The Market of Internet Sponsored Links in the Context of Competition Law: Can Modeling Help?

Natalia Kudryashova
University of Cambridge
Centre for Mathematical Sciences, Wilberforce Road, Cambridge, CB3 0WA
nk373@cam.ac.uk

ABSTRACT

Internet search market of key words attracts much attention in conjunction with the legal proceedings against Google. It has been recognized that legal argumentation alone may not be sufficient to disentangle the complexity of the case. An approach that includs mathematical modeling is needed, to distinguish the effects of the factors intrinsic to the market and the consequences of anticompetitive practices. This paper proposes a modeling framework based on explicit treatment of users' switching between the search platforms in the environment set by the platforms' strategic decisions, and demonstrates some of its applications.

Categories and Subject Descriptors

K.4.1 [**Public Policy Issues**]: Regulation Abuse of Power; K.4.4 [**Electronic Commerce**]: Miscellaneous; K.5 [**Legal Aspects**]: General; I.6.m [**Simulations and Modeling**]: Miscellaneous

General Terms

Economics; Legal Aspects; Theory; Human Factors

1. INTRODUCTION

Recent years have seen a considerable increase in users' engagement with the web search, and in growing revenue from selling the sponsored links. Also, the internet search market came under the spotlight in the context of antitrust litigation against Google, the major market player.

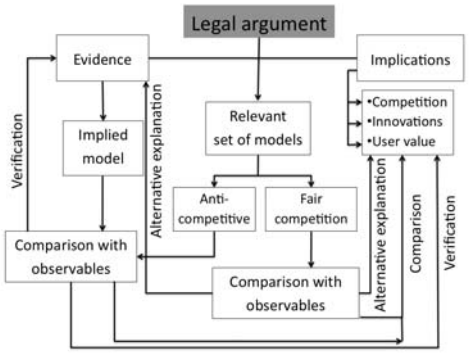

Figure 1. Modeling in the context of competition law

WWW'14 Companion, April 7–11, 2014, Seoul, Korea.
ACM 978-1-4503-4745-9/14/04.
http://dx.doi.org0.1145567948.2577369.

Previous modeling studies were focused mainly on particular aspects of the market, while not much attention was devoted to establishing a user-centered 'complete picture', which is required in the context of the antitrust proceedings. On the side of economics, the interest was largely centered on auctioning the sponsored links, optimal bidding strategies of the advertisers and strategies optimizing the platform's revenue ([1],[2],[4],[5]). On the legal side, at the centre of attention are complaints against Google, while attempts to illustrate and enhance the legal points (e.g. [3]) have not resulted in an adequate description of the market. These studies largely rely on a static approach and often arrive at conclusions that are counter-intuitive or contradict the real market situation, as, for instance, implying underspending of the dominant search platform on innovations [3], optimality of deliberate deterioration of the quality of organic search, and improving quality of organic search in response to increasing the switching costs for the users [4].

This paper explores the effects of the parties' decision-making on the market dynamics using a user-centered dynamic modeling framework which focuses on the net effects of the platforms' decisions. Since the users are not paying customers and the platform's revenue mainly comes from selling sponsored links, the platform's decisions may have to balance optimization of the user value and the revenue, thereby affecting users' preferences. Given there are several offerings in the market, a search platform has little direct control over individual preferences of the users, while the choices adopted by their sufficiently large proportion may play a critical role in determining the platform's market success, and hence the users have to be the starting point.

2. RESULTS AND DISCUSSIONS

Consider a large ensemble of randomly selected users (indexed by $i = 1, I$), whose preferences for a search platform (indexed by $m, m = 1..M$) are monitored over the period T at Poisson times $t_{i,k}, k = 1..N_i(T)$ of their searches. The time evolution of the users' preferences is expressed as a set of equations for probabilities of choosing a particular search platform at times $t_{i,k}$, $[p_{i,k}^{(m)} : \sum_{m=1}^{M} p_{i,k}^{(m)} = 1]_{m=1..M}$, in a changing market environment, subject to fairly unrestrictive assumptions regarding decision-making of both the users and the search platforms. The general form of the evolution equations reads as follows:

$$p_{i,k+1}^{(m)} = p_{i,k}^{(m)}(1-\beta_{i,k}^{(m)}\gamma_{i,k}^{(m)}) + \sum_{l=1}^{M} p_{i,k}^{(l)}\beta_{i,k}^{(l)}T_{i,k}^{(m,l)}\gamma_{i,k}^{(m)}\delta_{ml} \quad (1)$$

$(m = 1, ..M, i = 1, .., I, k = 1, ..N_i(T), T > 0)$, subject to initial conditions on $p_{i,0}^{(m)}$ and conditions ensuring normalization and detailed balance: $\sum_{i=1}^{M} p_{i,k}^{(m)} = 1$, $\sum_{l=1}^{M} T_{i,k}^{(l,m)} = 1$. Parameter $\beta_{i,k}^{(m)}$ denotes the probability that user i is dissatisfied with the search platform m at time $t_{i,k}$ to the extent that warrants switching to another search platform. There is a considerable discussion in the literature on how to define and quantify the quality of the displayed search results; we propose to use dissatisfaction as a measure of lack of quality or relevance.

The set $T_{i,k}^{(m,l)}$ denotes transition matrices that governs users' rational preferences upon switching. The explicit form of the matrix elements depends on the adopted model for the users decision-making. If the negative decision-making is assumed, i.e. the alternatives deemed to be worse than the chosen platform, the matrix elements are of the following form:

$T_{i,k}^{(m,l)} = \frac{\sum_{j=1}^{M} E\beta_{i,k}^{(j)} \delta_{jl} \delta_{jm}}{\sum_{j=1}^{M} E\beta_{i,k}^{(j)} \delta_{jm}}$.

In the case of positive decision-making, the user switches to another platform only if it offers a product which is perceived to be of better quality:

$T(m,l) = \frac{\max(0, E\beta_{i,k}^{(l)} - E\beta_{i,k}^{(m)} \delta_{lm})}{\sum_{j=1}^{M} \max(0, E\beta_{i,k}^{(l)} - E\beta_{i,k}^{(m)} \delta_{jl} \delta_{jm}}$.

Parameter $\gamma_{i,k}^{(m)}$ denotes habitual attraction to the platform m, i.e. the probability that the user i stays with the platform in case of dissatisfaction at the time $t_{i,k}$, which, if it is assumed to be present, depends on the expected probability of choosing the platform m by the user i. If the user i is searching with the platform m at times $t_{i,k}$, the probability that a sponsored link is clicked upon is denoted by $\tilde{p}_{i,k}^{m}$ and the probability that the user is dissatisfied with the displayed content is denoted as $\tilde{\beta}_{i,k}^{m}$. The former is independent of the probability of choosing the platform, but is assumed to depend on the user's previous dissatisfaction with the sponsored links displayed by the platform m. It is easy to see that the dissatisfaction parameter $\beta_{i,k}^{m}$ is a product of $\tilde{\beta}_{i,k}^{m}$ and the dissatisfaction rate for organic search. The user is assumed to be learning from the past experience, i.e. $\tilde{p}_{i,k}^{m}$ is a decreasing function of $E(\tilde{\beta}_{i,k}^{m})$. For the sake of simplicity, we may assume their equality. The $E(\tilde{\beta}_{i,k}^{m})$ is assumed to depend on the platform's decision-making with respect to the ranking of the competing advertisers.

The marginal revenue expected by the platform m obtains from the search at $t_{i,k}$ is:

$$\pi_{i,k}^{(m)} = p_{i,k}^{(m)} (\tilde{p}_{i,k}^{(m)} u_{i,k}^{(m)} (E(\tilde{\beta}_{i,k}^{m})) - k^{(m)}) \quad (2)$$

where $u_{i,k}^{(m)}$ is the price established in the second price auction in response to the user's search query, and $k^{(m)}$ are marginal fixed costs ($u_{i,k}^{(m)} \gg k^{(m)}$). Hence, the equations for corresponding expected values in the limit of the continuous search process and the infinite users' ensemble are straightforward.

3. APPLICATIONS

Explicit treatment of the user dynamics helps to remove a number of controversies associated with admittedly counter-intuitive conclusions resulting from the static modeling [4] (Propositions 1,3), and to provide further insights into the market dynamics (Propositions 2, 4). Applications to the legal argumentation are exemplified by Propositions 5-7. The proofs follow directly from solutions of the Kolmogorov equations corresponding to eq.(1).

Proposition 1: A general purpose search platform cannot ensure sustainable long-time growth and profitability by deliberately deteriorating the quality of organic search results.

Proposition 2: The condition for dominance in the market without habitual attraction corresponds to minimization of the perceived dissatisfaction to zero, while in the market with habitual attraction the dissatisfaction is to be perceived marginally smaller than that of the competing platforms.

Proposition 3: Large switching costs for the users do not stimulate improvement of the organic search quality.

Proposition 4. Habitual attraction modifies the notion of fair competition as well as its manifestations in the dynamics of the market share and the innovations.

Proposition 5. Habitual attraction in the internet search market is not negligible.

Proposition 6. The market share of the dominant player in the internet search market gained upon expansion into a content market is substantially higher than the perceived fair value, provided the quality of its product in the content market is not inferior to those of the incumbent players.

Proposition 7. Top-down approach in regulation of the market is unlikely to increase user value.

4. CONCLUSIONS

The modeling framework has been applied using a family of simplified models focusing on particular research questions or legal arguments in the context of the anti-trust proceedings. For instance, allegations of bundling were considered by modeling the coupled dynamics of the internet search market and the content market, while putative consequences of the proposed public regulations of the dominant player were modeled by constraining the market dynamics. The importance of accounting for the effects of habitual attraction, which modifies the manifestations of fair competition in the market dynamics and propagation of innovations, and learning of the users from their past experience was demonstrated. A number of controversies associated with counter-intuitive conclusions resulting from a static approach were solved.

5. REFERENCES

[1] S. ATHEY and G. ELLISON. Position auctions with consumer search. *Quarterly Journal of Economics*, 126(3):1213–1270, 2011.

[2] M. O. EDELMAN, B. and M. SCHWARZ. Internet advertising and the generalized second-price auction: Selling billions of dollars worth of keywords. *American Economic Review*, 97(1):242–259, 2007.

[3] I. LIANOS and E. MOTCHENKOVA. Market dominance and search quality in the search engine market. *Journal of Competition Law and Economics*, 9(2):419–455, 2011.

[4] G. TAYLOR. Search quality and revenue cannibalization by competing search engines. *Journal of Economics Management Strategy*, (22):445–467, 2013.

[5] H. R. VARIAN. Position auctions. *Position auctions*, 25(6):1163–1178, 2007.