Platform Search Design and Market Power

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Introduction

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- Policymakers are concerned about Amazon's **gatekeeper market power**

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  (i.e., search results)

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  $\Longrightarrow$ affects quantity and types of customers TPSs can access
- What products are seen *and* how they are arranged (i.e. platform search design) generates gatekeeper market power

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Q1 How much market power does Amazon gain from this position advantage? Are consumers missing out on valuable products?

- Policymaker's antitrust concerns

Q2 What policy could address the market power imbalance and how would it affect consumers, TPSs and Amazon?

This Paper

- Data:
  - Scrape product arrangement data from Amazon.com ('Home & Kitchen')
- Model:
  1. Consumers optimally search **through the product arrangement** before purchase
  2. Firms set prices in response to this search behavior
- Estimation:
  - Rich search model with agg. data (BLP w/ endogenous consideration set formation)
  - Recover heterogeneous search costs and price sensitivity (joint normal)
  - Recover unobserved product qualities and marginal costs
- Counterfactual product arrangements:
  - Isolate market power generated by Amazon's search design
  - Simulate effects of antitrust policies on consumers, Amazon and TPSs

Preview of Results

1. Amazon enjoys significant market power from their position advantage
   - Amazon's sales profits fall (-40%) when their position advantage is removed
   - Consumers search less and are slightly worse off (-8%)
   - Status-quo product arrangement aligns with consumers' preferences

2. Market power imbalance can be addressed by splitting the platform into an Amazon side and a TPS side
   - TPS profits increase (+382%) from greater market access
   - Consumers enjoy sorting gain (+3%) from option of "supporting small businesses"

Outline

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Background

Groups

Amazon (as a seller)

- Mass-market

  (e.g., AmazonBasics and Hamilton Beach)

TPSs

- Niche

  (i.e., very high/low price/quality)

Consumers

- Value variety
- Dislike price
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Search Design (i.e., product arrangement)

Search Results

- order that products are shown to consumers when they search

BuyBox

- group sellers of the same product (SKU) together
- for 98% products, lowest-price seller is the "BuyBox seller" (i.e., default)

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Search Design (i.e., product arrangement)

Search Results

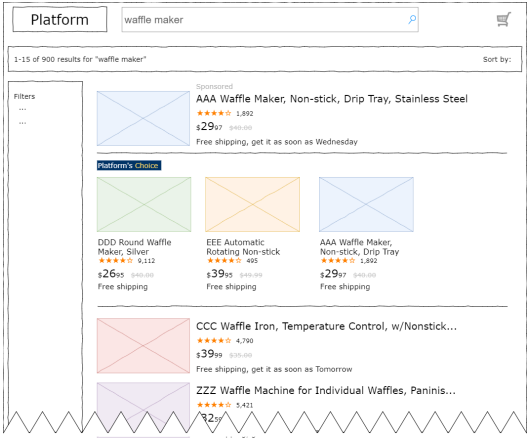
- differentiated products competition (e.g., AmazonBasics vs Hamilton Beach)

BuyBox

- homogeneous products competition (acute pricing pressure, 10% of products)

Search Design - Search Results

- Consumers use search results to discover products



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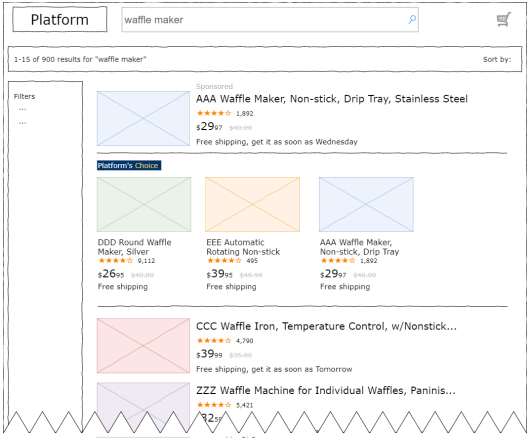

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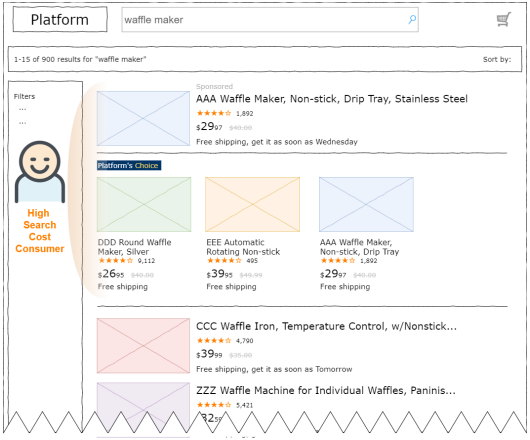

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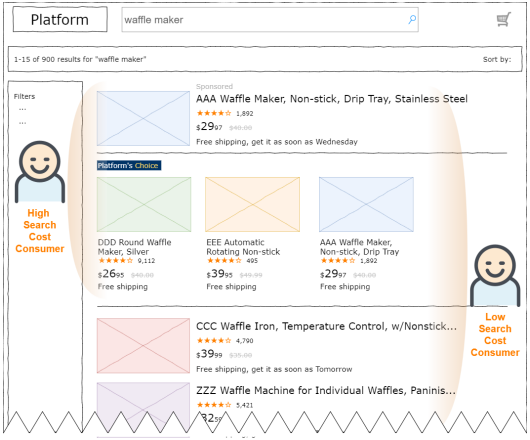

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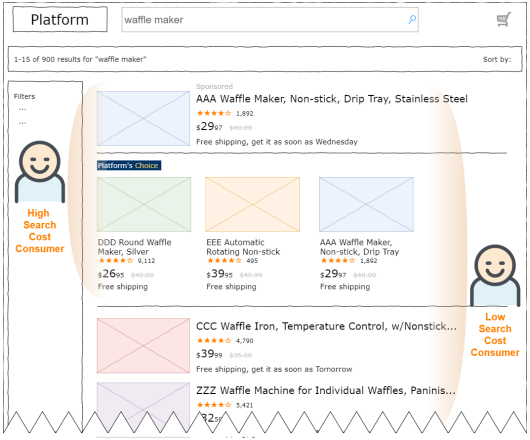

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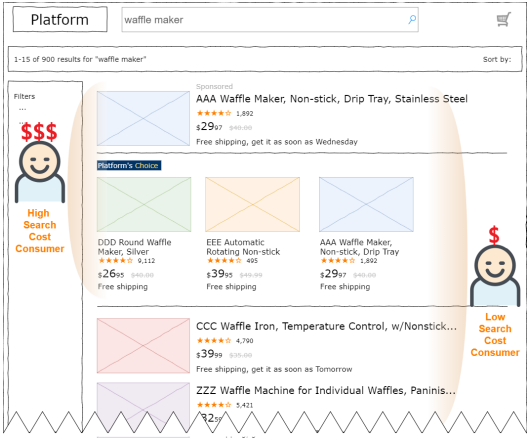

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- No personalization of search results in these markets
- Agnostic on obj. that generates search results

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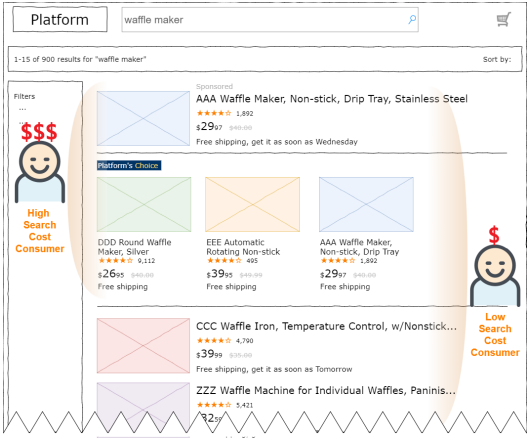

Search Design - BuyBox

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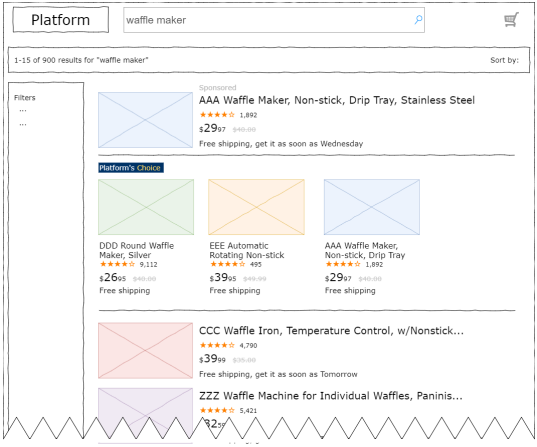

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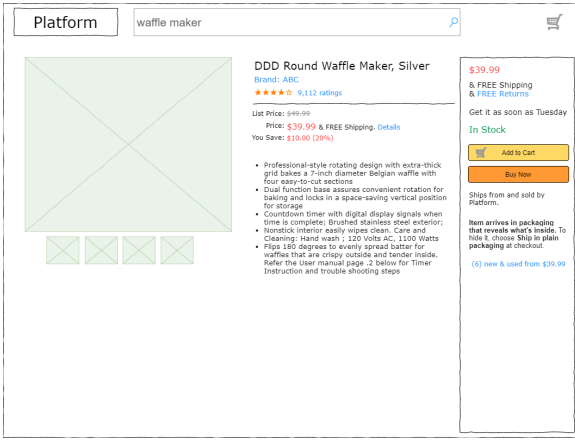

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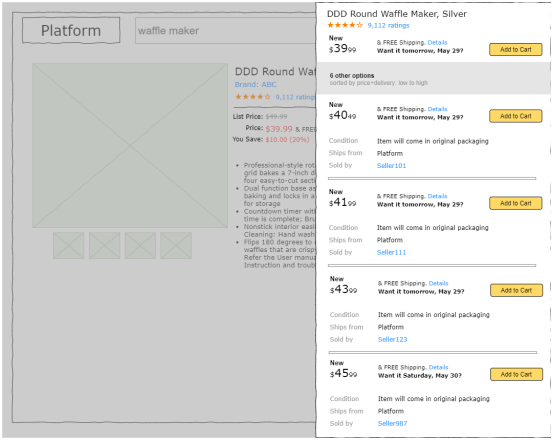

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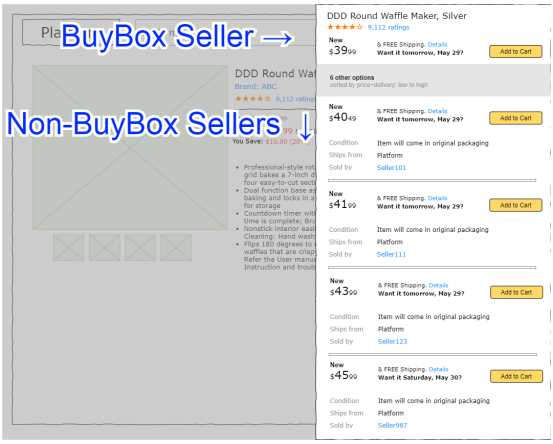

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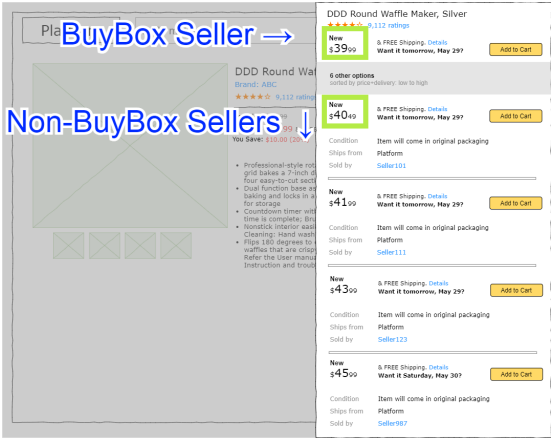

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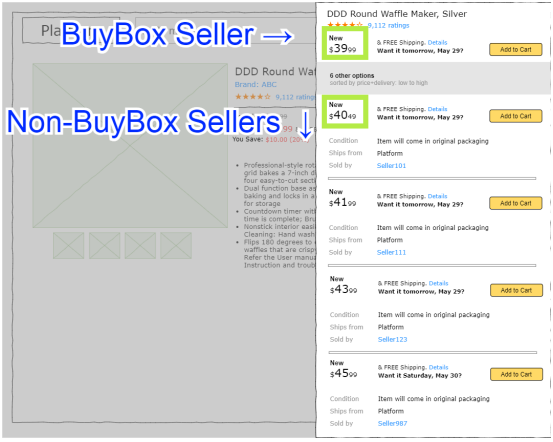
- **Pricing pressure from 2nd-lowest-price**
  - relevant for ~10% of products



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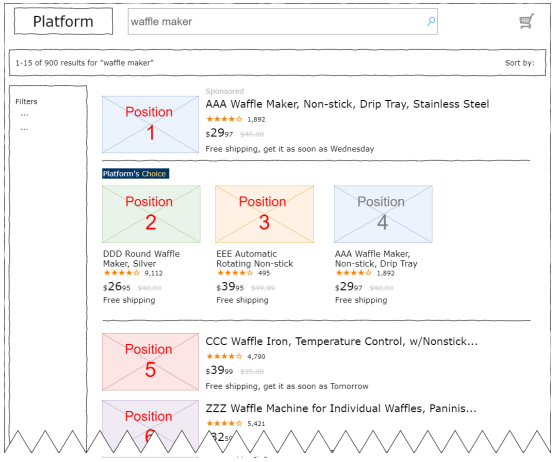
Average Search Result Positions - Amazon vs TPS



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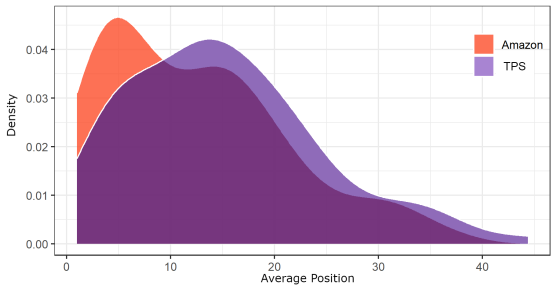

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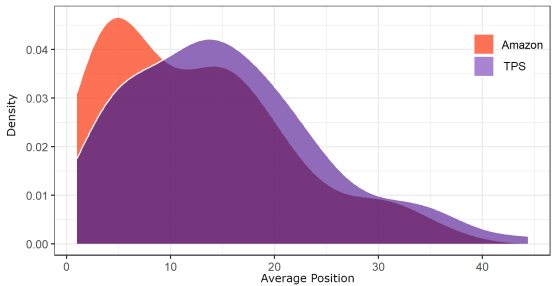

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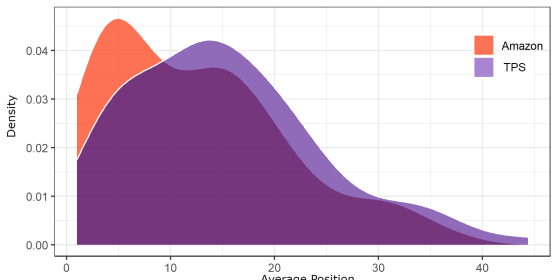

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- Randomize the product positions (for the set of top 20 products)
- Isolate the market power attributable to product arrangement

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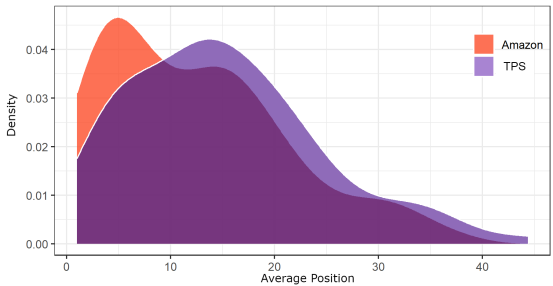

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- Need structural model for **how consumers will change their search behavior** in response

Data

- 58 'Home & Kitchen' Amazon.com markets (e.g., waffle makers, humidifiers, slow cookers)
- Scraper imitates a consumer searching on the platform
  - Search using typical keywords (SEO data)
  - Record everything (first 3 pages of results and product pages)
- Freq: ~30 obs/week for each market and up to 10 obs/day for product inventory
- Unit: product-week, 15 weeks (June-Sept 2020), top-20 products in each market

Key Variables

- Product arrangement
  - Search Results: product positions (empirical distribution)
  - BuyBox: 2nd-lowest-price seller
- Product characteristics
  - Price
  - Star rating, shipping, color, features, etc. (absorbed by fixed effects)
- Demand (Sales)
  - Observe sales directly for 1/3 of products (falling stock levels)
  - Estimate sales for remaining by mapping sales and sales ranking (Chevalier & Goolsbee 2003; He & Hollenbeck 2020)
- limited eBay data for 'outside platform' option

Price Pos

Reduced-Form Evidence

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$$\log(\text{Sales}_{jt}) = \beta_1 \log(\text{Price}_{jt}) + \beta_2 \log(\text{Position}_{jt}) + \beta_3 \log(\text{Price}_{jt}) \log(\text{Position}_{jt}) + \text{FEs}_j + \epsilon_{jt}$$

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Product FEs	*Y*
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Observations	11,164

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- **Search design matters for competition**
- Correlations in the expected direction
- Good within-product variation
- Remaining endogeneity (IV in struct. est.)
  - demand shocks
  - nothing capturing search costs
- Consumers will change their search behavior if product arrangement changes

Outline

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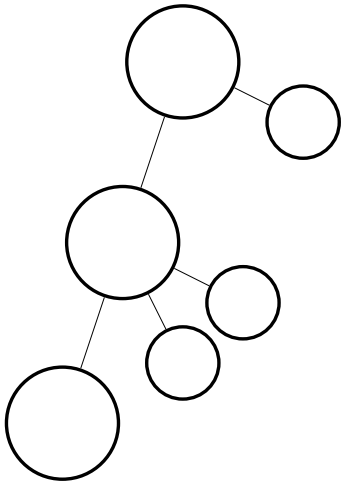
2b Purchase: once search stops, ϵ_{ij} shocks are realized, choose to purchase from $\mathcal{C}_i$

- $P(j|\mathcal{C}_i) = P(-\alpha_i p_j + \xi_j + \epsilon_{ij} > -\alpha_i p_{j'} + \xi_{j'} + \epsilon_{ij'} : \forall j \neq j' \wedge j, j' \in \mathcal{C}_i)$
- Timing of ϵ_{ij} shock is key for tractability (existing assum. in agg. demand est.)

- Static (one-shot), Subgame Perfect Nash Equilibrium, solve by backwards induction

Model - Product Arrangement and Search

- Consumer search is the traversal across an arrangement of products in tree form



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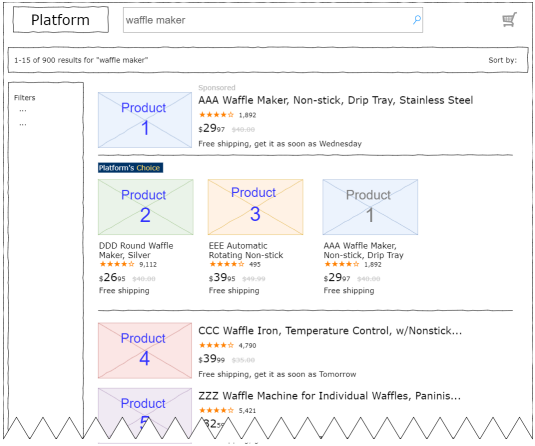

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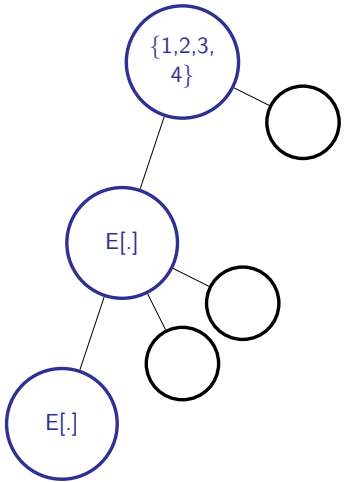

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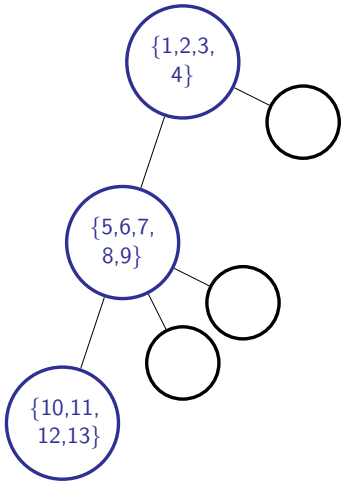

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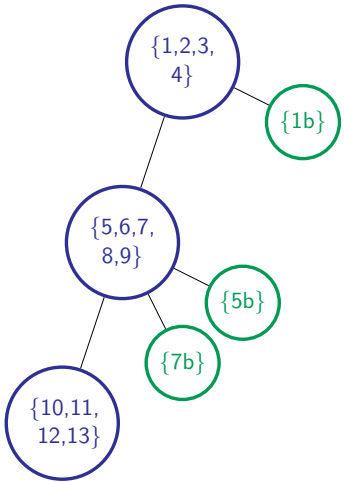

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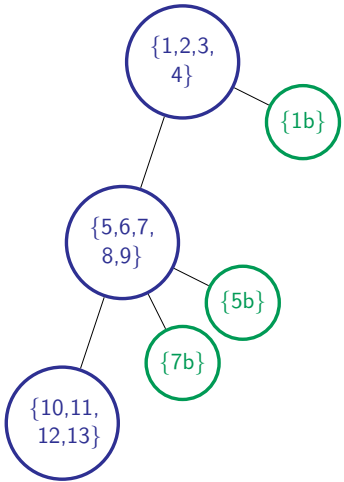

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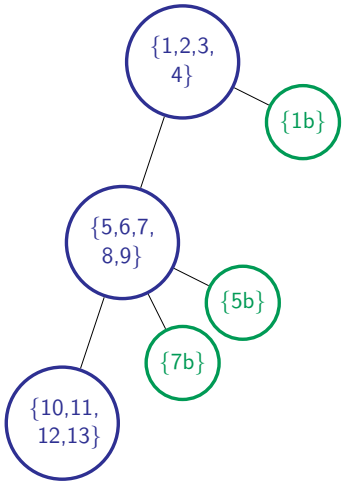
- Make clear possible consideration sets, and exclude 'impossible' consideration sets



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Model roadmap:

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Solution to simple 2-good example to provide intuition:

- Set aside branching paths, uncertain product arrangement, taste heterogeneity
- All of these are in the full structural estimation

Goeree model | Weitzman model

Model - Simplified 2 Good Example

- Logit, denote $e_j = \exp(-\alpha p_j + \xi_j)$
- No search (full consideration):

$$q_2 = \frac{e_2}{1 + e_1 + e_2}$$
$$q_1 = \frac{e_1}{1 + e_1 + e_2}$$

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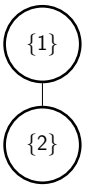

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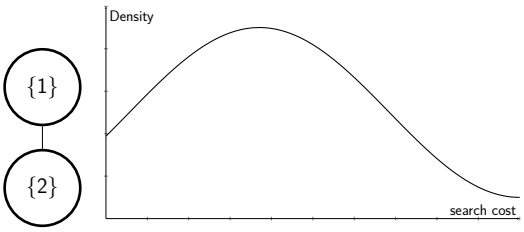

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Model - Simplified 2 Good Example

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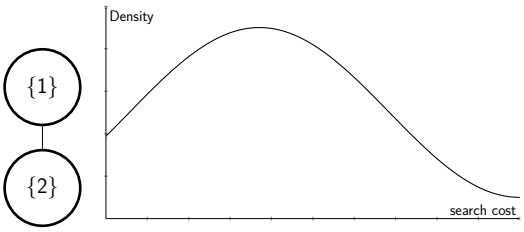

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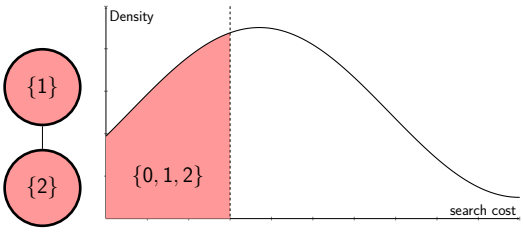

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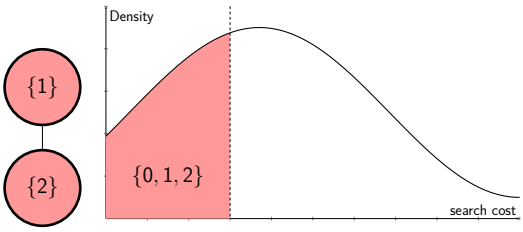

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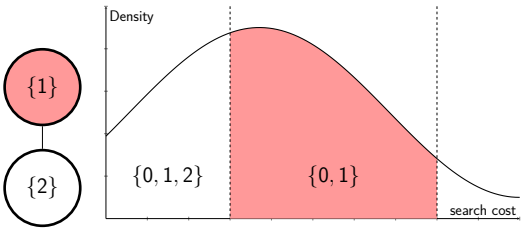

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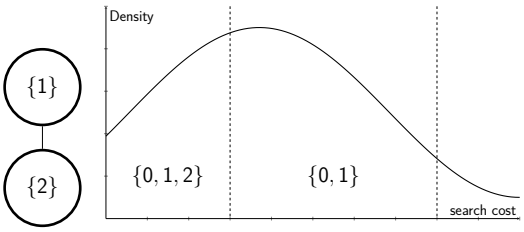
- **Search design → market structure**
- Mixture of duopoly and monopoly



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Outline

Estimation Details

- Indirect utility follows random-coeff. logit with unobserved product quality ξ_{jt}

$$u_{ijt} = -\alpha_i p_{jt} + \xi_{jt} + \epsilon_{ijt}$$

- Heterogeneity in price sensitivity α_i and search cost s_i (normal w/ correlation)

$$(\alpha_i, s_i) \sim F_{\alpha,s}\left(\begin{array}{cc} \mu_\alpha & \sigma_\alpha^2 \quad \rho_{\alpha s}\sigma_\alpha\sigma_s \\ \mu_s & \rho_{\alpha s}\sigma_\alpha\sigma_s \quad \sigma_s^2 \end{array} \right)$$

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- Nested Fixed Point and GMM (BLP) w/ optimal search computation Steps
- Allow no-purchase option and other-platform option
- Estimate model on one market (waffle makers)

Estimation Details - Identification and Endogeneity

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- Product position does not enter utility, variation in positions identifies s_i
- Endogeneity affects estimation of α_i and s_i
- AR(1) assumption on unobserved quality (leverage weekly observations)

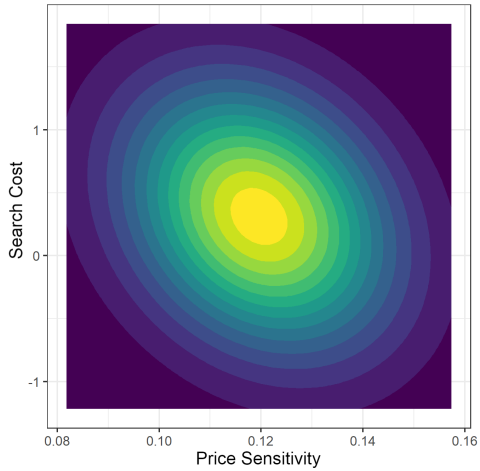
$$\xi_{jt} = \xi_j + \rho_{\text{ar1}}\xi_{jt-1} + \eta_{jt}$$

- Id. Assump.: Unobserved quality exhibits some relationship across weeks
  - AR(1) is sensible compared to extremes: $\xi_{jt} = \xi_{jt'}$ or $\xi_{jt} \perp \xi_{jt'}$

Estimation Results - Consumer Heterogeneity

- Avg consumer searches 10 products deep into the search results
- Negative correlation sensible
  - income may drive both price sensitivity and search costs

Figure: Estimated Consumer Heterogeneity

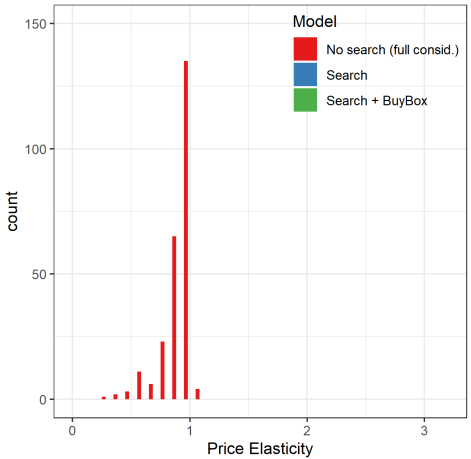


Depth Elast

Estimation Results - Price Elasticity

- Model without search underpredicts price elasticity (too high markups)
- Including search and search results produces more realistic markups
- Including BuyBox captures acute pricing pressure for certain products

Figure: Own Price Elast. Under Other Models



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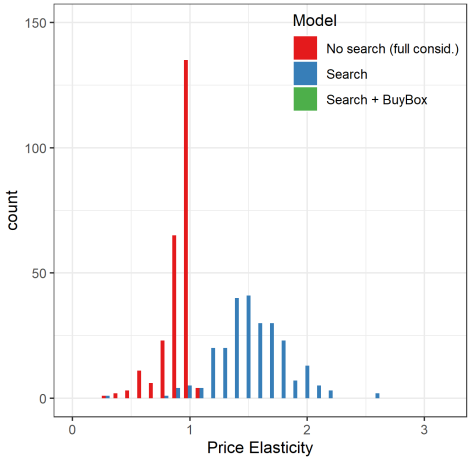

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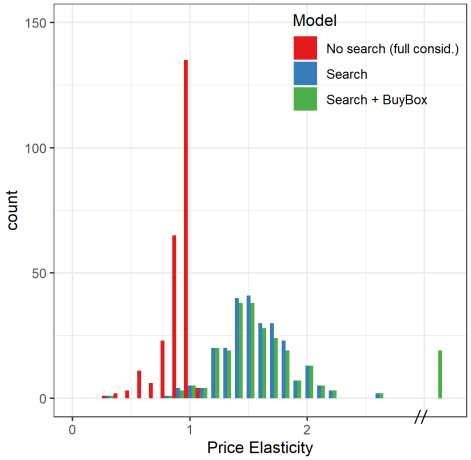


Outline

Market Power and Antitrust Action Counterfactuals

Use the model to shed light on market power and antitrust policy

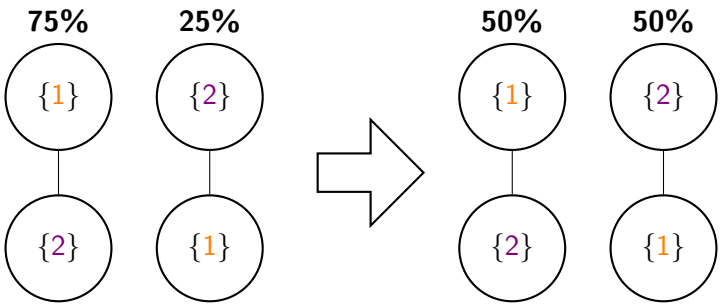
Counterfactual Exercise

1. Change the product arrangement
2. Consumers re-optimize search and purchase (with new rat. exp. of the new product arrangement)
3. Firms re-optimize prices (given new position in arrangement and new search behavior)
4. Calculate welfare and profits

Counterfactuals - Isolate Market Power

Q1 How much market power does Amazon exert over TPSs through the current product arrangement?

- Remove Amazon's advantage over TPSs by randomizing positions
- Effect of 'neutral' or 'fair' search results on sellers and consumers?



Summary of Counterfactuals

	Consumer Welfare	Amazon Sales Profits	TPS Sales Profits
Q1: *Market Power*			
Randomize Positions	-8%	-42%	+156%
Q2: *Antitrust Actions*			
Platform Split	+3%	-25%	+382%

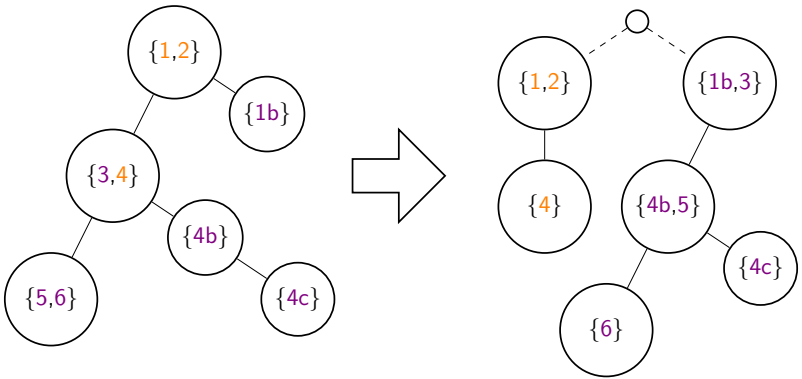
Equalize Amazon and TPSs

- Profits shift from Amazon to TPSs
- Amazon enjoys sizable market power under status quo
- Consumers reduce search b/c prices increase
- Consumers prefer status quo
- Amazon incentives and consumer preferences are aligned

Counterfactuals - Splitting the Platform

Q2 What would be the effect of separating Amazon and TPSs into separate sides?

- Consumers choose to see only Amazon or only TPSs in search results
- In practice, a filter on the website or a separate part of the website



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Support small business option

- High search cost choose Amazon (mass market)
- Low search cost choose TPS (niche)

- Minor sorting welfare gains
- TPSs gain greater access to consumers

Conclusion

- Retail platforms use search design to influence consumer search and exert market power on sellers
- Estimate a model of consumers searching over product arrangements and firms pricing in response

1. Amazon enjoys significant market power under status quo arrangement, but consumer welfare would be harmed by a 'neutral' arrangement
2. Allowing consumers to choose between Amazon and TPSs addresses market power imbalance

Questions?

- Thank you for your time!
- h.tai.lam@anderson.ucla.edu