A Model of Pricing in the Sharing Economy

Pricing dynamics with awareness-generating adoptions

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Introduction
The many names of the Sharing Economy

Also commonly referred to as

- on-demand economy
- gig economy
- P2P marketplaces
- crowd-based capitalism

A general definition

Rather than getting a good/service from an institution, government, or company, we instead get the same good or service from a decentralized crowd of individuals, mediated by a peer community and a market.
Economic Significance

(source: Bloomberg L.P.)
Sharing Economy

- early work and definitions (Gansky, 2010, Sundararajan, 2013)
- factors enabling Sharing Economy platforms (Einav et al., 2015, Horton and Zeckhauser, 2016)
- policy considerations (Malhotra and Van Alstyne, 2014)
- welfare distribution (Fraiberger and Sundararajan, 2015)
- impact on incumbent firms (Zervas et al., 2016)
- differences between pro and non-pro agents (Li et al., 2016)

Awareness

- time-decaying (Hutchinson and Moore, 1984)
- competitive brand interference (Burke and Srull, 1988)
- participants more likely to increase awareness (Banerjee, 2013)
- platform search rankings as awareness mechanisms (Ursu, 2015)
Two-sided S.E. Platforms

The demand side

- not very different than what traditional firms face
- addressed through marketplace structure

The supply side

- a decentralized crowd of providers (individual decision makers)
- higher decision power (since they own the assets)
- less experience, less information \(\Rightarrow\) bounded rationality
- fewer advertising capabilities
Research Questions

Q1: How do providers price their assets/services on S.E. platforms?

Q2: What phenomena does the behavior of providers engender?

In this paper

- We develop a model of dynamic pricing for a S.E. setting
- Providers do not have an accurate model of the market dynamics, and instead respond to a proxy
- We examine the phenomena that emerge
Model
A consumer arrives at $t \in \{1, 2, \ldots, T\}$ and makes a one-time decision

The consumer may or may not discover the provider

If she does discover the product:

- the consumer learns her valuation $\theta_t$
- the consumer adopts ($b_t = 1$) if the product price $p_t \leq \theta_t$ else she does not ($b_t = 0$)
The probability that a provider is discovered at period $t$ is $Q(a_t)$

- $Q$ any CDF
- $a_t$ the *population-level awareness*

Awareness obeys the law of motion

$$a_{t+1} = \delta a_t + kb_t$$

- Awareness decays over time at rate $\delta$
  $\uparrow \delta \implies$ faster decay, more intense competition
- Awareness increases in past adoptions by quantity $k$
  $\uparrow k \implies$ higher increase after adoption, more viral product
The Provider’s Problem

The provider solves the dynamic program:

\[
V_t(a_t) = \max_{p_t \geq 0} \left( Q(a_t)[1 - F(p_t)](p_t + V_{t+1}(\delta a_t + k)) + Q(a_t)F(p_t)V_{t+1}(\delta a_t) + [1 - Q(a_t)]\beta V_{t+1}(\delta a_t) \right),
\]

balancing between the three possible outcomes:

- (1) \implies \text{provider is discovered and adopted}
- (2) \implies \text{provider is discovered and not adopted}
- (3) \implies \text{provider is not discovered (and not adopted)}

_Bounded rationality through lack of information_
Results
Finite Horizon: Penetration Pricing

Optimal price (y-axis) as a function of time (x-axis)

△: adoption  ○: discovery without adoption  \( p_M = 0.55 \)
Finding: Superstar and niche providers set similar prices
Finding: Competition forces lower prices in between
Finding: Sharper awareness changes result in more aggressive pricing
Finding: *The evolution of the awareness process is inherently “tippy”*
Conclusion
Implications

Marketplaces where awareness is key

- intrinsic price fluctuation
- lower-than-monopoly prices

Superstar and niche providers

- natural emergence of the two extrema
- indistinguishable via price
- prices lowest in the middle

Platform design

- recommender systems exacerbate these phenomena
- platform fees have a dampening effect
Scope of the Model

Outside the Sharing Economy

- platforms & markets with awareness effects
e.g. Amazon, eBay, non-digital markets, ...

Inside the Sharing Economy

- not applicable to every S.E. platform
e.g. Uber, Instacart, ...
- useful when providers price & substitutability is not high

Limitations

- additional dimensions matter
e.g. ads, product design, ...
- competitive setting
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- fascinated by Econ, CS, and Tech everything

Other questions I am currently exploring

- **How should Airbnb be regulated?**  
  *(with John Horton)*

- **What is the optimal market structure for S.E. platforms?**  
  *(with Arun Sundararajan and Srikanth Jagabathula)*

- ... and how can their decentralized capacity be managed?  
  *(with Arun Sundararajan and Srikanth Jagabathula)*

- **How can Big Data be leveraged for simple and interpretable Natural Language Processing?**  
  *(with Theodoros Lappas)*