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Working Paper

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Leadership in Multisided Markets

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First Draft: November 2011

Abstract
I analyze the role of leadership in multi-sided markets as online advertising. Search and display advertising are better characterized by (respectively) quantity and price competition. A platform that reached dominance in search may have an incentive to limit services to consumers to be aggressive with the advertisers, to exploit its scale in search to build barriers to entry, or to adopt click-weighted auctions to manipulate the pricing of sponsored links. On the other side, a dominant platform in display advertising may increase the rewards of content providers to increase prices on advertisers, or may adopt exclusive clauses to predate on other platforms.

Keywords: Multisided markets, leadership, dominance

JEL Codes: L1

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The economics of multisided markets has recently attracted a lot of attention among economists (Rochet and Tirole, 2003; Caillaud and Jullien, 2003; Armstrong, 2006; Weyl, 2010; Athey and Ellison, 2011) because it characterizes a number of important markets of the New Economy and generates a number of new intriguing antitrust issues. In particular, a wide interest has been focused on the market for search and display advertising, whose dominant firm at the global level, Google, is currently being investigated by a number of antitrust authorities. Analyzing this market, it emerges that possible abuses may concern both search and display advertising, with particular reference to manipulation of the opaque bidding system for sponsored links leading to exploitative prices on advertisers, preferential treatment for Google's own services in its free (`universal') search and exclusivity clauses for advertisers leading to exclusion of competing platforms. However, the theoretical debate on the role of market leaders in multi-sided markets is still limited: most of the literature on multi-sided markets is focused on monopolistic pricing and symmetric competition between platforms, not on competition between a potentially dominant platform and its followers.

In this chapter, building on the literature on strategic commitments under different entry conditions (Fudenberg and Tirole, 1984; Etro, 2006) and its recent applications to antitrust and contract theory (Etro, 2010, 2011), we advance some preliminary insights on modeling leadership in multi-sided markets. As usual, the incentives to adopt different strategies or pre-commitments depend on the nature of competition, on the entry conditions and on the impact of those strategies or pre-commitments on marginal profitability. First of all, we argue that a model of quantity competition between platforms better characterizes the market for search advertising, while a model of price competition better characterizes display advertising. Second, we argue that online advertising can be realistically characterized by a fixed number of players in the short-medium run. And finally we examine the impact of different pre-commitments on the equilibrium of this multi-sided market. As far as we know, this is the first analysis of asymmetric competition between leaders and followers in multi-sided markets, even if it belongs to a growing body of literature on antitrust issues in multisided markets (Evans, 2003a,b; Behringer and Filistrucchi, 2010).

Our analysis suggests that a platform that has reached dominance in search advertising can have an incentive to limit services to consumers to be more aggressive in the competition for advertisers (a "lean and hungry look" strategy in the classic terminology of Fudenberg and Tirole, 1984), or to exploit its scale in search to build barriers to entry and to adopt price discrimination through opaque click-weighted auctions to manipulate pricing for sponsored links (a "top dog" strategy in the mentioned terminology). On the other side, a platform that has reached dominance in display advertising may increase the rewards of content providers to increase prices on advertisers (a "puppy dog" strategy), or may adopt exclusive clauses to marginalize other platforms or even induce their exit.

The chapter is organized as follows. Section 1 motivates our analysis describing the multi-sided markets of search and display advertising and introducing details of the Google case. Section 2 introduces a simplified version of our model of multi-sided markets and applies it to search and display advertising. Section 3 and 4 discuss the role of a leader in these markets. Section 5 concludes.

1. The structure of the online advertising market

The motivation for this paper derives from recent attention of the leading antitrust authorities on a prominent multi-sided market, the one for online advertising, which is dominated by Google at the global level. In November 2010 the European Commission has started an investigation on potential abuses concerning the preferential treatment for Google services in its free search engine, the manipulation of the pricing system for the sponsored links, and exclusivity clauses or other restrictions for advertisers using

Google services. The potential abuse is about lowering the ranking of unpaid search results of competing services (so-called vertical search services) and according preferential placement to the results of its own vertical search services, lowering the `Quality Score' for sponsored links of these competing vertical search services, imposing exclusivity obligations on advertising partners and restrictions on the portability of online advertising campaign data. The investigation started with the complaints of some European companies in February 2010: a UK price comparison site (Foundem), a French legal search engine (eJustice) and a comparison shopping site (Ciao!). Later on, also Microsoft, one of the main followers in online advertising, submitted its complaint to the European Commission.[i]

Market definition

Online advertising is a multisided market in which platforms such as Google, Yahoo! and others attract at the same time Internet users and companies willing to advertise their products to these users. The more Internet users reach a platform, the more effective is an advertising campaign on the same platform. Since Internet users often join the platform with a commercial purpose in mind and use it to find information on products and offers, advertising can be tailored on them in a much more effective way than with other means. Moreover, continuous technological innovations open new ways for advertisers to be always more effective on a platform online. This generates a very limited substitutability between online and traditional advertising, implying the existence of separate markets, which is confirmed by the outcome of multiple investigations.[ii] In spite of this, Ratliff and Rubinfield (2010) have advanced the hypothesis that some substitutability between online and traditional advertising could exist because they both serve broad advertising goals. However they have not provided any empirical argument in support of such a view and have neglected two key differences. First, traditional advertising is aimed at building a general brand-awareness usually without a specific target audience, while online advertising (especially search advertising) is largely aimed at generating market transactions online. Second, it is not enough to talk loosely about whether or not there is substitutability between two goods or services: there may be substitutability in one direction but not in the other direction, as it may be the case here, since online advertising may act as a competitive constraint on offline advertising without offline necessarily acting as a competitive constraint on online. From this perspective, traditional and online advertising are almost always complements rather than substitutes (or at most can be asymmetric substitutes),[iii] and for our purposes should be considered separate markets.

Within online advertising, one can also distinguish two markets, search and display advertising. Search advertising is aimed at direct demand fulfillment, as witnessed by the "text-only" composition and the payments on a Cost per click (CPC) basis; moreover, platforms compete to conquer the largest number of visitors (that is they compete in quantities) and charge advertisers for the clicks they receive on their ads. Display advertising is mainly aimed at brand awareness and directed to a targeted audience (always more so with new technologies allowing for forms of behavioral advertising that are impossible with traditional media): this is witnessed by the advanced graphic/video composition of the ads and the payments on a Cost per thousand impression (CPM) basis. Since firms pay exactly for what they value, an impression which gives general brand awareness to the web visitor (and not for a click which may, or may not, lead to a market transaction, as in search advertising), platforms can directly compete in prices for display advertising. In these two markets advertisers not only face different forms of pricing, but they actually buy different goods: clicks leading to market transactions with a certain probability on one side, and impressions that promote a brand on a targeted audience on the other side (for one of the first theoretical analysis on market definition in two-sided markets see Filistrucchi, 2010).

Search advertising

As well known, Google is the leading search engine in the world. It reached this position through constant innovations that have improved the search experience (think of Google Instant, Place Search, Real-time Search, Social Search and the Universal Search of course) and provided a wide array of services to Internet users. Beyond this, Google dominates the lucrative business of placing text ads next to search engine results. Google AdWords accounts for more than 70 % of search advertising revenue worldwide, leaving Yahoo! and Microsoft far behind. All these platforms choose a number of advertisements to be made available in a specific order for any search query. Given the space allocated to these sponsored links, an auction pins down the market clearing price for these advertisements. Payments are based on so-called Vickrey auctions between advertisers on the keywords that match the content of the webpages or searches: charges are typically for each click on the ad, and the highest bid for each keyword association wins, with the price given by the second highest bid: as shown by Vickrey (1961), this tends to force bidders to reveal their true evaluation of the click (for classic works on the theory of auctions see Riley and Samuelson, 1981, Myerson, 1981, and Milgrom and Weber, 1982), which allows the auctioneer to choose the profit maximizing auction mechanism. Contrary what is usually claimed (see, for instance, Ratliff and Rubinfleld, 2010) these auctions do not necessarily add a competitive element to online advertising, but allow a dominant firm to adopt complex forms of price discrimination aimed at excluding competitors in search advertising or at extracting all the surplus from the bidders (or even both aims at the same time). The auction process for search advertising is made more complex by the different places where the ad can appear on the search page (on these position auctions see Edelman *et al.*, 2007, Varian, 2007, Agarwal *et al.*, 2009, and Athey and Ellison, 2011), and remains largely obscure to advertisers and competitors. More recently, most platforms have introduced forms of click-weighted auctions that weight bids to give priority to ads with a larger chance to be clicked on: this mechanism is aimed at increasing the effective willingness to pay (see Athey and Ellison, 2011, for the most complete theoretical treatment of this issue).[iv]

The structure of the market for search advertising depends on a particular form of network externality which is quite different from the one emerging in other markets of the New Economy. This is due to two main reasons. First of all, network effects in search are combined with a form of learning by doing: search engines find more relevant results for each query when there are more queries and the subsequent clicks of the users provide information on what were the most relevant websites associated with particular keywords. Through this feedback mechanism, the same users improve the algorithms that govern the search engine. Therefore, not only more search generates more demand for advertising (as in any market with network effects), but more search generates also the scale needed to improve the search technology and provide more relevant results and ads, which in turn generates more search. This is a key difference compared to other markets with network externalities, as those of other software platforms: in traditional platforms the number of consumers determines the demand of application developers but does not affect the quality of the software platform for a given number of applications, while the number of visitors of a search engine determines not only the demand of advertisers but also the (future) quality of the search engine (in terms of ability to reach the most relevant results). This combination of network effects and learning by doing induces initial increasing returns to scale in this market.

As a consequence of the importance of scale in search, for a platform to enter the search advertising market (or increase its market share) and compete with the leader it is crucial to rapidly gain scale and close the technological and information gap on the search queries. At the same time, for a leading platform to maintain its market power it is crucial to protect the information gained through search and limit the scale of

the rivals and their learning by doing. Any exclusivity agreement between the dominant firm and hardware or software distributors to install only its search-related product and services or between the dominant firm and advertisers to rely only on its platform may jeopardize any hope of the competitors to gain scale and compete on the merit (see Argenton and Prufer, 2011). This may be the case of the exclusivity agreements on the Google toolbar or on the search default settings between Google and software vendors as Adobe, hardware vendors as Apple for the iPhone (and others adopting the Android operating system) or browser distributors as Firefox, Safari and Opera. Moreover, scale requires that any search engine must be able to have full access to all websites and "crawl" them to find new information to be provided in search queries. Clearly, if the dominant platform obtains a privileged access to some relevant websites and limits the access of competitors, competition is penalized because raising rivals' costs may exclude some of these competitors. In this case, innovation by the followers is penalized as well. This is what may have happened since the acquisition by Google of YouTube, the main website for video contents, to which access by competing search engines does not appear to be as direct and immediate as for Google.

The second reason for which network effects in search are different from the network effects of many other markets is that multihoming on both sides (by web visitors and advertisers) can easily spread their benefits between different providers. Of course, multihoming by consumers is key to drive the accumulation of information needed to build scale for a minor search engine. The fact that search engines are free and, most of all, are always "one click away" (for surfers) on the Internet plays a double role in this context. On one side, it allows consumers starting from the dominant search engine to easily try alternative ones to test their capabilities or to perform additional investigations whenever the initial search was not fully satisfactory. On the other side, multihoming by consumers allows those who are experimenting a minor search engine to quickly revert to the dominant one jeopardizing the chances of the former to develop and protecting the advantage of the latter. Equally important is multihoming on the advertisers' side. Since advertisers are uniquely interested in the effectiveness of their spending in search advertising, they have good reasons to diversify their investment between alternative platforms in such a way that the marginal returns are equalized. Multihoming guarantees that different Internet users can be reached with different search engines, typically with a higher budget destined to the leading channel (currently Google AdWord) and a smaller budget shared across the others (as Yahoo! Panama or Microsoft AdCenter). Moreover, data analysis can easily allow for a comparison of the return on investment in each channel to optimize spending. It is clear that multihoming by many advertisers would contribute to the development of scale and efficiency of minor search platforms. As a consequence, any policy aimed at limiting multihoming in search advertising (or simply at raising its costs) is going to create obstacles to the creation of network effects. This may be the case for the contracts with which Google prohibits advertisers from using competing platforms, and for the exclusive use by Google of the data on its clients which prevents them from performing data analysis to compare the return on investment of different advertising channels.[v]

Display advertising

The second field of dominance of Google is in display advertising. Google leads the business of directly placing banner ads on third-party publishers, accounting for three quarters of the direct channel, that is, the valuable ad inventory that large web publishers directly negotiate with the advertisers. Of course, a lot of the advertising space available on large websites and all of the space available on small websites cannot be sold in direct negotiations. Therefore, most advertising is typically sold through indirect intermediaries that pay a price for the so-called "remnant" ad inventory from publishers and charge advertisers to fill this space with their ads. Google plays a major role also in this market for intermediation services, providing a vertically

integrated platform between online web publishers and advertisers: Google's AdSense reaches more than 80 % of the ad revenue in the indirect channel with integrated ad networks. The Google platform targets advertising to the relevant websites - so-called contextual advertising (see Athey and Gans, 2010), and pays the web publishers (typically with a percentage of its revenues), but in the absence of any audit or data certification available for the same publishers. Meanwhile advertisers buy inventories from the platform through a bidding system.

Through all the mentioned services, Google controls at least 80 % of the worldwide market for online advertising, and, as confirmed by the sector inquiry by the French antitrust authority, is protected by high barriers to entry. As mentioned, a first source of barriers to entry is related to the importance of scale in search, and the huge lead time that the dominant player has because of the massive amount of data it can draw on to improve its organic search, which is due to the high volume of the search queries that are made and to the fact that Google is a laggard in the industry with respect to the anonymization of user data. A second source of barriers to entry applies both in search and display advertising. Alternatives to Google can be hardly offered to publishers using Google's services: switching to a different publisher tool involves high sunk costs in terms of substantial investments in software, in training the staff, coding all of the data about keywords' association and returns for search advertising or about publisher's web pages and their statistics for display advertising, managing novel datasets, transferring ad campaigns to the system and so on, with all the associated business risk.

This leaves space for multiple potential abuses by the dominant firm, including exploitative pricing on advertisers (with negative indirect consequences on all sectors depending on advertising) made possible through aggressive strategies on the other side (free services to consumers and free distribution of content produced by third parties), exclusivity clauses for advertisers using Google services and restrictions that Google can place on advertisers that wish to use the services of competing platforms. The clarification of these mechanisms requires a wide theoretical work on the role of leaders in multi-sided markets. In the rest of the chapter we provide some preliminary thoughts on this aspect, focusing on fully fledged multi-sided markets with and without a dominant platform.

2. A model of multi-sided platform competition

In this section we will examine a general model where a platform, as an online advertising platform (say Google or Yahoo!), charges for each interaction (pay per click). Denoting with c the marginal cost of an interaction for a platform, the profit of this platform is:

$$\Pi^i = (p_{ai} - p_{ci} - c_i)A_iC_i$$

where p_{ai} is the price charged on advertisers per interaction, p_{ci} can be seen as the cost per interaction to attract consumers, i.e.: the cost of the services freely provided to consumers (in search advertising) or the payment to the content providers (in display advertising), A_i is the number of ads available through the platform, C_i is the number of consumers reached by these ads through the platform, and their product represents (or is proportional to) the number of interactions. The number of consumers reached by an ad for each platform is increasing in p_{ci}, with $C_i = C^i(p_{ci})$. The supply of consumers can also be inverted to obtain $p_{ci} = p^i(C_i)$, which is increasing in the number of consumers. Below we provide alternative microfoundations for this in case of search and display advertising (for further details on search advertising see Etro, 2012). On the other side, an advertiser can choose between different platforms on the basis of their prices. We will adopt a reduced form for the number of ads offered to each platform: $A_i = A^i(p_a)$, where p_a is now the vector

of prices of different platforms. Analogously we can define the inverse demand of advertising as $p_{ai}=p^i(A)$ where A is now the vector of advertisement choices. In general these relations should depend also on the size of the potential consumers because of network effects, but we leave a full derivation of a microfounded model to a following section and Etro (2012), which discusses the changes occurring in this case.

The profit of platform i can be written as a function of the quantity of advertisements and consumers:

$$\Pi^i = [p^i(A) - p^i(C) - c_i)A_iC_i$$

or as a function of the prices for advertisers and publishers:

$$\Pi^i = (p_{ai} - p_{ci} - c_i)A^i(p_a)C(p_{ci})$$

Symmetric forms of competition in quantities and in prices have been analyzed by Armstrong (2006), Rochet and Tirole (2006) and others in detail. Both of them can be useful to describe the two main forms of online advertising, as shown in the next subsections. In the following sections we will move to the analysis of asymmetric forms of competition where one of the platforms is a market leader.

Search advertising

As argued earlier, search advertising can be interpreted in terms of quantity competition. On one side, each platform decides how many consumers will join the platform, typically providing free services that deliver utility for consumers and can be seen as a price paid to them. Natural search results and a vast array of free applications attract visitors on a search engine, making them available for sponsored search as well. Of course, the number of visitors is constrained by the technology available to the search engine and the exploitation of network effects built over time, but a larger number of visitors can be always obtained at a larger cost. To microfound the number of consumers on the platform, assume that platform i provides services with a cost per interaction given by with p_{ci}, and each web visitor k obtains utility $U_k = \theta_k p_{ci} - \overline{u}$ from visiting a platform, where θ_k is a preference parameter, distributed in the population according to a cumulative function $F(\theta_k)$ with density $f(\theta_k)$, and the reservation utility (from visiting other websites) is assumed constant. If total population is N_C, the number of visitors is given by the increasing function $C(p_{ci}) = N_C[1 - F(\overline{u} / p_{ci})]$, which can be inverted to obtain a function increasing in C_i.

On the other side, each platform decides how many ads will be made available on the search engine (typically above or on the right hand side of the natural search results for each query) and an auction pins down the market clearing price $p_a=p(A)$ for these advertisements. More recently, most platforms have introduced forms of *click-weighted auctions* that weight bids to give priority to advertisements with a larger chance to be clicked on (see Athey and Ellison, 2011): this amounts to a sophisticated mechanism aimed at increasing the effective willingness to pay, and therefore the total revenues.

Finally, notice that search advertising is characterized by barriers to entry due to the importance of scale in search, and the huge lead time that the dominant player has because of the massive amount of data it can draw on to improve its organic search (which is due to the high volume of the search queries that are made). For this reason, a focus on exogenous rather than endogenous entry appears proper. In our model, quantity competition between an exogenous number of platforms leads to a symmetric Cournot equilibrium satisfying the first order conditions:

$$p^i(A) - p^i(C_i) - c_i + \frac{\partial p^i(A)}{\partial A_i} A_i = 0$$

$$p^i(A) - p^i(C_i) - c_i - \frac{\partial p^i(C_i)}{\partial C_i} C_i = 0$$

which can be rewritten in terms of a Rochet-Tirole (2003) rule:

$$p_{ai} - p_{ci} - c_i = \frac{p_{ai}}{\varepsilon^i(A)} = \frac{p_{ci}}{\varepsilon^i(C_i)}$$

where the two elasticities at the denominators are respectively the elasticity of demand of advertising and the elasticity of supply of consumers. The equilibrium markups for each platform are decreasing in the relevant elasticities and in the marginal cost per interaction, but the relative charge on advertisers increases in the elasticity of demand of advertising and decreases in the elasticity of supply of consumers.

Display advertising

Display advertising is better described through price competition. On one side, each platform decides how much to reward the content providers that make available some space for advertising, choosing a price for each interaction between visitors and ads, or a percentage of the price paid by the advertisers.

More formally, to derive the supply of content as a function of the price offered by a platform, let us consider a content provider that decides C_j for each platform to maximize revenues net of the costs, which are proportional to the number of ads and increasing and convex in the number of consumers reached by them: in practice, we assume that advertising reduces the net utility of the web experience and, through this, the other revenues of the content provider. Therefore, the profits of the content providers are:

$$\pi^C = \sum_j p_{cj} A_j C_j - A_j g(C_j)$$

with the cost function $g(.)$ increasing and convex. Profits are maximized when the following first order condition is satisfied $p_{ci} = g'(C_i)$. This is an increasing function of the number of consumers made available, and provides a direct supply, increasing in the price. For simplicity, we have excluded substitutability between different platforms: this reflects the fact that most content providers adopt a single platform to reach advertisers.

On the other side, each platform decides the prices for the advertisers, depending on a number of features of the host website and of the same ads. Also in this case, the price of the advertisers is selected by an auction mechanism, but the wide and increasing mechanisms of price discrimination adopted by the online platforms to maximize revenues leads to an outcome that can be generally described in terms of price setting. Given prices, the demand function determines the equilibrium amount of ads (after all, space for ads on websites is unconstrained). Also in display advertising, entry is not endogenous because of substantial barriers to entry: alternatives to Google can be hardly offered to publishers using Google's services (switching to a different publisher tool involves high sunk costs in terms of substantial investments in software, in training the staff, coding all of the publisher's web pages, creating novel datasets, transferring ad campaigns to the system and so on, with all the associated business risk).

Price competition between platforms leads to a symmetric Bertrand equilibrium satisfying the first order conditions:

$$A^i(p_a) + (p_{ai} - p_{ci} - c_i)\frac{\partial A^i(p_a)}{\partial p_{ai}} = 0$$

$$-C(p_{ci}) + (p_{ai} - p_{ci} - c_i)C'(p_{ci}) = 0$$

which can be rewritten in terms of a Rochet-Tirole (2003) rule as:

$$p_{ai} - p_{ci} - c_i = \frac{p_{ai}}{\gamma^i(p_a)} = \frac{p_{ci}}{\gamma^i(p_{ci})}$$

where now the elasticities are respectively the elasticity of the direct demand of advertising and the elasticity of the direct supply of content. These rules are valid whenever some regularity conditions hold, otherwise extreme pricing rules can easily emerge, with zero price on one of the two sides (see Schmalensee, 2010). The equilibrium markups for each platform are decreasing in the relevant elasticities and in the marginal cost per interaction, but the relative charge on advertisers increases in the elasticity of demand of advertising and decreases in the elasticity of supply of content. Under regularity conditions, an increase in the number of platforms tends to reduce profitability and mark ups.

Contrary to what assumed until now, however, multi-sided markets are often characterized by the leadership of a firm, which creates the case for a strategic rationale behind pricing, to which we now turn for the rest of the paper. We will consider quantity and price competition in order in the following two sections.

3. Quantity leadership in search advertising

Consider now a situation in which one platform can act as a leader in the choice of a strategic variable and, therefore, precommit to it before competition with the other platforms takes place. In this section we examine this possibility in the application to search advertising, that is assuming that competition in quantities takes place between platforms to conquer ads. As long as the number of platforms is exogenous, we are in the situation characterized by Fudenberg and Tirole (1984) under the assumption of strategic substitutability.

Imagine that the dominant platform 1 can anticipate the choice of how many consumers to attract on the platform, C_1. In other words, in a first stage firm 1 chooses C_1 and in a second stage firms 1 and 2 choose C_2, A_1 and A_2. To verify the incentives of the leader to invest in attracting consumers, we need to look at the equilibrium cross-effect:

$$\frac{\partial^2 \Pi^1}{\partial A_1 \partial C_1} = -\frac{\partial p^1(C_1)}{\partial C_1} < 0$$

In the terminology of Fudenberg and Tirole (1984), this implies that we are in a "lean and hungry look" case: a leader has a strategic incentive to restrict or bias the size and quality of services made available on the platform, so as to decrease the utility of the consumers per interaction with the purpose of being more aggressive against the other platforms in the competition for the ads. Examples of this may include underinvestment in new services once dominance has been reached, preferential treatments for the services offered by the platform in the search engine (with limitations on the use of other services) and manipulation

of the natural search results to promote objectives of interest for the dominant firm (as promoting its own services or excluding competitors in particular services). The consequence is that the dominant platform reduces the gains of the consumers but conquers a larger share of total ads.

As an example, assume that there are two platforms and the cost per interaction is the same, c. The optimality conditions derive from the first order conditions for C_2, A_1 and A_2, which implicitly determine how these variables depend on C_1, and from the optimality condition for the precommitment variable, which is simplified because C_2 does not affect directly the profitability of the leader, and the impact of A_1 disappears by the envelope theorem. After straightforward manipulation, the equilibrium conditions can be expressed as:

$$p_{a1} - p_{c1} - c = \frac{p_{a1}}{\varepsilon^1(A)} = \frac{p_{c1}}{\varepsilon^1(C_1)} + \frac{\eta p_{a1}}{\zeta}$$

$$p_{a2} - p_{c2} - c = \frac{p_{a2}}{\varepsilon^2(A)} = \frac{p_{c2}}{\varepsilon^2(C_2)}$$

where $\zeta = -p_{a1}/A_2[\partial p_{a1}/\partial A_2] > 0$ and $\eta = (\partial A_2/\partial C_1)C_1/A_2 > 0$. This implies the modified Rochet-Tirole rule:

$$\frac{p_{a1}}{\varepsilon^1(A)} = \frac{p_{c1}}{\varepsilon^1(C_1)\left[1 - \frac{\eta \varepsilon^1(A)}{\zeta}\right]}$$

under the regularity condition $\varepsilon^1(A) \in (0, \zeta/\eta)$. A simple comparison of the equilibrium conditions under un symmetric and asymmetric competition shows that the dominant platform manages to increase its profits through an increase of the effective markup $p_{a1}-p_{c1}$, which requires a reduction of the reward of the consumers in terms of both services per interaction (p_{c1}) and size of the market (C_1) and generates an increase of its share of advertising $A_1/(A_1+A_2)$. Clearly, this is going to reduce consumer surplus compared to the case of symmetric competition. The impact on the advertisers is more complex but the price reduction is likely to end up in gains for this side of the market (the same would happen with free entry; see Etro, 2006).

Scale in search

Consider now a different precommitment of the leader. Suppose that the dominant platform can reduce its marginal cost per interaction through direct investments and through a process of learning by doing in service provision: in search advertising this happens because of the importance of scale in search and because of the huge lead time that a dominant player has because of the massive amount of data it can draw on to improve its organic search. Suppose that the number of visitors improves the search algorithms and reduces the cost of obtaining each click $c(C_i)$, with $c'(C_i) < 0$. As shown by Fudenberg and Tirole (1984) in the presence of barriers to entry, the nature of the incentives depends simply on the equilibrium cross-effect:

$$\frac{\partial^2 \Pi^1}{\partial A_1 \partial C_1} = -\frac{\partial p^1(C_1)}{\partial C_1} - c'(C_1) < 0$$

which is now ambiguous: the first factor is negative as before, but the second is positive because of the gains from scale. If the latter prevails, the dominant firm has an incentive to overinvest to create scale in search ad

reduce its cost per interaction. Moreover, the leadership is going to strengthen itself automatically as long as it leads to a quicker learning by doing process which reduces costs per interaction and provides an advantage in the conquest of larger market shares in advertising. The first mover advantage can easily lead to conquer the entire market: if it takes time to conquer visitors and improve the search algorithms, this can lock in the market into a monopolistic situation (as in Argenton and Prufer, 2011).

Click-weighted auctions

Most search platforms have introduced forms of click-weighted auctions that weight bids to give priority to ads with a larger chance to be clicked on (see Athey and Ellison, 2011): this amounts to a sophisticated mechanism aimed at increasing the effective willingness to pay, and therefore the total revenues. Similar systems have been introduced by Google and then by other platforms and represent crucial commercial secrets for this business.

Suppose that the dominant platform can introduce a mechanism of click-weighted auctions which increases the willingness to pay for ads on the platform. The mechanism is indexed by the parameter ϖ, which can be seen as the accuracy in discriminating between valuable and less valuable advertisers, or simply as the cost of development of the mechanism, which should be positively related to its accuracy. The profits of the leading platform are:

$$\Pi^1 = [\, p^1(A, \varpi) - p^1(C_1) - c_1)A_1C_1$$

A higher ϖ increases the inverse demand function for each interaction to $p^1(A, \varpi)$, but this impact is likely to be reduced when the level of advertising on the platform is larger. Therefore, we assume that the elasticity of $\partial p^1(A, \varpi)/\partial \varpi$ with respect to A_1 is less than unitary ϖ, which determines the sign of the following marginal effect:

$$\frac{\partial^2 \Pi^1}{\partial A_1 \partial \varpi} = \left[\frac{\partial p^1(A, \varpi)}{\partial \varpi} + \frac{\partial^2 p^1(A, \varpi)}{\partial A_1 \partial \varpi} A_1 \right] C_1 > 0$$

This cross effect suggests that we are in front of a classic "top dog" strategy in the terminology of Fudenberg and Tirole (1984): a dominant platform should overinvest in the development of a click-weighted auction mechanism. In case of two platforms, the equilibrium conditions would be given by the traditional Rochet and Tirole (2003) rules plus an optimality optimality condition for the choice of the strategic variable ϖ, which compares its marginal cost to the following marginal revenue:

$$\frac{\partial p^1(A, \varpi)}{\partial \varpi} + \frac{\partial p^1(A, \varpi)}{\partial A_2} \frac{\partial A_2}{\partial \varpi}$$

The second positive term shows that there is a strategic incentive to overinvest in sophisticated pricing mechanism that manipulate the willingness to pay of the advertisers, because this shifts advertising from other platforms to the dominant one. The higher marginal revenues per click induce the dominant platform to expand both its services to consumers and its space for advertisement, while reducing their counterparts for the competing platforms. Nevertheless, the higher willingness to pay (bid) for advertising induced by the enhanced mechanism may even increase the price charged by the leading platform on advertisers. In this

sense, these mechanisms may generate a non-transparent manipulation of the pricing system for the sponsored links which can limit competition.

Network effects that induce an increase in the willingness to pay for ads on platforms with more visitors can be easily introduced - see Etro (2012) for a microfounded model of quantity competition with network effects that generalizes the one above, and for its solution. Under some additional restrictions, the tendency of market leaders to restrict the services provided to the web visitors (to be more aggressive in advertising) persists. A counteractive force, however, emerges because a larger base of web visitors increases the willingness to pay of the same advertisers on the platform. If network effects and scale in search effects are strong enough, as we would expect given their importance in the market for search advertising, they induce a tendency for the dominant firm to overinvest to conquer visitors and lock in the market into a monopolistic outcome in which followers do not manage to catch up.

4. Price leadership in display advertising

Let us move to the case of price competition, which is the usual assumption in theoretical models of two-sided markets and allows us to better describe the market for display advertising. As long as the number of platforms is exogenous, we are in the situation characterized by Fudenberg and Tirole (1984) under the assumption of strategic complementarity.

As an example, assume that there are two platforms and the cost per interaction is the same, c. Imagine that the dominant platform 1 can precommit to the strategy adopted toward the content providers, i.e. the choice of the price for interaction destined to the content providers p_{c1}. In other words, in a first stage firm 1 chooses p_{c1} and in a second stage firms 1 and 2 choose simultaneously p_{c2}, p_{a1} and p_{a2}. To verify the incentives of the leader, we need to look at the cross-effect:

$$\frac{\partial^2 \Pi^1}{\partial p_{a1} \partial p_{c1}} = -\frac{\partial A^1(p_a)}{\partial p_{a1}} > 0$$

In the terminology of Fudenberg and Tirole (1984), this implies that we are in a classic "puppy dog" case: a leader has an incentive to choose a high reward of the pulishers for each interaction with the advertisers, with the purpose of softening competition with the other platforms for the advertisers. The consequence is that the dominant platform increases the gains of the content providers, but increases also the price obtained by the advertisers above that of the other platforms.

The equilibrium conditions can be easily rearranged as:

$$p_{a1} - p_{c1} - c = \frac{p_{a1}}{\gamma^1(p_a)} = \frac{p_{c1}}{\gamma^1(p_{c1}) + \vartheta\zeta}$$

$$p_{a2} - p_{c2} - c = \frac{p_{a2}}{\gamma^2(p_a)} = \frac{p_{c2}}{\gamma^2(p_{c2})}$$

where $\vartheta = p_{c1}[\partial p_{a2}/\partial p_{c1}]/p_{a2} > 0$ and $\zeta = -(\partial A^1(p_a)/\partial p_{a2})p_{a2}/A_1 > 0$. This immediately leads to the result that the dominant firm manages to increase its profits through an increase of the reward of the content providers (p_{c1}), and an increase of the price of advertising (p_{a1}). Strategic complementarity leads the other platforms to increase their prices on advertisers as well. Publishers may be better off, but the advertisers will have to pay

more for each interaction on every platform, which may ultimately lead to negative consequences on this sector and on the firms paying for the ads.

Let us briefly look at other forms of precommitment. In this case, a dominant firm that has reached the leadership would have low incentives to invest to reduce the cost per interaction. However, we can still have the tendency to overinvest in implementing sophisticated pricing schemes aimed at price discrimination toward the advertisers (think of the attempts to introduce forms of pay per action, which is directly associated with the final transactions). To verify this, imagine that demand is increased by ϖ defined as before. The relevant cross effect is:

$$\frac{\partial^2 \Pi^1}{\partial p_{a1} \partial \varpi} = -\frac{\partial A^1(p_a, \varpi)}{\partial \varpi} + \left(p_{a1} - p_{c1} - c\right)\frac{\partial^2 A^1(p_a)}{\partial p_{a1} \partial \varpi} > 0$$

which is positive if the second term is positive or not too negative (which is reasonable). In this case, sophisticated pricing is also aimed at softening competition with other platforms.

Finally, notice that the existence of barriers to entry is crucial for these effects to be at work, since in case of endogenous entry any accommodating practice would be self-defeating for attracting additional entrants (Etro, 2006, 2011).

Mergers

In a context of price competition as the one described above, there is another puppy dog strategy that can be adopted, which takes place through a merger with a rival. This allows the merged entity to increase prices on advertisers and, as long as entry is exogenous, to increase profits.

In our view, this is exactly what happened in the market for display advertising when Google acquired its main rival, DoubleClick, in 2008. As with Google's AdSense, DoubleClick offers an ad serving/management product, DART, for both publishers (DFP) and advertisers (DFA). The publisher tool, in particular, manages the inventory of a website, receives the ads from ad networks and delivers them in the relevant inventory (according to the behavioural history of Internet users), usually for a percentage of the price charged by the publishers on the advertisers. Before the merger, Google was controlling about half of the global market for display advertising and DoubleClick about a third of it. Today, they jointly control at least 80 % of the worldwide market. Most important, the merger has led to softer competition. The two services offered by Google and DoubleClick are highly substitutable and, as a matter of fact, many web publishers use both for different inventories in the same website. The high switching costs, together with the difficulty for other companies to build alternative high quality intermediation services (even Yahoo! and Microsoft had a hard time), represent a substantial limit to endogenous entry of other firms in the short/medium run.
The implication is simple. Before the merger, competitive forces kept prices under control: DoubleClick could not increase prices because many consumers would have quickly switched to AdSense, and vice versa. After the merger, these competitive constraints have disappeared: Google could increase the price of DFP services, sure that most of the lost customers will switch to AdSense. The profitability of the price increase would be enhanced further because of the high margins and of the network effects that Google could enjoy by increasing its market share.

A similar result is emerging in display advertising for mobiles, whose largest provider and main rival of Google, AdMob, has been acquired by Google in November 2009. Another related case could emerge with

the latest acquisition under consideration by Google, the one of ITA Software, a flight information company (whose software is used by some of the leading travel sites as Travelocity, Orbitz and others). This may lead to accommodating strategies also in the market for price comparisons on the Internet.

Exclusivity agreements

What happens if a dominant firm adopts exclusivity clauses toward its advertisers or other restrictions for advertisers using its services? Our model suggests a simple consequence of similar agreements in terms of a standard strategy of entry deterrence. If the dominant platform has a technological advantage (say a lower cost per transaction), exclusivity clauses allow this platform to protect its comparative advantage in attracting both content providers and advertisers. Losing content providers and advertisers, the other platforms may even fail to cover their fixed costs and exit the market, in which case the exclusivity clauses would be predatory. Advertisers, and ultimately consumers, may be worse off, both because the price would increase and because there would be a reduction of variety in the provision of advertising.

5. Conclusions

In this chapter we have analyzed the role of leadership in multi-sided markets, with a particular emphasis on online advertising, which is characterized by a single dominant firm in both search and display advertising. The case of quantity competition better characterizes the market for search advertising, while the case of price competition better characterizes display advertising. In both cases the borders of the market should be limited to online advertising, which potentially leads to market transactions (as opposed to offline advertsing). We have shown that a platform that has reached dominance in search can have an incentive to limit services to consumers to be more aggressive in the competition for advertisers or to adopt click-weighted auctions to manipulate the pricing for sponsored links. A platform that has reached dominance in display advertising may increase the rewards of content providers to increase prices on advertisers, or may adopt exclusive clauses to predate on other platforms. Comparing these results with the market for online advertising, it emerges that possible abuses by Google may concern both search and display advertising, with particular reference to exploitative prices on advertisers, preferential treatment for Google's own services in its free (`universal') search and exclusivity clauses for advertisers. Additional research on the antitrust implications of asymmetric models of competition in multisided markets appears fruitful to better understand the structure of these markets and the appropriate antitrust policies.

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[i] Other complaints have been also filed in front of the US, German and Italian authorities, mainly regarding unfair competition with publishers and other content providers. The French competition authority has also carried out a consultation, concluding in December 2010 that Google holds a dominant position both in search-related advertising and contextual advertising and that "competition law can apply limits to Google's actions and provide a response to the competitive stakes brought to light by the actors, without the need to implement sector-wide regulations." Some constraints to the activity of Google have been decided also in Italy in January 2011, but the main antitrust debate will take place at the EU level.

[ii] See the Google/DoubleClick investigations by the European Commission and the U.S. Federal Trade Commission and the Microsoft/Yahoo! investigations by the European Commission, the U.S. Department of Justice and the Australian Competition Commission.

[iii] Analogously, Amazon may compete with traditional bookstores, but does not compete with traditional advertisers of books (whose services actually promote the business of Amazon rather than being substitutes for it). For a theoretical investigation on the relation between traditional and online advertising see Athey, Calvano and Gans (2011) and Blasco, Pin and Sobbrio (2011).

[iv] The lack of transparency of this pricing and ranking scheme, when implemented by a dominant firm, could easily hide abusive forms of exclusionary behavior, predatory strategies against competing services specialized in providing users with specific online content (price comparisons), price discrimination or even exploitative pricing toward selected advertisers. For instance, an exclusionary behavior was identified by the French national competition authority when Google suspended the AdWords account of a French company providing online services (Navx); Google was subsequently forced by the competition authority to re-establish the account.

[v] Besides general search engines, some search platforms focus on specific issues, as news, travel information, academic works, finance, videos, maps, and more: since these services offer a deeper information within particular fields, they are usually referred to as vertical search services. To be reached and used (as for any website) these vertical services rely on general search engines as Google. In the last years Google has also introduced new services, some of which raise serious concerns not only about antitrust, but also about copyright protection (Google Books) and privacy (Youtube and Google Maps with Street View, which emerged ignoring any privacy regulation). This is particularly evident in terms of predatory pricing or free riding against content providers, whose information is freely aggregated and displayed by Google News. On this front, the Italian and French competition authorities have obliged Google to guarantee that press publishers will be able to request and obtain exclusion from Google News, but without being de-listed from the general search. On the antitrust front, the new services of Google have rapidly gained success over competing vertical search services, but possibly with the help of manipulated ranking in the natural search of Google, which ends up marginalizing any competing vertical engine (Tarantino, 2011). As long as a dominant search platform gives priority to its own vertical services and diverts traffic away from its competitors, it is destined to reach leadership in any service provided, hurting competition on the merit. Moreover, alternative specialized search engines are the only entry constraints that Google could face in the short and medium run, and protecting their viability is crucial to protect competition.