Ad Server and Firm Strategies in Contextual Advertising Auctions

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Overview

Contributions of this paper:

- De ne a model of consumer behavior in ad listings,
- Derive rm equilibrium bidding strategies,
- Consider rationality of consumer behavior, and
- Compare ad server incentives to the desires of rms and consumers, including
  - Improving match quality,
  - Reducing search costs,
  - Establishing length of the listing, and
  - Privileging its own rm's ad.

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Why should we care?

- Incentives for innovation
- Competition policy

Structure

Unit mass of consumers indexed i; J rms, M included in ad listing.

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Consumers have lexicographic preferences for the good being o ered by rm j:

$$v_{ij} = \begin{cases} v_i & \text{with probability } q_j \text{ and} \\ 0 & \text{with probability } 1 \quad q_j: \end{cases}$$

q_j is the *relevance* of rm J.

v_i F

This formulation allows

- Product di erentiation yielding
- Many rms with positive market share

Firm qualities

All firms charge the same price p.

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Firm j has relevance q_j and a margin of m_j. Let the index j reflect the rank of the firm's full expected margin $q_j m_j$.

We show that this ranking maps directly to the ad slot placement of firm j M in equilibrium for an arbitrary M.

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If he does, he starts by visiting the site of the first ad. He determines whether that product is relevant for him and whether the price is less than his valuation. If so, he makes the purchase and his search ends.

If not, he continues to site 2 with probability (conditional on visiting site 1 and not making a purchase) s_1.

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Consumers do not search for the best price; since prices are the same across firms, this does not matter.

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  Relevant quantity when paying per click in ad auction,
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- Total revenue received by ad server.

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Using our results for total ad revenue, we can consider the incentives facing the ad server to change the structure of the market and how these incentives compare to the desires of consumers and rms.

Changing the probability of matches

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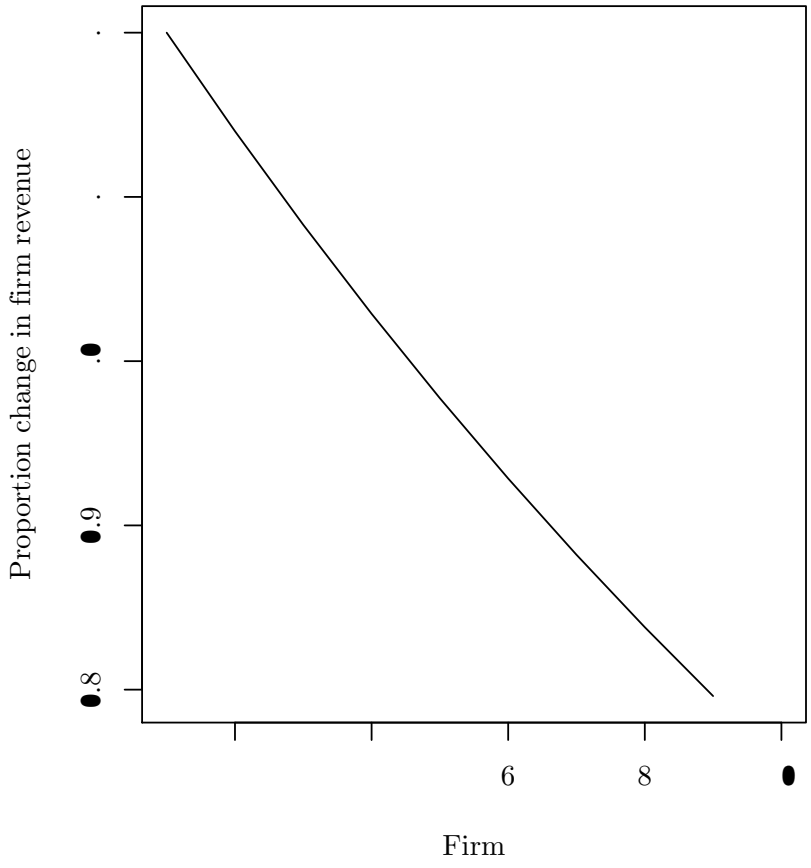
For concreteness, let:

- The number of rms be 10,
- The number of slots be 9,
- $s_j = 1$ for all slots
  Consumers don't give up,
- All rms have a relevance of $q = 0{:}2$, and
- Margins range from 0.1 to 1.0.

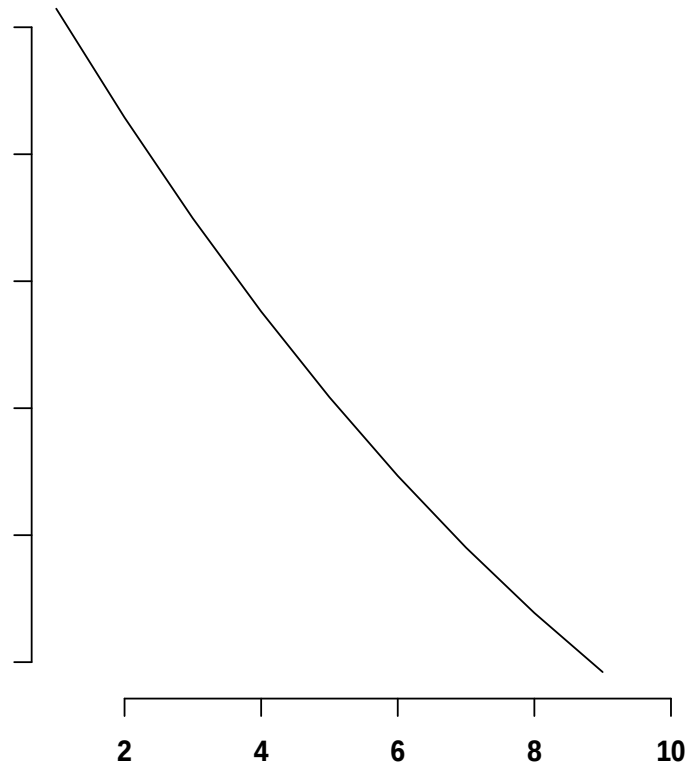
Changes in revenue

Suppose that we increase q proportionally.

- The expected full margin increases
  Bids go up
- The CTR falls as consumers are now satis ed higher on the list.



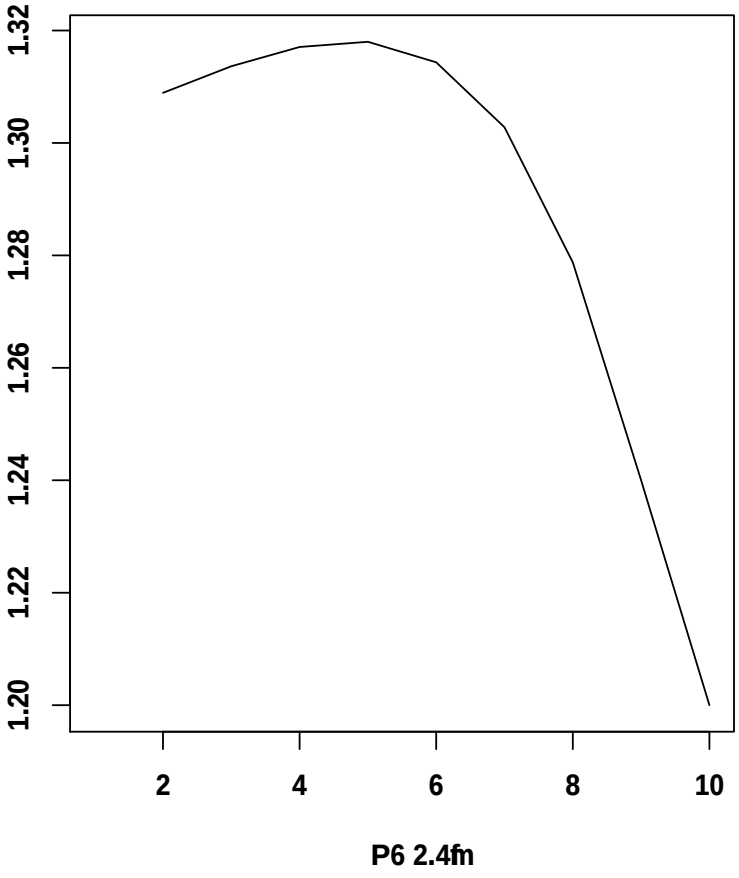
(a) Firm revenues



(b) Firm net revenues

Figure: Impact of a 20% increase in relevance from $q = 0{:}2$

All but the top 2 rms lose net pro t after the change; total net pro t falls by 2.2%.



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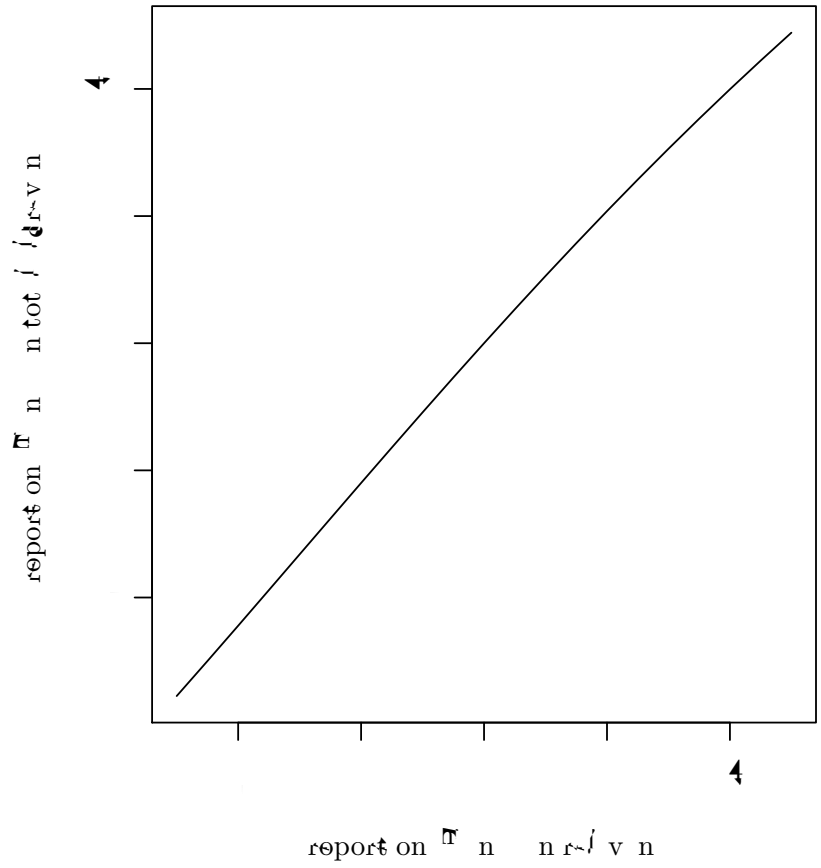
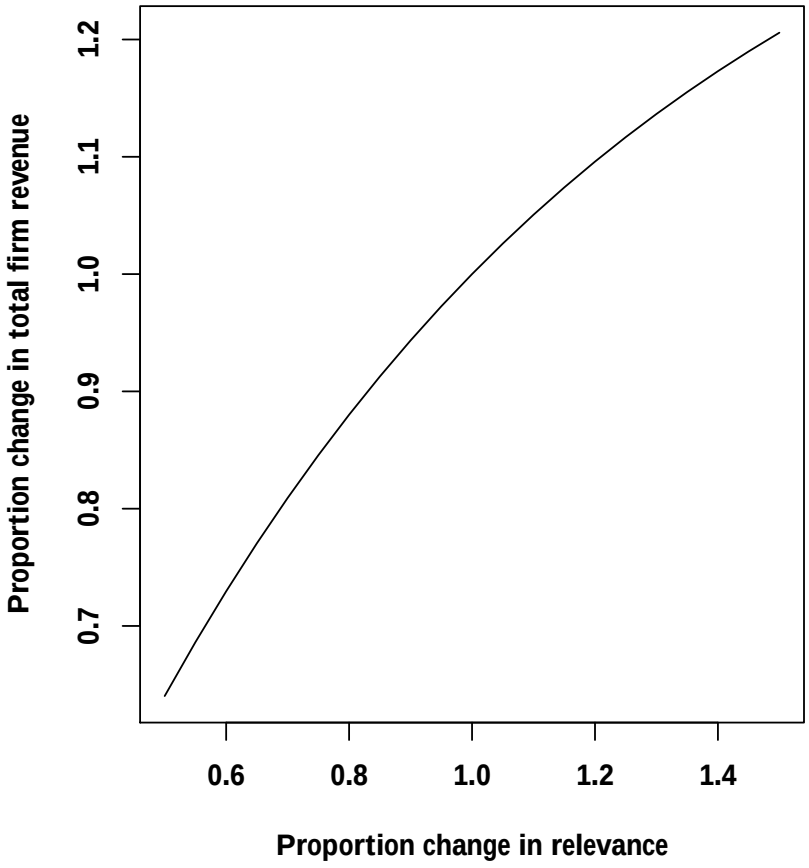


(a) Total ad revenue

(b) Ad elasticity

Figure: Impact of changes in relevance from $q = 0.2$ on aggregates



(a) Total rm revenues

(b) Total rm net revenues

Figure: Impact of changes in relevance from $q = 0{:}2$ on aggregates

Firms in t-333(on)-ggrega5 0 0 K [(:)]TJ06efer498 0 Td 2.478 Td [(101.

Summary of incentives in changing relevances

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Consumers unambiguously prefer higher relevances.

Optimal number of ads

In choosing the optimal (from its perspective) number of ads M to display, the ad server chooses to satisfy

$$\frac{m_{M+2}q_{M+2}}{m_{M+1}q_{M+1}} \quad \frac{M}{M+1};$$

the ratio of full expected margins between a rm and the next higher ranked rm must be large (the di erences between them must be small).

This accords with the fact that the ad server wants to minimize the dispersion in full margins to maximize pro ts.

Self-subsidization

Suppose that the ad server has a separate division that sells the product being advertised. What incentive does the ad server have to subsidize the bid of that firm to raise it to the top of the list?

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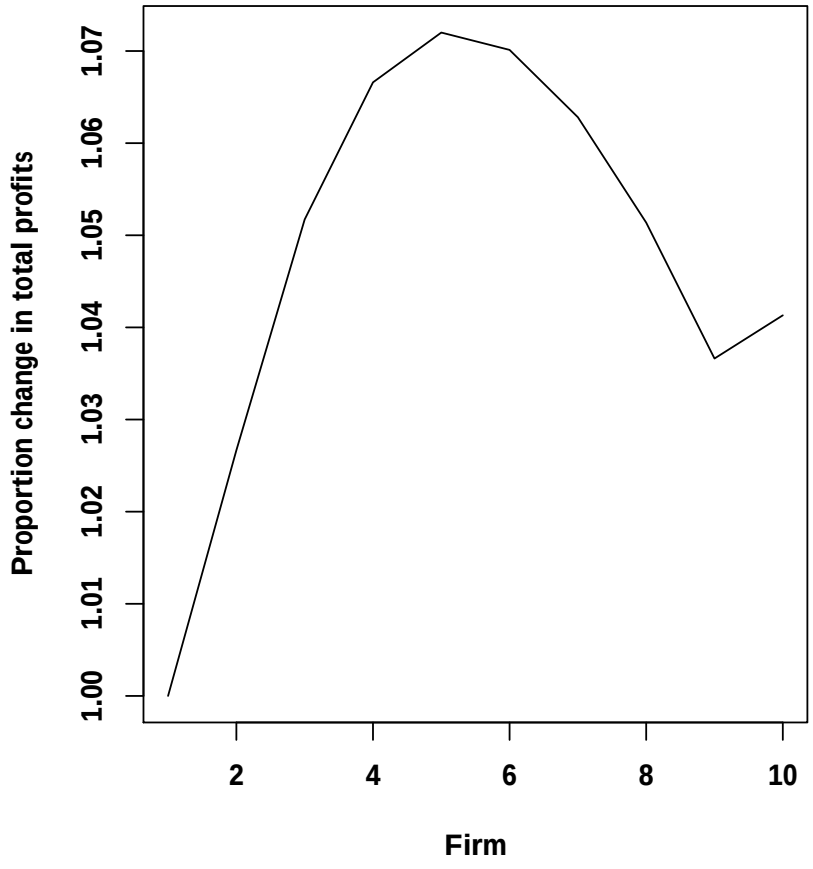
Again, these forces are o setting. We expect the smallest overall revenue change to come from a favored rm that would be ranked highly anyway (low bene ts) or ranked quite low (high costs).

Consider a case with

- All rms having margins of 1,
- $s = 1$, and
- Relevances that vary from 0.5 to 0.05.


Proportion change in total profits
1.00
1.01
1.02
1.03
1.04
1.05
1.06
1.07
2
4
6
8
10
Firm

Conclusions

In the case of increasing relevances and decreasing search costs, the interests of the ad server and consumers align.

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The ad server wants fewer firms listed than consumers prefer and have an incentive to privilege its own firm selling the advertised product, reducing the matching probabilities for consumers. These actions also lowers total producer surplus.

These later points have important implications for competition policy.