ORIE 6180: Design of Online Marketplaces	Spring 2016

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Lecture 12 — March 14

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12.1   Overview of the last lecture

So far, we have looked at mechanism designs of auctions with independent and interdependent valuations. We've also looked at pricing theory of multi-sided platforms. We now move on to looking at recent papers dealing with online marketplaces.

12.2   Overview of this lecture

The three main operational details, or control levers, of online platforms that we will look at over the following weeks include:

- Pricing,

- Search & recommendation systems,

- Reputation & feedback system.

Time permitting, we may also look at competition across platforms and learning in online marketplace. Learning in online marketplaces is slightly different from other machine learning problems in that we cannot incur a loss just for the sake of learning.

The paper that we will look at this week is:
Sales Mechanisms in Online Markets: What Happened to Internet Auctions?

12.3   Purpose of the paper

When online markets first became popular in the early 2000s, auctions were the most popular method to sell goods online. It seemed like the perfect setting to see the theory of microeconomics at work, where prices move to equilibrium and the market clears. Theoretically, auctions are more efficient than posted-price markets. However, auctions are no longer the prevalent on sites like Ebay and a large proportion of transactions are now posted-price sales. This paper tried to explain the phenomenon through both theoretical and data analysis.

The main observations that the authors make are:

- The share of Ebay's revenue from posted-price sales (over total sales) has increased over the share of revenue from auction sales.

- The selling price in posted price sales is greater than the selling price of auctions.

- The probability of a sale occurring when we have a posted price is less than the probability of a sale occurring when we have an auction.

Possible explanations that the authors considered are:

- Changes in marketplace composition,

- Decrease in idiosyncratic items for sales, and

- Increase in sellers' experience.

12.4   Preliminary evidence

The authors considered the percentage of auction versus posted-price listings, according to the explanations above. To describe idiosyncrasy, they considered whether items are labeled as "new" or "used", and whether duplicates were available. The set of traits to describe the items is denoted C. To describe seller experience, they used Ebay's classification system of $S = \{\text{business, intermediate, occasional}\}$. Notable preliminary evidence includes:

- Figure 1 (page 30): The share of revenue and active listing on Ebay due to auctions have decreased since 2003.

- Figure 3 (page 32): Items that are sold as new are more likely to be sold under a posted-price listing (e.g. dvds). Similarly, items for which duplicates are available are more likely to be under a posted-price listing.

- Figure 4 (page 33: Over time, sellers are making more revenue from posted price sales rather than auctions.

To measure the change in the listing type, we introduce some notation. Let Z be the share of posted-price transactions in 2005 and Z' be the share in 2009 (in dollars). Let $s \in S$ describe the seller's category and $c \in C$ describe one of the 33 product categories of Ebay. Let $\sigma_{c,s}$ denote the share attributed to item category c and seller s, where $\sigma_{s|c} = \sigma_{c,s}/\sigma_c$.

Then we can describe the change in share by:

$$Z' - Z = \sum_{c,s} Z'_{c,s}\sigma'_{c,s} - \sum_{c,s} Z_{c,s}\sigma_{c,s}$$

$$= \sum_{c,s} Z_{c,s}\sigma_{s|c}(\sigma'_c - \sigma_c) + \sum_{c,s} Z_{c,s}(\sigma'_{s|c} - \sigma_{s|c})\sigma'_c + \sum_{c,s}(Z'_{c,s} - Z_{c,s})\sigma'_{c,s}$$

Each term attributes the shift to posted-price for the following factors: the first term attributes it to a change in product composition, the second to seller composition given the product category, and the third to changes within a product-seller category. It turns out the first two terms are small. This leads to the next question: What has changed in the seller incentives?

12.5 The model

From now, we will denote posted-price transactions as PP and auctions as A. Consider the following model:

- A single seller, with 1 item and cost c.

- ≥ 2 buyers, with common reservation utility u. That is, the buyers have an outside option with utility $u \geq 0$, and will only purchase the good if they can get utility $\geq u$.

- Each buyer has the same private value $V \sim F_v$ (with monotone hazard rate)

- A nuisance value λ of participating in the auction.

Let $Q_{PP}(p)$ be the probability of a sale occurring given a posted-price of p, and $Q_A(r)$ be the probability of a sales occuring given an auction with reservation price r. The following analysis is straightforward:

Posted price

- $Q_{PP}(p) = 1 - F_v(p + u)$

- Profit $\Pi_{PP}(p) = (p - c) \cdot Q_{PP}(p)$

Auction

- $Q_A(r) = 1 - F_v(r + u + \lambda)$

- Price conditional on sales $p(r) = E[V - u - \lambda | V \geq u + \lambda + r]$

- Profit $\Pi_A(r) = (p(r) - c) \cdot Q_A(r)$

With the posted-price sale, the optimal price is the monopoly price:

$$p^* = c + \frac{1 - F_v(p^* + u)}{f_v(p^* + u)}$$

On the other hand, the optimal reserve price for the auction is $r^* = c$.

Figure 5 (page 34) depicts this model with the assumptions that $V \sim \text{Unif}[0, 1]$, $u = 0$,

and $\lambda = 0.2$. It shows the probability of a sale against i) a posted-price, ii) a start price for an auction, and iii) the expected sale price from a given start price.

The comparative statics (similar to sensitivity analysis) from the model suggest the following:

1. A higher λ means posted-price should be used.

2. A higher c means posted-price should be used.

3. A higher u (narrower margin) means posted-price should be used.

4. $Q_{PP}(p^*) \leq Q_A(r^*)$ and $r^* \leq p^*$.

12.6 Miscellaneous

The analysis in this paper is called a "positive analysis" in economics. This means that for the given rules of the market, we consider how the participants react to it, but not how to change their behaviours. The other type of analysis is called a "normative analysis". In this case, we consider how to get the desired behaviours by the way we structure the market.

Bibliography

[1] EINAV, FARRONATO, LEVIN, SUNDARESAN *Sales Mechanisms in Online Markets: What Happened to Internet Auctions* May 2013.