Platform Regulation on Seller Heterogeneity

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“Marketplace” Platforms

Introduction

Model Setup

Equilibrium

Platform Regulation

Conclusion

Literature
Key Characteristics

- Trades between sellers and buyers
Key Characteristics

• Trades between sellers and buyers
• Wide diversity of sellers (horizontal & vertical)
• Varied taste among buyers
Between the Two Sides

• User payoff not only depends on sheer scale of user base
  – Heterogeneity matters!
• Strategic trading decisions
  – Pricing under competition
  – Purchasing
  – Profits
• Platform’s profit and regulatory incentives
Platform Regulation

• Non-pricing instruments on user incentives
  – Ranking
    • Mobile applications
    • Airbnb’s listings (based on reviews, response rate, etc.)
  – Awards
    • Apple Design Awards (ADA) and Android Developer Challenge (ADC)
      – Monetary awards and publicity
Research Questions

• What is the economic mechanism behind non-pricing regulation on platform users?
  – How does quality heterogeneity among a variety of sellers affect their competition, pricing strategies and profits?
  – How do both seller variety and quality affect the platform’s profits?
  – How should the platform regulate seller quality heterogeneity?
Contribution and Literature

• Two-sided platforms
  – Our work: transaction-level problems and account for seller price competition
    • Economides and Katsamakas (2006)
    • Hagiu (2009)
    • Lin et al. (2011)
Contribution and Literature (cont’d)

• Two-sided platforms
  – Our work: non-pricing regulation
    • Boudreau and Hagiu (2009)
    • Casadesus-Masanell and Halaburda (2011)
    • Claussen et al. (2013)

• Spatial competition with heterogeneity
  – We derive closed-form equilibrium solution
    • Syverson (2004)
    • Alderighi and Piga (2012)
Model Setup
Platform Owner

• A monopolistic platform owner
• Transaction-based percentage royalty, $\gamma$
• Uncertainty on sellers’ quality, only distribution is known
• Platform sets policies based on distribution
• Once quality levels are realized
  – Policies take effect
  – Transactions take place
Extended Circular-City Model (Salop 1979)

• A continuum of buyers located uniformly on a circle
• n sellers indexed by i ∈ {0, 1, …, n − 1}
• \( v_i \) - seller i’s quality
• Each seller sets price \( p \)
• Buyers incur linear transportation cost \( t \)
• For a buyer located at \( x \), her utility from consuming seller i’s product is

\[
v_i - p_i - t \left| x - \frac{i}{n} \right|
\]
Extended Circular-City Model (Salop 1979)

- Let $v_i$ be i.i.d.
- Indifferent buyer: $x = \frac{1}{2t}(v_i - v_{i+1} - p_i + p_{i+1}) + \frac{i}{n} + \frac{1}{2n}$
- Condition for localized competition (Alderighi and Piga (2012), Eaton and Lipsey (1978)):
  \[ \forall i \in \mathbb{Z}, |v_i - v_{i+1}| < \frac{t}{n} \]
- Seller i’s profit:
  \[ (1 - \gamma)p_i \left[ \frac{1}{2t} (2v_i - v_{i+1} - v_{i-1} - 2p_i + p_{i+1} + p_{i-1}) + \frac{1}{n} \right] \]
Platform sets regulation based on distribution of $v_i$

Regulation policies are effective

$v_i$ is realized for each seller

Sellers compete in price, and buyers make purchasing decisions

Introduction → Literature → Model Setup → Equilibrium → Platform Regulation → Conclusion
Equilibrium
Equilibrium Characterization

**Proposition 1.**
Seller $i$’s equilibrium price is

$$p_i^* = \frac{t}{n} + v_i - \sum_{d=0}^{n-1} b_d v_{i-d}, \forall i \in \{0, 1, \ldots, n-1\},$$

where $b_d = \frac{\delta^{n-d} + \delta^d}{\sqrt{3}(\delta^{n-1})} > 0, \delta = 2 + \sqrt{3}.$

– Positive own-quality effect
– Negative competing quality effect

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Equilibrium Characterization

• Diminishing *ripple effect*
  – A seller’s price, demand, and profit are negatively affected by an increase in any other seller’s quality
  – Impact more pronounced from sellers with more similar products (i.e., sellers located more nearby)
Proposition 2.

Average price: \( \bar{p} = \frac{t}{n} \)

*Independent of quality*

- Ripple effect distributes impact of quality
- Price changes follow a zero-sum game
Platform Regulation
Lemma 1.

\[ E(\Pi^*) = \frac{\gamma t}{n} + \frac{\gamma n}{t} \text{Var}(v) \left( 1 - \frac{4}{3\sqrt{3}} \frac{\delta^n + 1}{\delta^n - 1} + \frac{2n}{3} \frac{\delta^n}{(\delta^n - 1)^2} \right). \]

- Independent of expected quality
- Benefits from quality heterogeneity
- Mixed impact of variety
Average Quality Level

• Does not affect platform’s (or sellers’) profit
• Shifts in quality dissipate in competition
• Relative competitive pressure unchanged
Quality Heterogeneity

• A higher degree of QH leads to higher profit
• More competitive pressure on lower-quality sellers
• Not all sellers are better off
• Total gains outweigh total losses – platform wins
Variety

• Without quality heterogeneity, \( E(\Pi^*) = \frac{\gamma t}{n} \)
  
  – More variety reduces profit
  
  – Reason: intensified competition

• With quality heterogeneity

\[
E(\Pi^*) = \frac{\gamma t}{n} + \frac{\gamma n}{t} \text{Var}(v) \left( 1 - \frac{4}{3\sqrt{3}} \frac{\delta^n + 1}{\delta^n - 1} + \frac{2n}{3} \frac{\delta^n}{(\delta^n - 1)^2} \right)
\]

  – More variety amplifies positive impact of quality heterogeneity
  
  – Reason: stronger quality effect between sellers
Platform as a Regulator

• Shifting average quality is ineffective
  – Shifts in quality dissipate in competition
  – Relative competitive pressure unchanged
  – All profits remain the same
Platform as a Regulator

• Proportional quality support at rate $\alpha$
  – Generates added value of $\alpha v_i$
  – Incurs convex variable cost of $c(\alpha v_i)^2$

\[
E(\Pi^{support}) - E(\Pi^*) = \frac{\gamma n}{t} \Var(v) (\alpha^2 + 2\alpha) \left(1 - \frac{4}{3\sqrt{3}} \frac{\delta^n + 1}{\delta^n - 1} + \frac{2n}{3} \frac{\delta^n}{(\delta^n - 1)^2}\right) - nca^2 (\Var(v) + E^2(v))
\]
Optimal Quality Support

Proposition 3.

\[ \alpha^* = \frac{1}{\gamma \left(1 - \frac{4}{3\sqrt{3}} \delta^n + 1 + \frac{2n}{3} \frac{\delta^n}{(\delta^n - 1)^2}\right) \left(1 + \frac{E(v)^2}{Var(v)}\right) - 1} > 0 \]

- It is optimal to provide *discriminatory quality support* to sellers
Discriminatory Quality Support

• Give more advantage to higher-quality sellers
• Higher-quality sellers’ gains outweigh losses of lower-quality sellers

Examples:
• “Top Chart” for mobile app market
• Mobile app award programs: ADA and ADC
• Airbnb ranking: promote better-performing hosts
• Additional technology to offer benefits proportional to seller’s quality
Comparative Statics

• Higher *variance* of quality levels, higher support rate
  – The degree of quality heterogeneity is more sensitive to quality support
• Higher *average* quality, lower support rate
  – At the same rate, quality support is more costly
• Higher *transportation cost*, lower support rate
  – Profits are less responsive to quality
Other Side of the Coin

- Quality support *in reverse* has the same effect
- Undermining lower-quality sellers indirectly offers advantages to higher-quality sellers
- A real example:
  - Taobao Mall imposes a heavier burden on low-performing sellers
Conclusion

• Economic mechanisms of a monopoly platform’s non-pricing regulation on seller heterogeneity
• Seller competition generates a ripple effect
• Platform benefits from discriminatory quality support to increase quality heterogeneity

Future work:
– Endogenize entry on both sides of the platform
– Platform competition
Thank You!