Bilateral Ratings and P2P Market Competition and Segmentation

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Unilateral Ratings on Traditional Platforms

Customer Reviews

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5 star: 59%
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3 star: 10%
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Good book, possibly mistaken interpretation of how the transformation happened.
By David D. Friedman on March 10, 2015
Format: Kindle Edition  Verified Purchase

An interesting and very detailed book about a very interesting period in history. My main reservation is that I found the sequence of events confusing. It might have helped if there was a one or two page outline of what happened when.

I had some reservations about the author’s understanding of the relevant economics (my field), in particular the causes of the inflation that was a serious problem during parts of the period. For a different interpretation of the transition from socialism to capitalism, I recommend the book by Ronald Coase and Ning Wang. As they see it, neither Deng nor the other top people initially intended what happened—they were trying to get the bugs out of socialism, which they believed was a superior system. What they got right was the attitude that facts trump theory, with the result that when things they had neither intended nor approved of, such as the shift in agriculture to something close to private property (the household responsibility system), initiated covertly from below not openly from above, turned out to work, they didn’t stop them and eventually endorsed them.

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An important biography of one of the major figures in China's transformation
By Steven Peterson  TOP 1000 REVIEWER  VINE VOICE on August 9, 2015
Format: Paperback  Verified Purchase

A wonderful biography of Deng Xiaoping. There is more emphasis on the later as opposed to earlier years of his life. He was a survivor, having been purged twice by Chairman Mao Zedong. But Mao was not to be
Bilateral Ratings at Airbnb

Our community is built on a great deal of trust—trust that makes hosts feel comfortable allowing travelers to stay in their home, and trust that helps travelers feel like they belong anywhere. The foundation of that trust is our review system.

For each guest review, a host is asked to give a star rating for the guest’s cleanliness and communication. Airbnb allows hosts to pick and choose these strangers by publishing guest profiles and reviews.
After each ride, you have the opportunity to rate your driver, and they will rate you. Before a ride, you’ll be able to see your driver’s rating and they’ll be able to see yours. Lyft has rigorous standards for drivers, and each rating you give can have an impact on that driver’s future with Lyft. In addition, passengers with a low star rating may have a harder time getting a Lyft.
Research Questions

- How does the availability of rating of consumers affect the competitive landscape?
- How do prices change when such ratings are available?
- Among platforms, service providers and consumers, who benefit from the bilateral rating system?
Literature Review

- Competitive search in labor market

- Behavior-based discrimination
e.g., Fudenberg and Villas-Boas (2006), Pazgal and Soberman (2008), Shin and Sudhir (2010), Shin (2012)

- P2P market
Compared with unilateral ratings, bilateral ratings may lead to higher prices, and thus lower consumer surplus.

Consumers with good ratings apply to only high-quality service providers, and expect a higher utility; while consumers with bad ratings apply to both high-quality and low-quality service providers, and expect a lower utility.
MODEL
Service Providers

- $M$ service providers are distinguished by service quality, with $\gamma \in (0, 1)$ in high quality $q_H$, and $1 - \gamma$ in low quality $q_L \leq q_H$.
- Marginal cost of service provision is normalized as zero.
\begin{itemize}
  \item $N$ consumers distinguished by serving cost, with $f(\theta)$ positive and finite for $\theta \in [0, \bar{\theta}]$.
  \item To serve a consumer of cost type $\theta$, a service provider of quality $q$ incurs cost $\theta g(q)$, where $g(\cdot) > 0$ and $g'(\cdot) \geq 0$.
    \begin{itemize}
      \item e.g., $g(q) = 1$. $g(q) = q$.
    \end{itemize}
  \item Consumption utility of quality $q$ and price $p$ is $u(p, q) = q - p$.
\end{itemize}
Rating System

- **Bilateral ratings**: both service providers’ quality $q$ and consumers’ cost type $\theta$ are common knowledge (main model).
- **Unilateral ratings**: only service providers’ quality $q$ is common knowledge; a consumer’s cost type $\theta$ remains her private information (extension).
1. Service providers post prices.
   - Service providers can commit to their posted prices.
   - Prices do not depend on $\theta$.

2. Consumers submit applications. One per person.

3. Service providers make offers. One per person $\rightarrow$ lowest $\theta$ at hand.

4. Trade and payoffs realize. Zero payoff for no matches. Matching platform charges $\delta$ percent commission for each matched transaction.
Market Frictions

Where do frictions come from in this model?

- **Coordination frictions**—multiple consumers apply for the same service provider; meanwhile, some service providers receive no applications.

- Allow unmatched agents play the same matching game again → some more will get matched → lower coordination frictions and mismatches.

- We only consider one-shot game.
  - Multiple-round matching games are difficult to analyze.
  - Mismatches and market frictions are both important in reality and interesting in theory.
$M, N \to \infty$, and $0 < n \equiv N/M < \infty$.

- We only consider symmetric strategy:
  - Service providers of the same type post the same price.
    
    \[
    p_{H1} = \cdots = p_{H\gamma M} = p_H, \\
    p_{L1} = \cdots = p_{L(1-\gamma)M} = p_L.
    \]

- Consumers of the same type use the same mixed application strategy. $a_j(\theta)$ is the probability a consumer applies to one particular service provider of type $j \in \{H, L\}$.
EQUILIBRIUM ANALYSIS
Consumers’ Problem: Application Strategy

- Normalization condition:
  \[ \gamma Ma_H(\theta) + (1 - \gamma) Ma_L(\theta) = 1. \]

  \[ a_j(\theta) \to 0, \text{ as } M \to \infty. \]

- Introduce queue length of a service provider of type \( j \) as
  \[ x_j(\theta) \equiv Nf(\theta)a_j(\theta). \]

  \[ \gamma x_H(\theta) + (1 - \gamma)x_L(\theta) = nf(\theta). \]

  \[ x_j(\theta) \to \text{finite, as } N, M \to \infty. \]
Consumers’ Problem: Acceptance Rate

- Acceptance probability of consumer $\theta$ by a service provider of type $j$ conditional on the consumer applied to this service provider:

$$b_j(\theta) = \lim_{N \to \infty} \prod_{t=0}^{\theta} (1 - a_j(t))^{Nf(t)} dt$$

$$= \lim_{N \to \infty} \prod_{t=0}^{\theta} \left( 1 - \frac{x_j(t)}{Nf(t)} \right)^{Nf(t)} dt$$

$$= \prod_{t=0}^{\theta} e^{-x_j(t)} dt$$

$$= e^{- \int_0^\theta x_j(t) dt}.$$  

- $b_j(\theta)$ decreases with $\theta$, i.e., consumers with higher serving cost expect a lower acceptance rate.
Let $U(\theta)$ be the maximum expected utility of consumer $\theta$.

A consumer of type $\theta$ submits an offer to a service provider of type $j$ with positive probability if and only if $b_j(\theta)(q_j - p_j) = U(\theta)$.

$$x_j(\theta) \begin{cases} > 0, & \text{if } b_j(\theta)(q_j - p_j) = U(\theta), \\ = 0, & \text{if } b_j(\theta)(q_j - p_j) < U(\theta). \end{cases}$$

Consumers’ tradeoff in application: everyone prefers higher $q_j - p_j$ but service providers with higher $q_j - p_j$ are more competitive and thus have lower acceptance rate $b_j(\theta)$. 

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Characterization of Consumers’ Application Strategy

\[ \frac{q_H - p_H}{q_L - p_L} \]

- Apply to \( H \) with \( x_H(\theta) > 0 \)
- Apply to \( L \) with \( x_L(\theta) > 0 \)

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If $1 < \frac{q_H - p_H}{q_L - p_L} < e^{\frac{n}{\gamma}}$, consumers with type $\theta \in [0, \theta_H]$ apply to service providers of high quality only, and consumers with $\theta \in (\theta_H, \bar{\theta}]$ apply to both types of service providers. For $\theta \in [0, \bar{\theta}]$,

$$x_H(\theta) = \begin{cases} \frac{n}{\gamma} f(\theta), & 0 \leq \theta \leq \theta_H \\ nf(\theta), & \theta_H < \theta \leq \bar{\theta} \end{cases},$$

$$x_L(\theta) = \begin{cases} 0, & 0 \leq \theta \leq \theta_H \\ nf(\theta), & \theta_H < \theta \leq \bar{\theta} \end{cases},$$

$$U(\theta) = \begin{cases} (q_H - p_H)e^{-\frac{\gamma}{\gamma}F(\theta)}, & 0 \leq \theta \leq \theta_H \\ (q_H - p_H)\left(\frac{q_H - p_H}{q_L - p_L}\right)^{-(1-\gamma)}e^{-nF(\theta)}, & \theta_H < \theta \leq \bar{\theta} \end{cases}.$$

Other cases can be similarly characterized.
Consider an individual service provider of type $j$, who deviates to post price $p_j^0$.

As $M \rightarrow \infty$, this deviation imposes no impact on $U(\theta)$.

If $U(\theta) < q_j - p_j^0$, consumers of type $\theta$ will apply to this service provider until $b_j^0(\theta)(q_j - p_j^0) = U(\theta)$, where $b_j^0(\theta)$ is this service provider’s acceptance rate for a consumer of type $\theta$. Otherwise, consumers of type $\theta$ will not apply to this service provider.

$$b_j^0(\theta) = \frac{U(\theta)}{q_j - p_j^0} \text{ for } \theta \geq \theta^0 = \begin{cases} 0, & q_j - p_j^0 \geq U(0), \\ U^{-1}(q_j - p_j^0), & \text{otherwise}. \end{cases}$$

The service provider’s profit function under full market coverage:

$$\pi_j^0(p_j^0; p_H, p_L) = \int_{\theta^0}^{\bar{\theta}} [(1 - \delta)p_j^0 - \theta g(q_j)] \cdot \left[-\frac{db_j^0(\theta)}{d\theta}\right] d\theta.$$
Concavity condition: a pure strategy Nash equilibrium \((p^*_H, p^*_L)\) exists if \(\pi^0_j(p^0_j; p_H, p_L)\) is concave.

This imposes some lower bound on \(nf(\cdot)\). We will restrict our attention to uniform distribution only, where \(f(\theta) = 1/\bar{\theta}\).

Optimality condition: a pure strategy Nash equilibrium \((p^*_H, p^*_L)\) is determined by,

\[
p^*_j = \arg \max_{p^0_j} \pi^0_j(p^0_j; p^*_H, p^*_L), \text{ for } j \in \{H, L\}.
\]
EQUILIBRIUM IMPLICATIONS
Equilibrium

**Theorem**

*Under the concavity condition and uniform distribution of $F(\cdot)$,*

- there always exist infinite number of pure-strategy Nash equilibria, which satisfy $q_H - p_H^* = q_L - p_L^* = \varepsilon$ for $\varepsilon \in (0, \bar{\varepsilon}]$;
- in the case that $g(q) = 1$ or $g(q) = q$, all equilibria satisfy that $q_H - p_H^* \geq q_L - p_L^*$.

- As a parallel with Diamond Paradox, competitive firms gain monopoly power in a homogeneous product market with coordination frictions.
- After adjusting for price, high quality service providers are more preferred in equilibrium.
Equilibrium Prices

Figure: Equilibrium prices under the parameter setting that $n = 1$, $\gamma = 0.5$, $q_H = 2q_L$, $\delta = 0.1$, $\bar{\theta} = 0.2q_L$, and $g(q) = 1$.
Equilibrium Market Segmentations

\[ \frac{q_H - p_H}{q_L - p_L} \]

- apply to \( H \) with \( x_H(\theta) > 0 \)
- apply to \( L \) with \( x_L(\theta) > 0 \)

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Equilibrium Application Strategies

Figure: In the left panels, \((p^*_H, p^*_L) = (0.787q_H, 0.573q_L)\) with \(q_H - p^*_H = q_L - p^*_L\); in the right panels, \((p^*_H, p^*_L) = (0.666q_H, 0.533q_L)\) with \(q_H - p^*_H > q_L - p^*_L\).
Equilibrium Acceptance Rates

Figure: In the left panels, \((p^*_H, p^*_L) = (0.787q_H, 0.573q_L)\) with \(q_H - p^*_H = q_L - p^*_L\); in the right panels, \((p^*_H, p^*_L) = (0.666q_H, 0.533q_L)\) with \(q_H - p^*_H > q_L - p^*_L\).
Figure: In the left panels, \((p_H^*, p_L^*) = (0.787q_H, 0.573q_L)\) with \(q_H - p_H^* = q_L - p_L^*\); in the right panels, \((p_H^*, p_L^*) = (0.666q_H, 0.533q_L)\) with \(q_H - p_H^* > q_L - p_L^*\).
Consumer to Service Provider Ratio

\[
\begin{align*}
\text{n} &= 0.5 \\
\text{n} &= 1 \\
\text{n} &= 2
\end{align*}
\]

\[
\begin{align*}
p^*_L \\
p^*_H
\end{align*}
\]
Fraction of High-Quality Service Providers

\[ \gamma = 0.1 \quad \gamma = 0.5 \quad \gamma = 0.9 \]

\[ p^*_L \]

\[ p^*_H \]
Range of Consumer Serving Costs

\[ p^*_L \] vs. \[ p^*_H \]

- \( \bar{\theta} = 0.1 \)
- \( \bar{\theta} = 0.2 \)
- \( \bar{\theta} = 0.4 \)
Platform Commission

\[ \delta = 0 \quad \delta = 0.1 \quad \delta = 0.5 \]

\[ p^*_H \]

\[ p^*_L \]
UNILATERAL RATINGS
Consumers’ Problem

- Under unilateral ratings, service providers cannot discern low-cost consumers from those with high costs, so they will randomly choose a consumer given multiple consumers’ applications.

- Queue length $X_j \equiv NA_j$, where $A_j$ is a consumer’s application probability. Normalization condition: $\gamma X_H + (1 - \gamma) X_L = n$.

- Acceptance rate:

$$B_j = \lim_{N \to \infty} \sum_{i=0}^{N-1} \binom{N-1}{i} A_j^i (1 - A_j)^{N-1-i} \frac{1}{i+1} = \frac{1 - e^{-X_j}}{X_j}.$$  

- A consumer’s maximum expected utility:

$$U = (q_H - p_H) \frac{1 - e^{-X_H}}{X_H} = (q_L - p_L) \frac{1 - e^{-X_L}}{X_L}.$$
Consider an individual service provider of type $j$, who deviates to post price $p_j^0$.

As $M \to \infty$, this deviation imposes no impact on $U$.

Correspondingly, his acceptance rate:

$$B_j^0 = \min \left\{ \frac{U}{q_j - p_j^0}, 1 \right\}.$$

The service provider’s profit function:

$$\Pi_j^0(p_j^0; p_H, p_L) = \left[ (1 - \delta)p_j^0 - \frac{\bar{\theta}}{2} g(q_j) \right] X_j^0 B_j^0,$$

where $X_j^0$ is the corresponding queue length given $B_j^0$. 
Equilibrium

**Theorem**

Under unilateral ratings, there exists a pure strategy Nash equilibrium \((p_H^{**}, p_L^{**})\). In the case that \(g(q) = 1\) or \(g(q) = q\), we have that

\[ q_H - p_H^{**} > q_L - p_L^{**}. \]
Comparison of Equilibrium Prices

Why are equilibrium prices lower under unilateral ratings?

- Cost-based market segmentation softens competition.
Comparison of Consumer Surplus

Qualitatively similar findings for all parameter settings in comparative statics studies.
Comparison of Welfare Breakdown

- Bilateral ratings
- Unilateral ratings

- High-quality service providers' total profit
- Low-quality service providers' total profit
- Platform's profit
- Consumer surplus
- Social welfare

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CONCLUSION
Conclusion

- **Higher prices**: Compared with unilateral ratings, bilateral ratings may lead to higher prices, and thus lower consumer surplus, due to softened competition by market segmentation.

- **Cost-based market segmentation**: consumers with good ratings apply to only high-quality service providers, and expect a higher utility; while consumers with bad ratings apply to both high-quality and low-quality service providers, and expect a lower utility.

- Higher commission fee from the platform may lower market prices.
Thank You!