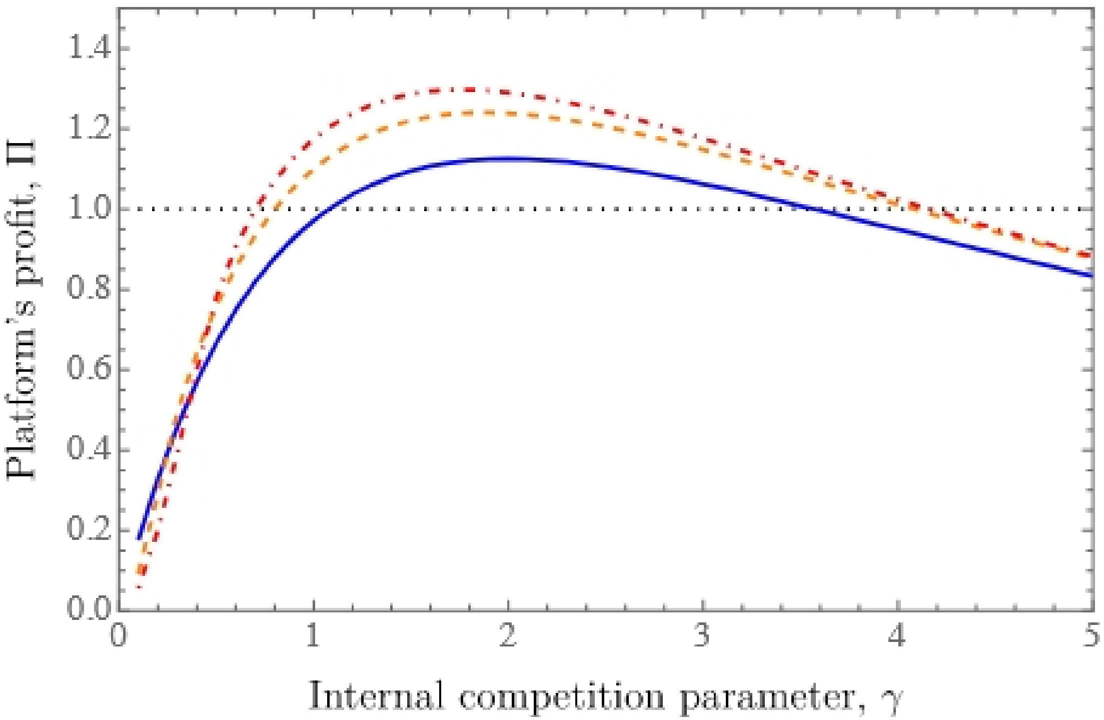


Figure 6: Platform's profits under server pricing for α = 0 (solid), α = 0.3 (dashed) and α = 0.5 (dot-dashed), as a fraction of platform pricing (scaled to 1).

Decentralized vs. Centralized Pricing

- **Flexibility for High-Cost Servers:** Decentralized pricing allows high-cost servers offering higher quality to set their own prices and attract demand.
- **Platform Profit and Server Participation:** Platforms benefit from including high-cost servers, but centralized pricing lacks incentives for their participation.

Observations and Preferences

- **Figure 6 Analysis:** With increasing α, the preference shifts towards server pricing.
- **Market Implications:** Decentralized pricing gains importance in markets where service quality is directly tied to server costs.

Decentralized Pricing Advantage: More beneficial in markets where higher costs are associated with better service quality, attracting more demand.

Conclusion: Pricing Control on Service Platforms

Key Insights:

- **Server Pricing Dynamics**: Servers are aware of their costs and can tailor prices, but individual power is limited, leading to challenges in balancing competitive and platform attractiveness effects.
- **Risks of Decentralized Pricing**:
  - **Server Competition Effect**: Can lead to destructively low prices, reducing supply and revenue.
  - **Platform Attractiveness Effect**: A lower average price can increase total demand but complicates competition.
- **Centralized Pricing**: Centralized platform pricing prevents extreme adverse scenarios.
- **Combining Approaches for Optimal Outcomes**:
  - Utilizing quantity pricing, platforms can align incentives, maximizing profit, and benefiting both servers and consumers.
  - Addresses the need for balance between aggressive and timid pricing strategies by servers.

Strategic Considerations:

- **Adaptive Pricing Strategies**: Platforms should seek a balance between centralized control and decentralized server input, possibly through quantity-based approaches.
- **Technology and Pricing**: For platforms exploring distributed ledger technology, it's crucial to mitigate the downsides of decentralized pricing to avoid negative market impacts.

Effective pricing on service platforms requires an approach that considers the benefits of both server-led and centralized pricing strategies, with a focus on regulation and incentive alignment to ensure market health and platform success.

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Thank You !