Choice Screen Auctions

Introduction

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Auction as the Solution to Antitrust

Dominance of Search Engine

- Buying Android smartphones forces users to use Google as their default search engine
- Buying Windows forces users to use Bing
- This may cause monopoly on the information industry

What can the regulators do to avoid dominance (antitrust)?

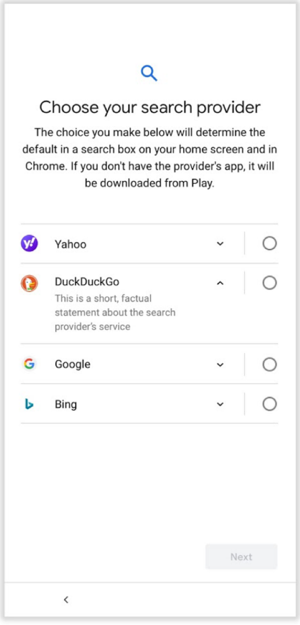
- 1990s, US court wants to break Microsoft because IE dominates (X Not a good idea)
- Negotiation: Must let users choose their preferred search engine **on a search screen**

Problems of Search Engine Selection

Being chosen by users have benefits, i.e., advertising revenue. But the platform itself has no benefit.

Platforms must decide *who should appear on the choice screen?*

- Decided by auction



Implementations of the Auction

The Two Implementations (with $n = 2$)

Two bidders (i.e., Yahoo and Bing) bid to be the **alternative on the choice screen** beside the original search engine (i.e., Google).

The author pointed out two implementations of the auction:

- per appearance
  1. the bidder with highest bid wins
  2. pays the amount equal to the other bidder's bid *each time the choice screen appears*
- per install
  1. the bidder with highest bid wins
  2. pays the amount equal to the other bidder's bid *when being chosen*

Google chose to implement the *per install basis*, but is this the best implementation for the government, regarding practicality on avoiding dominance?

A Simple Model for $n = 2$

Consider **G**oogle being the dominant search engine on Android, and **Y**ahoo and **B**ing are bidding to be the alternative.

	Bidder	
	Y	B
revenue per install	\$10	\$20
probability of being chosen when appear	10%	1%
Expected value	\$1	\$0.2

- per appearance basis
  - B is only willing to pay \$0.2
  - Y wins
  - Y pays \$0.2 whenever choice screen pops up
  - Prob of choosing G: 90%
- per install basis
  - Y is only willing to pay \$10
  - B wins
  - B pays \$10 whenever its search engine is chosen
  - Prob of choosing G: 99%

We can see that when *per install basis* is implemented, G is more likely to be chosen.

Extending the Model

A (Slightly) More General case: Exogenous Popularity and RPU

- there are $n = 2$ bidders
- Popularity q_i and revenue per user p_i
- $q_i, r_i \overset{iid}{\sim} \text{Unif}(0, 1)$

Bid

- Under *per appearance* auction, bidder i will bid $q_i r_i$
- Under *per install* auction, bidder i will bid r_i

The expected value of the popularity of the winner as well as the payoff of the platform(Google) can be calculated.

The result is shown below:

	per appearance	per install
Expected popularity of winner	$\frac{11}{18}$	$\frac{1}{2}$
Expected payoff of platform	$\frac{7}{54} + \frac{7}{18}\pi$	$\frac{1}{6} + \frac{1}{2}\pi$

* π is the payoff of Google being chosen

Extending the number of bidders, we found that :

- When implementing per appearance, the expected popularity of the winner (not Google) converges to one
- When implementing per install, the expected popularity of the winner does not change

Extension: Endogenous Popularity and RPU

- In general, the search engine can adjust how ”user friendly/unfriendly” it is, by decreasing/increasing its number of ads
- This is a trade off between **popularity** and **revenue per user**
- Thus, q_i and r_i can actually be **endogenous** when bidding

Notations:

- n bidders
- Each bidder is exogenously type $t_i \overset{iid}{\sim} \text{Unif}(0, 1)$, with CDF $= F(t)$
- Bidder selects popularity $q_i \in [0, t_i]$
- The revenue is then $r_i = t_i - q_i$, a tradeoff

The bidder now has to decide, given t_i

- How much to allocate, q_i
- How much to bid, b_i

Similarly, we discuss bidders' behaviors under the two different implementations: *per appearance* and *per install* basis.

Endogenous q: Per Appearance Auction

- $G(b_i) =$ CDF of b_i being lowest (the first-order statistic)
- $P(b_i) =$ Expected payment when winning with bid b_i
- $G(b_i), P(b_i)$ is independent of q_i, only functions of bid and others' decisions

Bidder i's payoff function, per appearance auction

$$\Pi(q_i, b_i) = G(b_i) \times (q_i(t_i - q_i) - P(b_i))$$

After differentiating, bidder i's optimal choice is to set

$$q_i = \frac{t_i}{2}$$

and bids

$$b_i = \left(\frac{t_i}{2}\right)^2$$

Endogenous q: Per Install Auction

We have to specify the payoff function and the order statistic in this case. Recall that in per install basis, bidder bids about its revenue-per-user, $r = t - q(t)$.

- Bidder of type t_i might choose popularity $q(t_i) + \Delta_q$ but bids $b(t_i)$
- Where $q(t_i) + \Delta_q \in (0, t_i)$ for some real number Δ_q

Bidder i's payoff function, per install auction

$$\begin{aligned}\Pi(\Delta_q; t_i) =& F^{n-1}(t_i) \times (q(t_i) + \Delta_q) \\ & \times \left(t_i - (q(t_i) + \Delta_q) - E[b(\max_{j \neq i}\{t_j\} \mid \max_{j \neq i}\{t_j\} \leq t_i)] \right)\end{aligned}$$

The optimal result for type t_i is

$$q(t_i) = \frac{t_i}{n+1}$$

Note that when implementing the *per install basis*, as $n \to \infty$

- popularity of a bidder in the equilibrium $q(t_i) \to 0$
- The dominant search engine (Google) then has 100% share of installs
- This **completely undoes the choice auction's reason for existence**

Conclusion

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- No matter under what setting, implementing the per install basis ruins the meaning of choice screen
- It is best to let platforms charge other search engines with the per appearance basis

Other parameters could be included to extend the model

- Frequency of choosing (once, each update, every year, etc.)
- More specific probability distribution
- Other scenario (i.e., default application on smartphones)

My Opinion

This model is rather simple but interesting, since it pointed out that the two seemingly equivalent descriptions of the auction can actually lead to completely different bidding behavior, as well as the result a government is trying to resolve.

I think the model can be extended by considering the asymmetry of information, under which bidders do not know exactly the revenue-per-users of other bidders, but can buy information so this is no longer a random variable.