MKT927: INTRO TO QUANTITATIVE MARKETING

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Lecture 7: Platforms

MBA LEVEL PLATFORMS

WHAT IS A PLATFORM?

- Company/service/technology that primarily facilitates transactions between two or more parties.
- What makes platform companies different from other companies?
  - They are not 'producers' of content, product, etc…
  - They structure the rules of interaction.
  - Provide complementary investments.
  - Platform design hinges on network effects.
  - Don't have full control over interaction experience (which content is shown on feed, quality of Airbnb stay).

PLATFORM VS RETAILER/RESELLER

- Marketplaces are one type of platform.
- Resellers buy goods and sell them to customers.
- Marketplaces do not directly own the goods.
- Platform or not is a continuum, Amazon is a producer, reseller, and marketplace.
- See Hagiu and Wright: "Marketplace or reseller?"

WHY DO WE CARE ABOUT PLATFORMS?

- Some of the most important companies in the world are platforms: Meta, Apple, Microsoft, Amazon, Visa, Uber, many others.
- Economics of platforms are different and more complicated than traditional industries.
- Potential for design and experimentation.
- Bill Gates:
  "A platform is when the economic value of everybody that uses it, exceeds the value of the company that creates it. Then it's a platform."

HOW TO START A PLATFORM?

- Value proposition: Is enough value generated through the interaction? (Consider success of Airbnb but not of marketplaces for home improvement tools).
- Chicken or the egg problem: How do you get the first users?
- Complementary investments: Trust, safety, app, payment, etc.
- Network effects: Avoiding congestion, designing to increase the value of interactions as platform grows.
- Avoiding dis-intermediation (i.e., taking the transaction off platform).

PLATFORM COMPETITION

- Which users to focus on? Side of the market, user type?
- Pricing, which side of the market to charge? Usage fees or participation fees?
- In some markets, platforms split the market by catering to different segments.
- In other markets, platforms compete for the same users.
- Platform competition can be bad for consumers if it reduces network effects. See for example X vs Bluesky vs Mastodon vs Threads.

PLATFORMS REGULATION

- Competition policy: Antitrust cases against Google, Apple, Meta, Amazon.
- Data and privacy: GDPR, CCPA, etc.
- European Digital Markets Act and Digital Services Act.

PLATFORM DESIGN

- Search, matching, and recommendation.
- Pricing and fees.
- User interface and experience.
- Advertising.
- Trust and safety / content moderation.
- Data and privacy.
- Growth strategy. How to acquire and keep users?
- *This is a live issue.* Platform design is changing and academic work can influence it.

PLATFORMS AND SOCIETY

- Politics: Misinformation, political polarization, beliefs about political issues, political participation.
- Well-being: Mental health, relationship formation, social capital.
- Economy: Effects on competition, workers, innovation, business formation, etc...

FOUR SESSIONS IN THIS COURSE

- Today: frameworks, network effects, user acquisition, competition.
- Week 2: recommendations, reviews, search, and information design.
- Week 3: experimental design in digital platforms.
- Week 4: big tech, impacts and regulation.

TYPES OF PLATFORMS RESEARCH: THEORY

- Very important. Lots of counter-intuitive results, details of the models have huge implications.
- Examples:
  - Rochet and Tirole (2006) "Two-sided markets: a progress report."
  - Caillaud and Jullien (2003) "Chicken and egg: competition among intermediation service providers."
  - Tan and Zhou (2021) "The effects of competition and entry in multi-sided markets."
  - Karle, Peitz, and Resinger (2020) "Segmentation versus agglomeration: Competition between platforms with competitive sellers."

TYPES OF PLATFORMS RESEARCH: REDUCED FORM SIDE EFFECTS OF PLATFORMS

- New platforms affect other things in the economy.
- Examples:
  - Craigslist and newspapers.
  - Airbnb and hotels.
  - Uber and taxis.
- These papers can be interesting, but often have the following weaknesses:
  - Rely on questionable diff-in-diff.
  - Focus on third-order effects (e.g., effect of bike-sharing on Airbnb).
  - No counterfactuals.

A WARNING ABOUT 'FAST PAPERS'

- New platforms or companies come out.
- There's a race to write papers about them.
- These "fast" papers rarely have interesting insights, and at best describe what is already known, I think of them as "Ambulance Chasing." This is better left for industry analysts.
- A lot of early work on online reviews, Airbnb, Uber, etc... is like this. Lots of citations but few insights.
- Today's version, work on genAI.
- **If you write about a new phenomenon, make sure you actually have non-obvious insights.**

TYPES OF PLATFORMS RESEARCH: STRUCTURAL INDUSTRY MODELING

- Today's paper about Airbnb and hotels, various papers on Amazon, papers on credit card networks, papers on food delivery apps.
- Gives us insights on welfare and efficiency.
- Allows us to simulate the effects of different regulations.
- Our comparative advantage as researchers.

TYPES OF PLATFORMS RESEARCH: REDUCED FORM STUDIES OF MARKET DESIGNS

- Typical paper: What is the effect of a change in algorithm, reputation system, pricing, etc?
- Three approaches:
  - Observational (typically) scraped data.
  - Experiment the platform conducted.
  - Run your own platform and do experiments.
- Often best to combine two of these approaches.
- These papers are more interesting if we learn something about human behavior.
- Challenge for these papers: Can't data scientists at the company do a better job? Don't they already know the answers?

TYPES OF PLATFORMS RESEARCH: STRUCTURAL MARKET DESIGN WORK

- Use experimental data to estimate a model of the platform.
- Think about equilibrium effects.
- Think about experiment designs that haven't been tried yet.
- For example, moving from 'what is the effect of a review on a seller's rating' to 'what is the effect of more reviews on marketplace outcomes in equilibrium.'
- Very related to regulation, when the policymaker has a different objective than the platform.

FRAMEWORKS FOR MODELING PLATFORMS

NETWORKS AND PLATFORMS

- Network effects: the value of a good or service depends on the number of other people using it.
- Platforms: a network that facilitates transactions between two or more parties.
- Platforms research typically focuses on the two (or many) sides of a platform.
- Network effects are more general, for example they can exist in non-platform settings.

ROCHET AND TIROLE (2003)

TABLE 1. ILLUSTRATIONS OF EXISTING BUSINESS MODELS

Product	Loss leader/break-even segment/subsidized segment	Profit-making segment/ subsidizing segment
	Software	
Video games	consumers (consoles)	software developers
Streaming media	consumers	servers
Browsers	users	Web servers
Operating systems (Windows; Palm, Pocket PC)	application developers (development tools, support, functionality, . . .)	clients
Text processing	reader/viewer	writer
	Portals and media	
Portals	"eyeballs"	advertisers
Newspapers	readers	advertisers
(Charge-free) TV networks	viewers	advertisers
	Payment systems	
Credit and differed debit cards (Visa, MasterCard, Amex, . . .)	cardholders	merchants
Online debit cards	merchants	cardholders
	Others	
Social gatherings	celebrities in social happenings	other participants
Shopping malls	consumers (free parking, cheap gas)	shops
Discount coupon books (Want Advertiser)	consumers	merchants
(Legacy) Internet	Web sites	dial-up consumers
Real estate	buyers	sellers

JULLIEN, PAVAN, AND RYSMAN (2021)

- Benchmark model of pricing in a platform.
- Two sides, i = 1, 2.
- Each side-i agent has a type $\theta_i \in (v_i, \gamma_i)$. Such that

$$u_i(\theta_i, q_j) = v_i + \gamma_i q_j$$

- Notice the importance of heterogeneity of users on the same side.

PRICING

- Payment to the platform can consist of an access fee and a transaction fee proportional to the number of interactions.
- $P_i = p_i + t_i q_j$
- Platform's pricing problem: $\max_P \sum_{i,j=1,2,j\neq i} (P_i - c_i) q_i - \sigma q_1 q_2$

SPECIAL CASES: HOMOGENEOUS INTERACTION BENEFIT (ARMSTRONG, 2006)

- Also assume no interaction costs to the platform, but fixed costs.
- $P_i^* = c_i - \gamma_j q_j^* + \eta_i(P_i^*, q_j^*)$
- η_i is the side-i inverse elasticity of demand.
- Notice the new term here is an adjustment for the other side's quantity. It captures the value of a marginal user of side i to side j.

SPECIAL CASES: HOMOGENEOUS STAND-ALONE BENEFIT (ROCHET AND TIROLE, 2003)

- Assume the firm has no fixed costs but interaction costs.
- Assume no transaction fees, not access fees.
- Optimal price for side i: $P_i^* = \sigma q_j^* - \frac{P_j^* q_i^*}{q_j^*} = \eta_i(P_i^*; q_j^*)$
- Optimal transaction fees:
- $t_1^* + t_2^* - \sigma = \frac{1-F_{\gamma_1}(t_1^*)}{f_{\gamma_1}(t_1^*)} = \frac{1-F_{\gamma_2}(t_2^*)}{f_{\gamma_2}(t_2^*)}$

DIFFERENCE BETWEEN WELFARE OPTIMAL AND PLATFORM OPTIMAL PRICES

- Average interaction benefit: $\bar{\gamma}_j$, Marginal interaction benefit: $\tilde{\gamma}_j$

$$
\begin{aligned}
P_i^* - P_i^e = & \underbrace{\eta_i(P_i^*; q_j^*)}_{\text{markup}} \\
& + \underbrace{q_j^e(\bar{\gamma}_j(P_1^e, P_2^e) - \tilde{\gamma}_j(P_1^e, P_2^e))}_{\text{Spence distortion}} \\
& + \underbrace{q_j^e(\tilde{\gamma}_j(P_1^e, P_2^e) - \tilde{\gamma}_j(P_1^*, P_2^*))}_{\text{displacement distortion}} \\
& + \underbrace{(q_j^e - q_j^*)(\tilde{\gamma}_j(P_1^*, P_2^*) - \sigma)}_{\text{scale distortion}}
\end{aligned}
$$

THE SPENCE DISTORTION, SPENCE (1981), TAN & WRIGHT (2018)

- The profit-maximizing firm wants to induce marginal users to come into the platform, since it helps the other side of the market.
- Policies that increase the number of marginal users may hurt the average user.
- For example, in a social media platform, promoting viral content that appeals to marginal users to increase engagement, but reducing quality for regular users.
- Sign of effect depends on setting.

CHICKEN AND EGG / MULTIPLE EQUILIBRIA

- Chicken and Egg: If no one is on the platform, why would anyone join?
- Multiple equilibria are possible. For example, no one joins the platform.
- How to solve this? Can subsidize usage. See Caillaud and Jullien (2003) and the 'Insulated Equilibrium' way of modeling coordination.

PLATFORM COMPETITION

- Literature on ‘divide and conquer’ strategies.
- Multi-homing is first order.
- Often modeled with an incumbent and an entrant to make things tractable.
- Often a non-negative price constraint. This makes a big difference.
- Differentiated platforms? Farronato, Fradkin, Fong (2024).

EMPIRICAL WORK

TWO IMPORTANT EARLY PAPERS ON PLATFORMS

- First well-known structural paper is Rysman (2004) on Yellow Pages. Finds yellow pages competition is good, estimates indirect network effects.
- Lee (2013) on video games. A classic paper studying the effects of platforms producing their own exclusive content (e.g. Xbox and Halo). "if Microsoft lost Halo...5.5% fewer Xbox consoles would have sold."
  - Finds exclusivity is bad for welfare, but doesn't consider incentive to produce a new video game console.

DO PLATFORM MARKETS TIP?

- Given two platforms, if one randomly acquires more users does it inevitably dominate?
- What determines tipiness of a market?

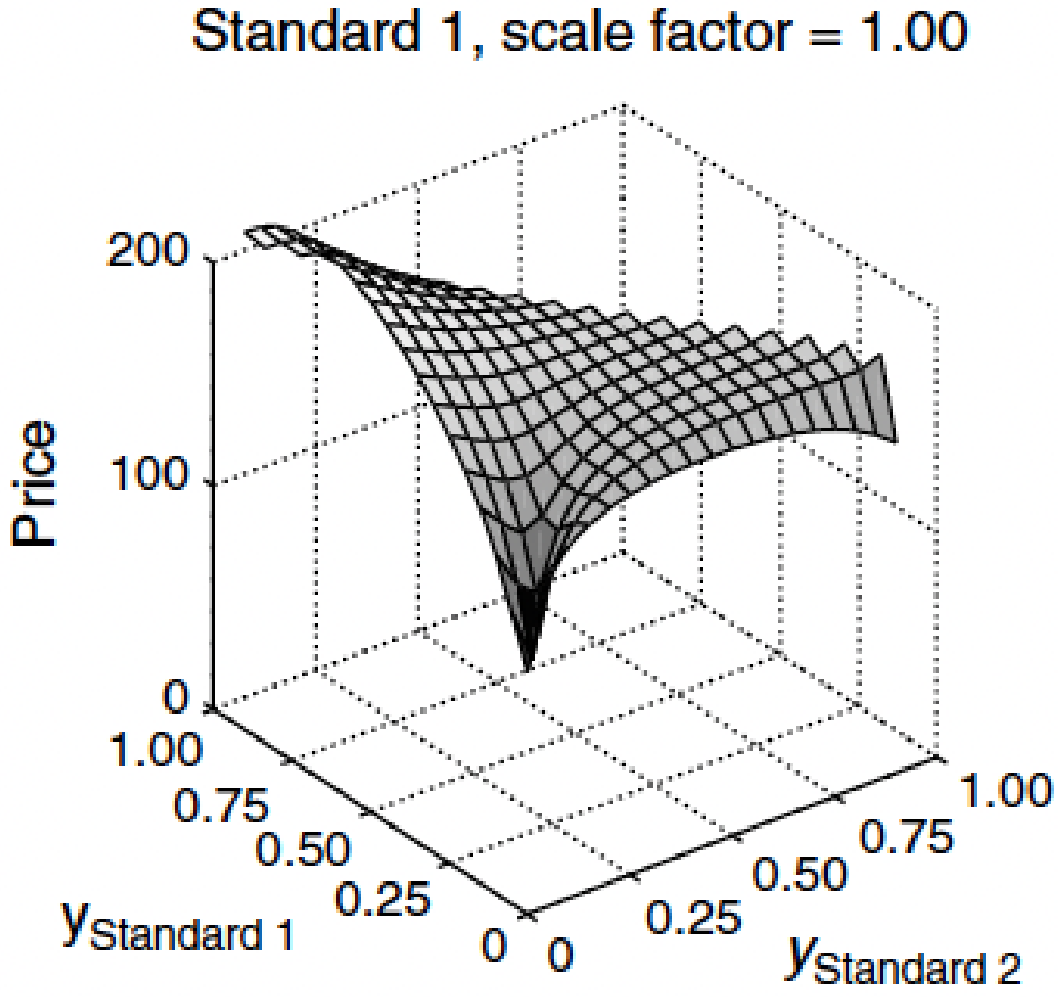
DUBE, HITSCH, AND CHINTAGUNTA (2010)

- Dube, Hitsch, and Chintagunta (2010) on video games.
- Market evolution:
  - If one platform gains an advantage, more video game makers will make games for that platform (Positive Feedback).
  - If everyone thinks that the platform will win, they will join that one, even if two platforms are otherwise identical.
  - Make the point, still true, that 100% tipping rarely happens, and that even without network effects differentiation and cost can lead to lobsided market shares.
  - Propose tipping measure.

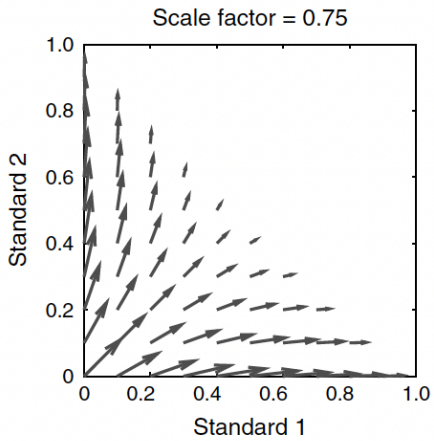
TIPPING MEASURE THEY ARE INTERESTED IN:

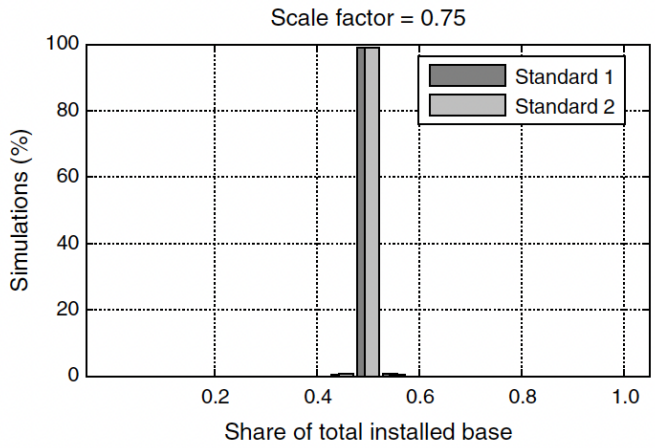
- $\Delta C_i = C_i(\theta, \mathcal{G}(\theta)) - C_i(\theta', \mathcal{G}(\theta'))$
- C_i is the concentration ratio of platform *i* in the market and θ are parameters, some of which govern the strength of indirect network effects.
- $\mathcal{G}$ is the concentration ratio up to that point.
- Key idea: Isolate the effect of indirect network effects.
- They calibrate a demand and pricing model to measure how likely markets are to tip.

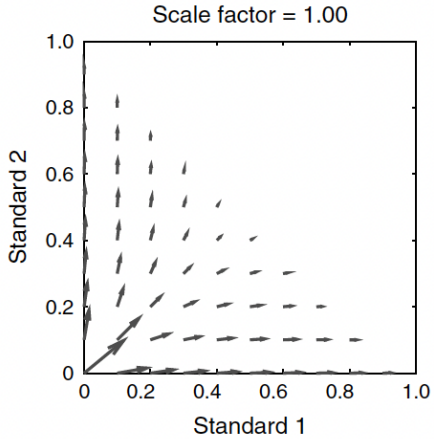
PRICE SURFACE FOR MARKET WITH LOTS OF INDIRECT NETWORK EFFECTS

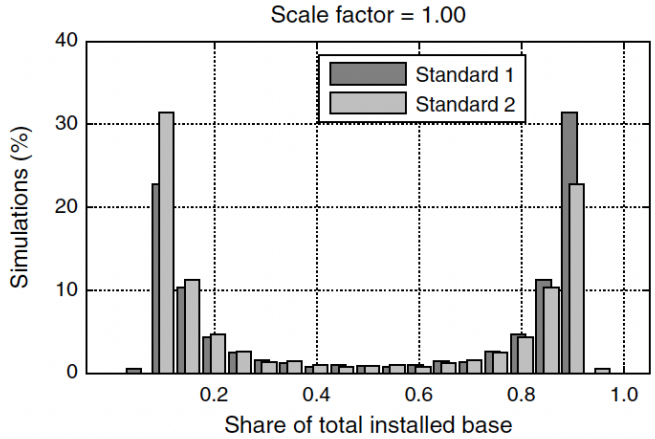


MARKET SHARES









LESSONS FROM DUBE, HITSCH, AND CHINTAGUNTA (2010)

- Indirect network effects are important but do not guarantee tipping.
- Penetration pricing happens when indirect network effects are strong.
- Also examine the role of the discount factor. If customers are patient, tipping is more likely.

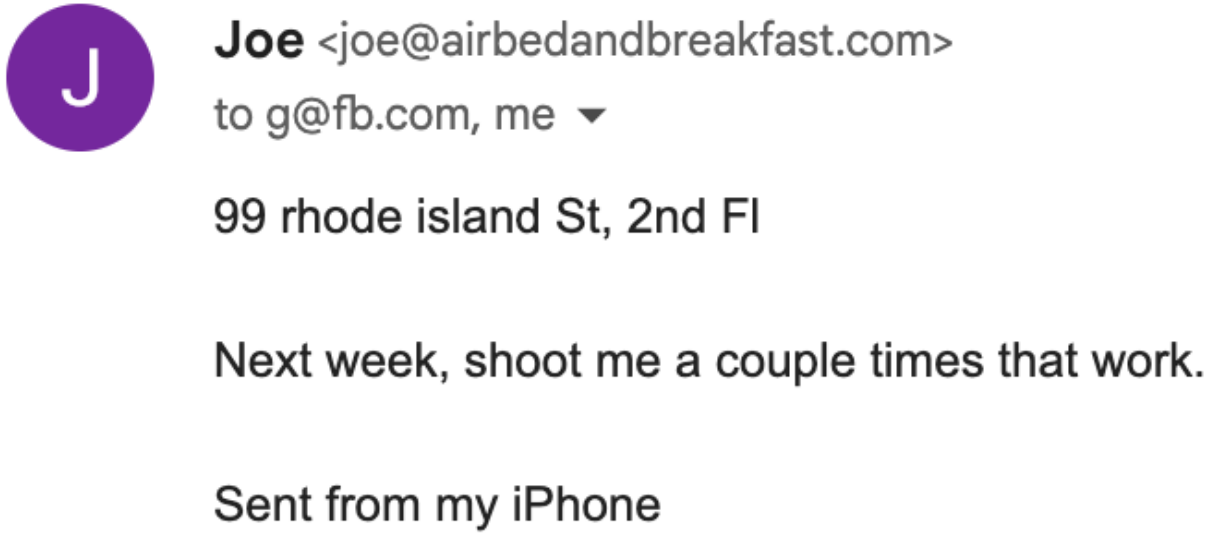
FARRONATO, FONG, AND FRADKIN (2024)

- Look at the merger of two platforms for Dog Sitting (Rover and DogVacay).
- The two-platforms co-existed, with differing market shares across zip codes.
- As a result, merger created a differential shock across zip codes to Rover's user base.
- We find that existing Rover users benefited from the merger but some DogVacay users dropped out.
- Evidence of platform heterogeneity and dis-intermediation caused by the merger.
- Winner take all market created by the merger.

FARRONATO AND FRADKIN (2022)

STORY OF THE PAPER

- I was interested in getting data from platforms in order to study economic behavior.
- Tried for LinkedIn, Mint, and a bunch of other platforms.
- Went to a Quora party in 2011 and met Joe Gebbia (co-founder of Airbnb).
- Pitch: Want to study competition between Airbnb and hotels.



DID NOT INITIALLY STUDY COMPETITION BETWEEN AIRBNB AND HOTELS

- Why? No hotel data.
- Airbnb was still too small in 2012.
- Job Market Paper: “Search frictions and the design of online marketplaces.”
- Build a model of search and matching on the platform. It was ahead of its time, and I wasn’t skilled enough to execute it alone at the time.

CO-AUTHORING WITH CHIARA FARRONATO

- Chiara was working on eBay on peer-to-peer platforms.
- We started talking about tackling the Airbnb and hotels issue in 2013/2014.
- Problem 1: Where to get hotel data? Smith Travel Research (STR).

APPROACH WE TRIED: PURE REDUCED FORM

- Regress log(q) on log(p) and Airbnb share.
- Problem 1: quite sensitive to the fixed effects, Airbnb growth is not random, market penetration was still super low in 2014!
- Problem 2: Welfare? Regulation? We decided to go structural.

ZERVAS, PROSERPIO, AND BYERS (2017)

Peer-to-peer markets, collectively known as the sharing economy, have emerged as alternative suppliers of goods and services traditionally provided by long-established industries. The authors explore the economic impact of the sharing economy on incumbent firms by studying the case of Airbnb, a prominent platform for short-term accommodations. They analyze Airbnb's entry into the state of Texas and quantify its impact on the Texas hotel industry over the subsequent decade. In Austin, where Airbnb supply is highest, the causal impact on hotel revenue is in the 8%–10% range; moreover, the impact is nonuniform, with lower-priced hotels and hotels that do not cater to business travelers being the most affected. The impact manifests itself primarily through less aggressive hotel room pricing, benefiting all consumers, not just participants in the sharing economy. The price response is especially pronounced during periods of peak demand, such as during the South by Southwest festival, and is due to a differentiating feature of peer-to-peer platforms—enabling instantaneous supply to scale to meet demand.

SOME COMMENTS ON ZERVAS, PROSERPIO, AND BYERS (2017)

- Concurrent to us, in fact maybe they started after us.
- Co-evolution of how papers were written.
- Scraped data from Airbnb and Texas hotels.
- Scraped data from Airbnb was imperfect, did not track availability.
- When we ran same regressions with ground truth Airbnb data and for large US cities, we did not get same answers.
- Reduced form is much faster to publish!

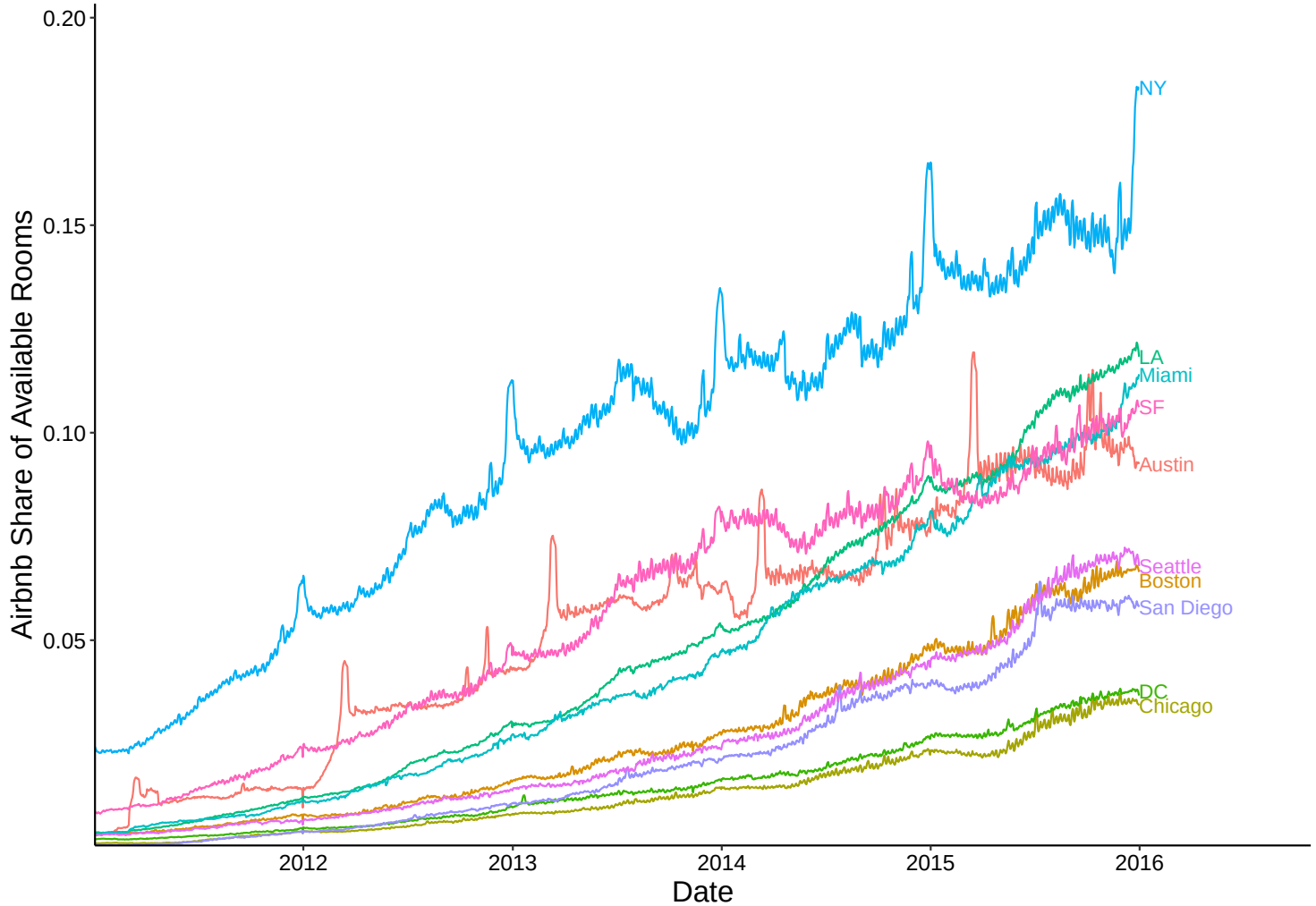
OUR PAPER

- Submitted in 2018, and response half a year later.
- Took us 3 years to resubmit due to Airbnb data sharing reasons as well as due to a huge amount of work.
- Had another round of reviews in 2021.
- Published in 2022.

WHAT WE DO:

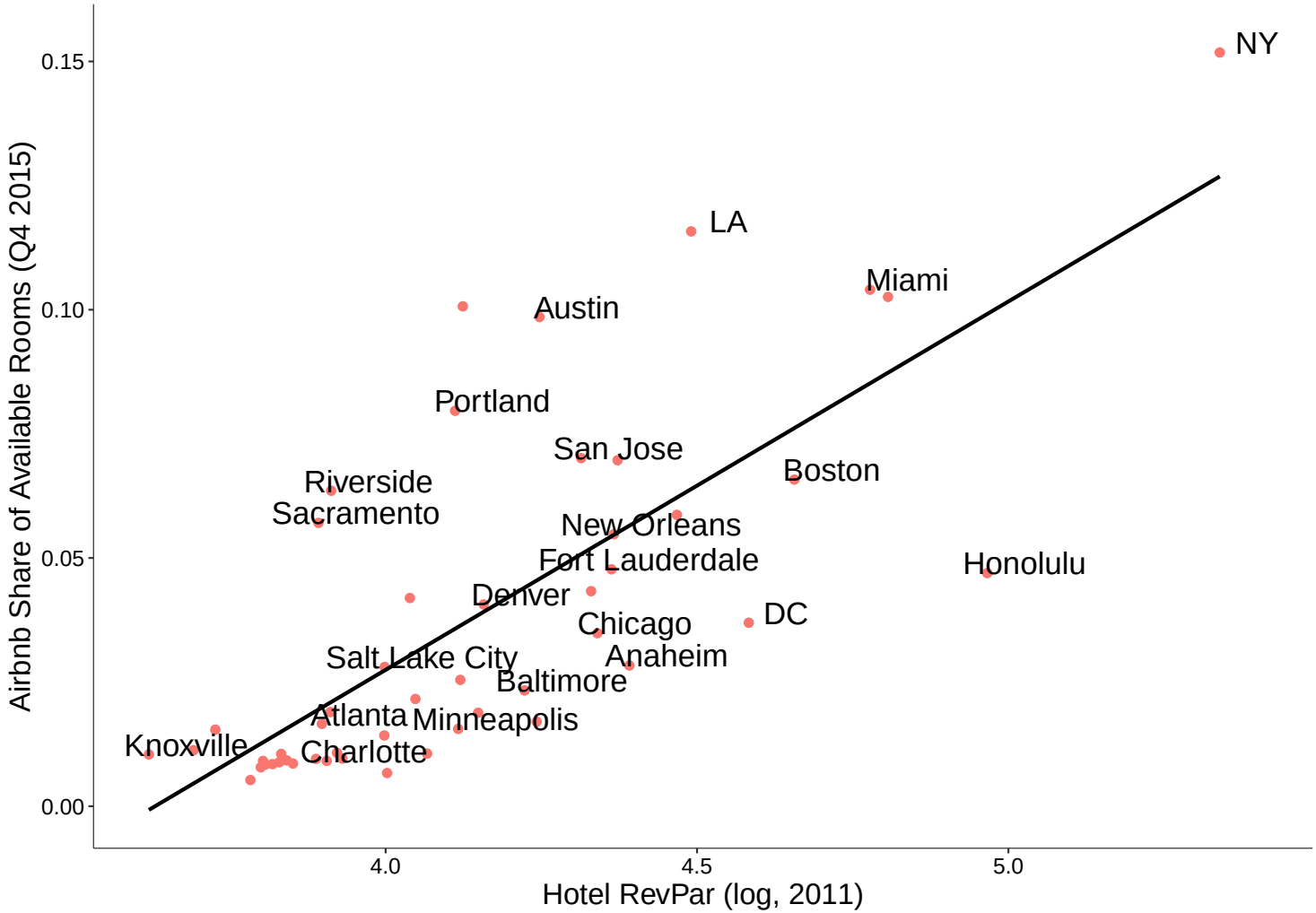
1. ‘Stylized facts’ about the data including descriptive regressions.
2. Model:
   - Consumer utility.
   - Host choices to host.
   - Hotel pricing.
   - Note, no real role of the platform in our paper.
3. Counterfactuals:
   - No Airbnb.
   - Lodging tax on Airbnb.
   - Airbnb with quotas for number of nights.
   - Double Airbnb.

GROWTH OF AIRBNB SUPPLY



- Rapid growth in Airbnb supply across major US cities
- Different penetration rates across markets

AIRBNB SIZE VS HOTEL PRICES



CONSUMER DEMAND MODEL

- Random coefficients logit model (Berry, Levinsohn, and Pakes 1995)
- Utility for consumer *i* from room option *j* in market *n*:

$$u_{ijn} = \mu_{ijn} + \alpha_i(1 + \tau_{jn})p_{jn} + \epsilon_{ijn} \tag{1}$$

- Where:
  - μ_{ijn} is mean utility including preference heterogeneity
  - p_{jn} is accommodation price
  - τ_{jn} represents tax/fee wedge between traveler payment and supplier receipt
  - ϵ_{ijn} is idiosyncratic type I extreme value component
- Allows for heterogeneity in price sensitivity and preference for inside options

MODELING HETEROGENEITY IN AIRBNB LISTINGS AND HOTELS

- STR: groups hotels by scale (‘luxury’, etc..).
- We created a similar grouping of Airbnb listings based on the number of reviews and prices they tended to transact at.
- Modeling Airbnb demand listing by listing would have been very tough, and methods to do this well are just being developed now (e.g. see recent work by Yufeng Huang).

CONSUMER SUBSTITUTION PATTERNS

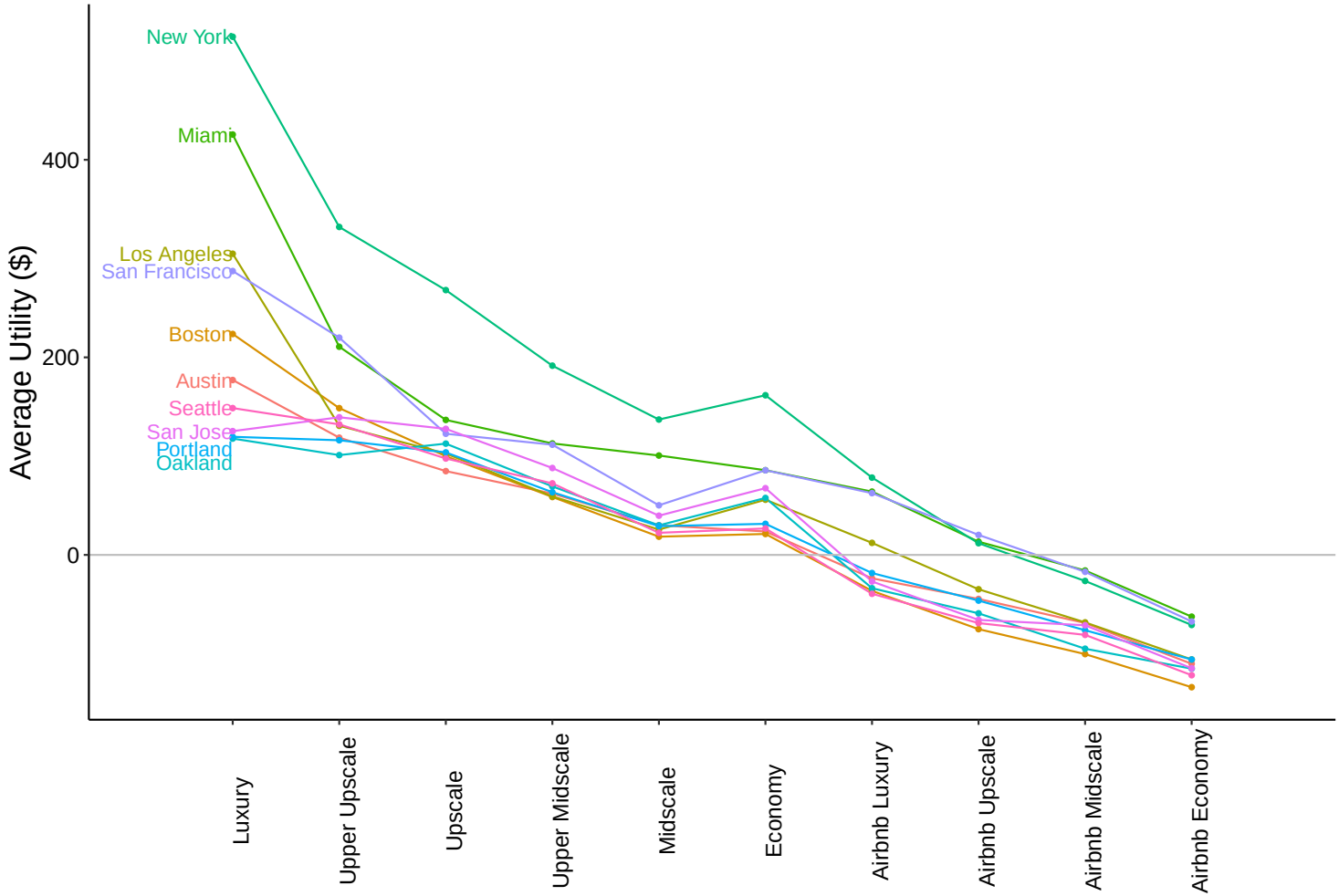
- Would Airbnb guests book hotels if Airbnb didn’t exist?
- Airbnb user survey data: 32% would choose outside option.
- Use this as a moment for estimation.

DEMAND ESTIMATES

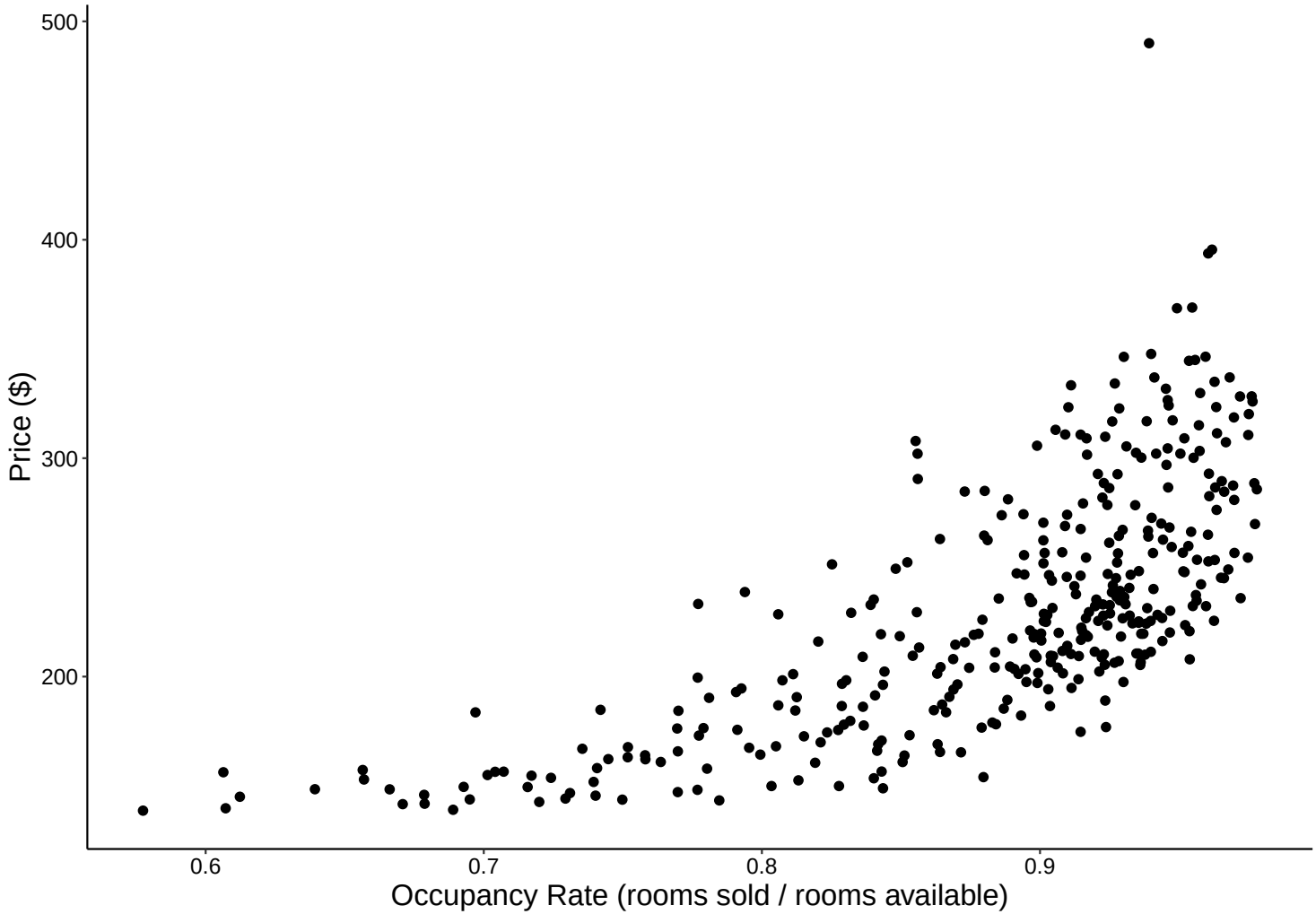
	Random Coefficients Logit		Standard Logit	
Parameter	Estimate	Std. Error	Estimate	Std. Error
Log Google Trend	2.355	0.281	1.783	0.059
Price	-0.031	0.002	-0.025	0.001
Std. Deviation on Inside Option	1.725	1.060	.	.
Std. Deviation on Price	0.004	0.004	.	.

- Note, heterogeneity is not very precisely estimated.
- Still needed to match outside option share.
- It's still fine, need to be honest about this in the paper.
- Used instruments for price (were hard to find since most variation is 'demand shifter' variation). Ratio of the log of Google searches for hotels and the available hotel room and the lodging tax.

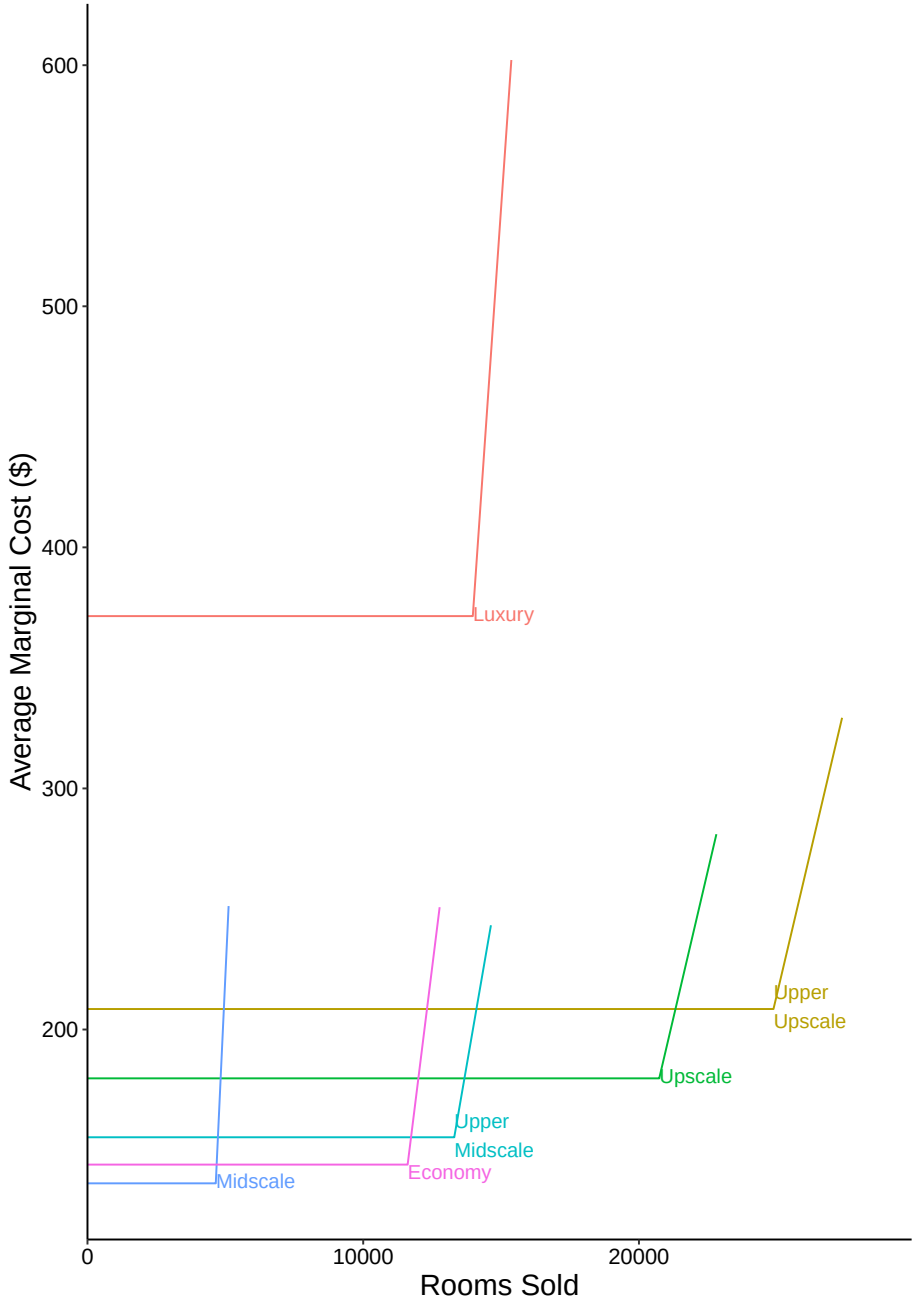
WILLINGNESS TO PAY



HOTEL PRICE-QUANTITY RELATIONSHIP



COST STRUCTURE: NEW YORK MARKET



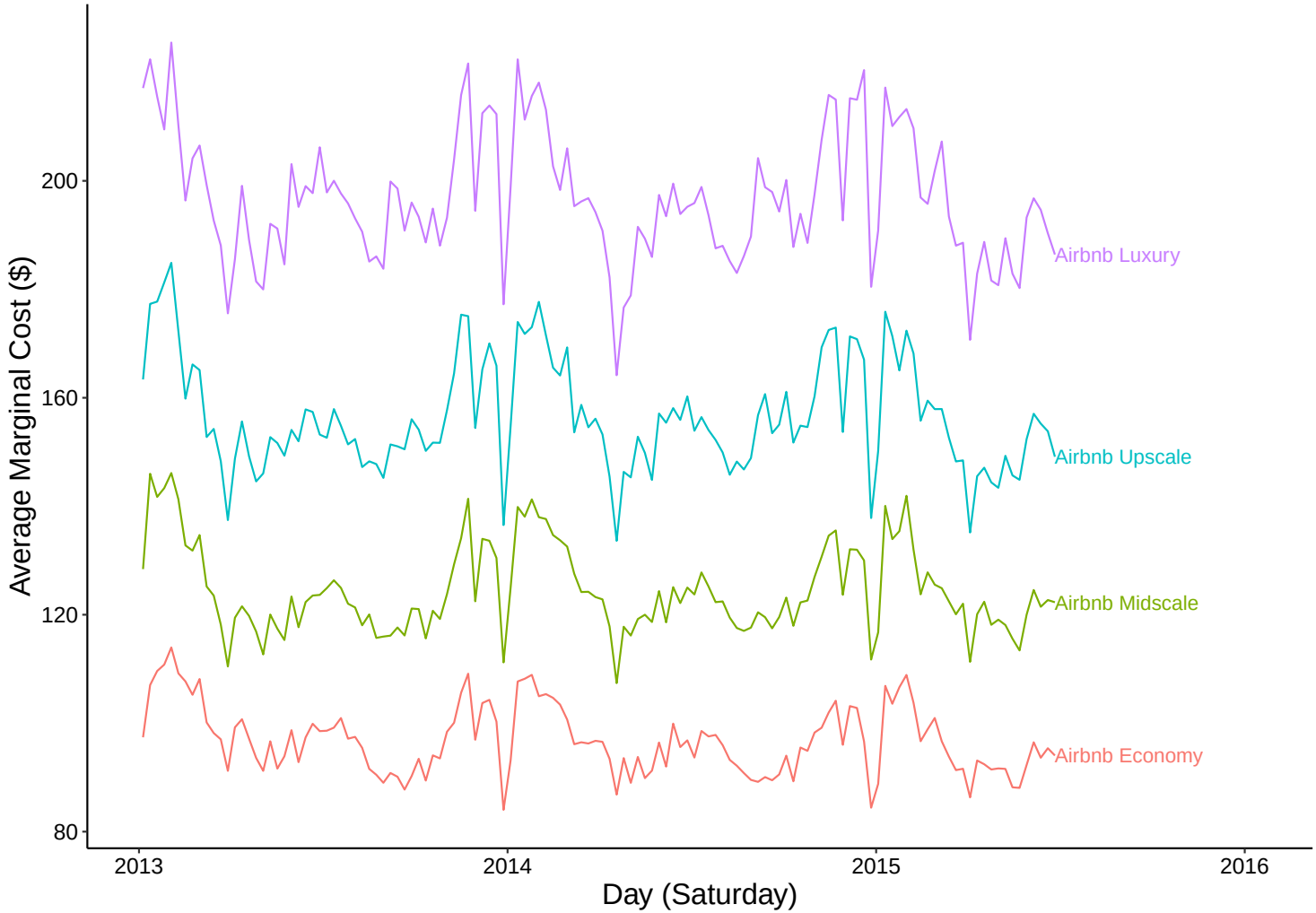
AIRBNB SUPPLY MODEL

- Peer hosts of each quality type a (luxury, upscale, midscale, economy) are price takers
- Hosts draw marginal costs from a normal distribution:
  - Mean cost: ω_{an}
  - Standard deviation: σ_{an}
- Hosts choose to host only if price exceeds their cost
- Supply function for Airbnb listings:

$$Q_{an}(p_{an}) = K_{an}\Pr(c \leq p_{an}) = K_{an}\Phi\left(\frac{p_{an} - \omega_{an}}{\sigma_{an}}\right) \tag{2}$$

- Where:
  - K_{an} is the number of available listings of type a in market n
  - $\Phi(\cdot)$ is the standard normal CDF

AIRBNB COST CATEGORIES



CONSUMER SURPLUS

Consumer Surplus Under Different Scenarios (MM)

Scenario	Change in Consumer Surplus	
	All Markets 2014	Compression Nights
Baseline	–	–
No Airbnb (Unconstrained)	-147	-39
No Airbnb	-305	-121
Airbnb With Lodging Tax	-65	-24
Airbnb With Quotas	-157	-14
Double Airbnb Rooms	130	53

HOTEL OUTCOMES

Hotel Outcomes Under Different Scenarios (MM)

	All Markets 2014		
Scenario	Rooms Sold	Revenues	Profits
Baseline	146	26,803	5,687
No Airbnb (Unconstrained)	149	27,412	5,833
No Airbnb	148	27,238	5,852
Airbnb With Lodging Tax	146	26,891	5,718
Airbnb With Quotas	147	27,106	5,754
Double Airbnb Rooms	145	26,630	5,623

PEER HOST AND GOVERNMENT OUTCOMES

Peer Host and Government Outcomes Under Different Scenarios (MM)

	Peer Hosts - All Markets			Government
Scenario	Rooms Sold	Revenues	Surplus	Lodging Taxes
Baseline	4.38	517	112	3,986
No Airbnb (Unconstrained)	–	–	–	4,071
No Airbnb	–	–	–	4,045
Airbnb With Lodging Tax	3.47	377	82	4,058
Airbnb With Quotas	1.49	181	40	4,027
Double Airbnb Rooms	6.18	672	146	3,962

INTERESTING PLATFORM IMPLICATIONS

- Airbnb is differentiated supply, not just a pure price reducer.
- Diminishing marginal returns to platform growth.
- Benefit especially big on ‘compression nights’ which comprise 19.6% of all nights, comes in large part from price reduction of hotels.

DISCUSSION QUESTIONS

- Is Airbnb a winner take all / most market? If so, why?
- What roles of the platform are we missing in this analysis?
- How should hotels respond to Airbnb?