

Competition in the web search market

A report for Microsoft

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Executive summary

Web search engines have become very important for users and online advertisers since their rise in the early 1990s. Search engines are popular with users, as they offer ordered access to the continuously increasing amount of available web content. Search engines are also highly valued by advertisers, as they offer targeted access to users by matching advertisements to the key words of search queries. This concept has proven to be extremely successful and search engines have developed into a billion dollar business.

The growth of the search engine business has been concurrent with a strong market concentration process. Today there are only a few big players left. Google, the largest search engine, receives 62 percent of search queries worldwide. Yahoo!, the second largest player, accounts for 10 percent. The rapid development of only a very few big firms that dominate the market gives rise to fears about potential abuse of market power. With these concerns in mind, this paper analyzes the forces that determine competition among web search engines and evaluates the possible outcomes for the market.

We observe that the concentration process is driven by the cost structure of the industry and network externalities of search engine products. In particular, the industry is characterized by high fixed and mostly sunk costs, since providers are required to operate a huge server infrastructure and finance-intensive R&D activities. Switching costs for users and advertisers are also high. This cost structure acts as a barrier to entry, which prevents new players from entering the market and reducing concentration. Furthermore, network externalities produce a concentration-driving feedback loop. A dominant search engine has access to the most information on past user behavior and personal preferences of individual users, enabling it to best improve the quality of its search results. Improvements attract more users and advertisers, increasing the information available to the search engine. Better information allows the search engine to produce even better results, further driving user concentration around the dominant player. Thus it is increasingly difficult for smaller competitors to enter the market and to gain market share, while the position of a dominant firm is ever harder to contest. Eventually, these forces are likely to create a winner-takes-it-all competition in which a single firm wins the market.

Once the likelihood of market concentration has been established, this paper turns to an analysis of the incentives and opportunities for market power abuse. We conclude that there

exist clear incentives for a dominant web search provider to abuse its market power. With regard to users, the firm can take advantage of significant information asymmetries and provide suboptimal search results, redirecting the user's attention to sponsored advertisements which provide revenue for the search engine. With regard to advertisers, a dominant provider can prevent certain competitors from advertising on its websites, and leverage its market power into other areas of the online advertising market. In addition, a dominant search engine can distort competition by displaying links to its own products and services in more prominent positions within its organic search results.

Given the strong concentration forces in today's markets and the many possibilities for market power abuse, policy makers and regulators need to think wisely about potential preventive measures. On the one hand, any policy intervention needs to carefully consider its impact on the incentives for web search providers to further improve the quality of their services. Web search is a capital- and innovation-intensive business which has greatly improved the economic and non-economic benefits of the internet, and this innovation should not be unnecessarily stifled. On the other hand, it is unrealistic to assume that a dominant firm will simply generate valuable innovations for internet users and advertisers without attempting to abuse its position if such abuse is found to be profitable. Given the extent to which search engines control the sorting and shaping of online information, the accumulation of power in the hands of a commercial search engine without policy-based mitigation is likely to cause harm to both users and advertisers. Hence, policy makers must seek to gradually improve transparency in the industry and to limit the potential benefits to search engines from market abuses, while maintaining strong incentives for further growth and innovation.

As an initial guide for policy makers, this analysis closes by discussing relevant policy options. In addition to highlighting the necessity of further research on the dynamics of competition in the web search market, we offer concrete intervention schemes that include mandatory information sharing and third party auctions of ad inventory. The most dramatic intervention would be the unbundling of Google's computing grid in order to stimulate competition among web search providers based on different search algorithms, just as unbundling in network industries such as energy and telecommunications has stimulated competition. The choice now lies in the hands of policy makers, and the final decision will require more detailed research and policy formulation. However, the analysis conducted in this paper implies that policy intervention in the search engine market is a question of timing and scope; the need for intervention is no longer in doubt.

1. Introduction

With the rise of the internet since the beginning of the 1990s, the amount of information on the web has increased dramatically. Access to this information has become increasingly important. Consequently, web search engines have experienced rapid growth. While initially, only a small number of tech-savvy people used search engines, today nearly 600 million searches are conducted every day (Rashtchy et al., 2007, p.155). In 2007 almost half of US internet users (49 percent) used search engines on a typical day, compared to 30 percent in 2004 (Fallows, 2008). With strong further increase of information, products and services on the web, future growth of the search engine market seems to be assured.

The rise of internet search went along with a boom of online advertising. Internet advertising revenues in the United States increased more than twenty fold from around 0.9 billion US-Dollars in 1997 to 23 billion US-Dollars in 2008 (IAB, 2009). The boom of internet search and advertising was also concurrent with a tendency of increasing market concentration. Only a few firms emerged as winners.¹ Today the three big global players Google, Yahoo!, and Bing (former MSN) control 78 percent of the market worldwide (ComScore, 2008a). Google – the market leader – reached a market capitalization of more than 140 billion US-Dollars in 2009.² Both Google and Yahoo! are among the most valuable brand names worldwide (Interbrand, 2008).

The emergence of Google as a leading search engine gives rise to fears about a potential abuse of market power. This paper evaluates these possible concerns through an analysis of the forces that determine the competition between web search engines and the possible outcomes of competition for market players. The analysis is organised in four parts. Chapter 2 provides a broad description of the web search industry from an economic perspective with a focus on the special characteristics of the two main activities – organic web search and advertising – that are relevant in the web search industry. In chapter 3 we explore the nature of competition in the search engine industry. We find that because the specific characteristics of this industry induce scale economies and positive network effects with feedback loops, a winner-takes-it-all competition is likely to occur. Moreover, the existence of high barriers to entry implies that such a monopoly structure is increasingly hard to contest. Chapter 4

¹ An overview about the history of search engines and their relationship can be found at Bruce Clay Inc. <http://www.bruceclay.com/searchenginereationshipchart.htm>.

² Yahoo Finance: <http://finance.yahoo.com/q?s=GOOG>, assessed June 9, 2009

discusses the incentives for a dominant firm to abuse its market power at the expense of both users and advertisers. We find incentives for a leading search engine provider to provide search results of suboptimal quality by placing product links on prominent positions within the search results, thereby increasing its revenues from advertising and promote its own products. We also find that the provider might abuse its position at the expense of advertisers, e.g. by hindering competitors from advertising on its web sites or by leveraging its market power into other areas of the online advertising business. In light of these findings, the final chapter discusses remedies that regulators and policy makers might introduce to prevent a dominant search engine provider from abusing its market power.

2. Description of the web search industry

The purpose of web search engines is to make the information on the web available to their users. Google, for instance, states as its mission: “[...] to organize the world’s information and make it universally accessible and useful” (Google, 2008, p.1). Typically, web search engines do not charge their users for their services. In fact, the provision of web search has turned profitable only after their providers began to sell their users’ attention to advertisers.³ By submitting a search query, users reveal private information about their current interests. This information enables advertisers to precisely target advertisements to users’ needs. Thus search engines operate in a two sided market, providing a connecting platform for searches and advertisers (Armstrong, 2006; Evans and Schmalensee, 2005). The distinguishing characteristic of such a two sided platform is that customers on both sides (users and advertisers) need one another but lack a means of connection. The platform helps customers to get connected and thereby creates value for both sides. The fact that only the advertisers side of the market is charged for using platform services indicates how highly advertisers value this access to users’ attention.

This chapter discusses the main characteristics of both sides of the search market in more detail. Section 2.1 focuses on organic web search and section 2.2 deals with advertisement. Finally, in section 2.3 we briefly discuss the cost structure of search engine providers.

³ This was first practiced in 1995 when Infoseek targeted banner ads to keywords that users entered (Evans 2008, p.369). In 1998 GoTo (later Overture, 2003 acquired by Yahoo) introduced the first clearly marked ads alongside search results (Evans 2008, p.369; Fain & Pedersen 2006, p.12).

2.1 Organic web search

The central function of web search engines is to provide the most relevant links to a query based on the content available on the web. The central portion of content provided to the user of a search engine are organic search results, which are the results generated through a search engine's own information sorting processes. These organic results should be distinguished from paid search results (advertising), which will be discussed further in later sections of this paper. In order to provide organic search results, search engine providers regularly explore the web and rank its content so that they can answer specific search queries as well as possible. The procedures and principles underlying such content rankings are proprietary information which allows the respective providers to distinguish their results from one another. Hence, this information constitutes highly confidential business secrets.

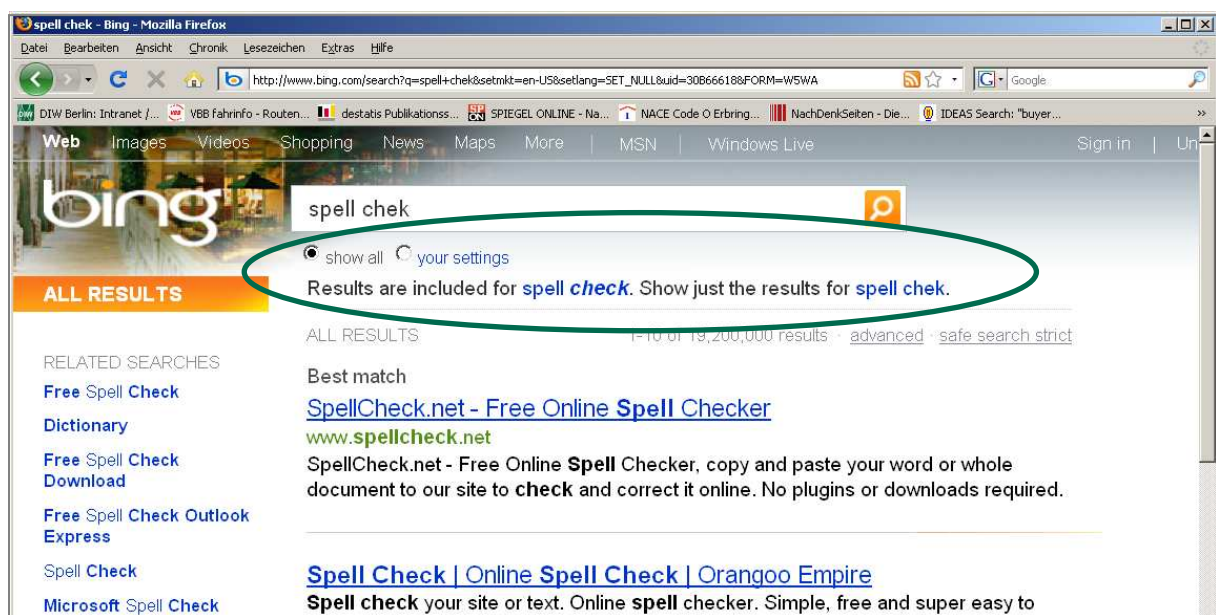
Nevertheless, some basic principles and processes of how search algorithms work are commonly understood:

- **Crawling and indexing:** Search engines rely on hard- and software to crawl the web and create an index of web site content (Hargittai, 2008; Lewandowski and Höchstötter, 2007; Machill et al., 2007). When a query is submitted to a search engine the algorithm matches the query keywords as closely as possible to this index, thereby also considering if the specified terms appear in the title or in various tags of different web sites.
- **Reputation:** A web site's reputation is important for improving the ranking of different search results (Hargittai, 2008; Lewandowski and Höchstötter, 2007; Machill et al., 2007). Reputation of a specific web site is commonly measured by the number of links on other web sites that point to it. In particular, links from popular, well-established web sites improve the ranking of a specific web site.
- **Past user behaviour:** Historical data on previous search queries is permanently used to improve search results (Machill et al., 2007). For instance, incorporating user behaviour on past queries can significantly improve the ranking of search results (Agichtein et al., 2006; Fagni et al., 2006). For the top positions, such improvements are particularly strong.⁴ Hence, the ability of a search algorithm to incorporate such implicit feedback is an important success factor.

⁴ Agichtein et al. (2006, p.6) for instance report show that incorporating implicit feedback can augment other features, improving the accuracy of a competitive web search ranking algorithms by as much as 31% relative to the original performance.

A demonstrative example of how a search engine efficiently uses information from past queries to improve its service is the spell check. Using information from past user behaviour, major web search engines such as Google, Yahoo! or Bing offer alternative suggestions for search queries that appear to be incorrectly spelled. As shown in the following example, Bing understands that there might be a spelling mistake in the query “spell chek” and includes search results for the more commonly used query “spell check”:

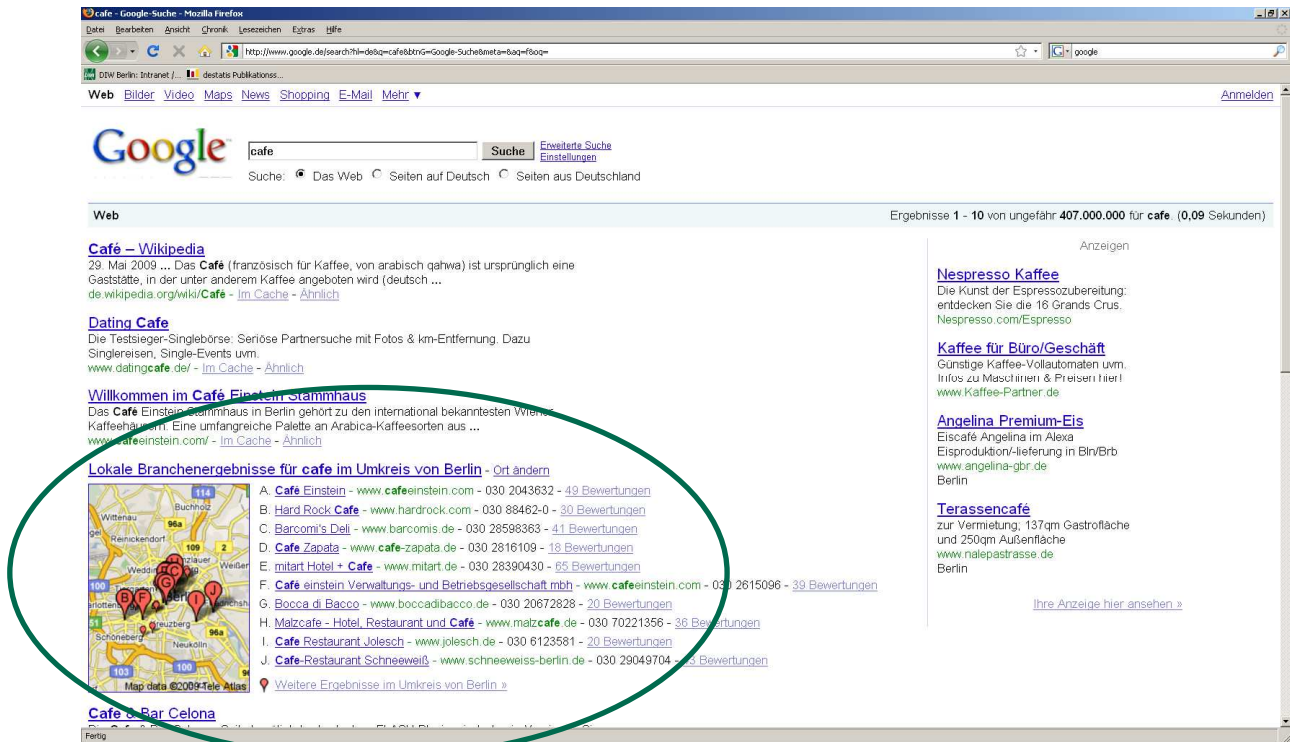
Figure 1: Example of Bing’s spell check option



Source: Bing.com – assessed in June 2009.

- **Personalized search:** The major web search providers automatically receive and record a vast amount of personalized information as well as information on user searches, including URL of the page requested, computer IP addresses, browser type and language and unique cookie information (Godoy, 2006). Using this information is important for improving search results and tailoring them to the specific user needs (Machill et al., 2007, p.12). For example, the geographic information of an IP address is often used to narrow down search results. To illustrate this, Figure 2 shows search results for “café” in Google Germany. The search query was sent from a computer in Berlin. Google first displays three general search results for “café”, followed by a list of coffee shops in the area of Berlin.

Figure 2: Example of Google using IP address information to improve search results



Source: Google.com – assessed in June 2009.

Although all algorithms used by the major search engines are based on these principles, there remain substantial differences. In particular, the services they provide to users differ in search quality, access to search platforms, and by additional provided features.

- The **quality** of a specific search engine can be measured by different criteria such as the *precision* (number of *relevant results* relative to all reported results for a certain query) and *uniqueness* of the results it provides. For both measures, empirical investigations demonstrate clear differences. In Germany, for example, Lewandowski (2008, p.20) finds that the five major providers (Google, Yahoo!, MSN, Ask, and Seekport) realise precision values for their first 20 results in a range from 37 to 52 percent. Spink et al. (2006) report that out of the top-ten results of four search engines (Google, Yahoo!, MSN and Ask), 85 percent are unique to only one engine and 12 percent are unique to two engines. Out of all top-ten results, only 2.6 percent were found by three and only 1.1 percent by all four search engines.

A major factor underlying the quality of a search engine is the web coverage and up-to-datedness of its index. It is especially noteworthy that indexes are not always complete and web coverage differs greatly across countries and regions. Vaughan and Thelwall

(2004), for instance, estimate that the three search engines Google, AltaVista and AllTheWeb realise coverage levels from 80 to 87 percent for all US-based web sites, while for web sites in China their coverage is only between 52 and 70 percent. With regard to the indexing depth (defined as the share of pages on a web site that is indexed by the search engine) the authors find a depth of 89 percent for US web sites compared to 22 percent for Chinese web sites.

Finally, the design of the interface and presentation of search results are important determinants of a search engine's quality. In particular, users value an intuitive user interface for all available search features and functions such as picture- and map search or translation of search results.

- A second important difference across search engines is their **accessibility**. All major search engines can be used free of charge by typing a specific web address into a web browser. Access can be further facilitated through specific toolbars which are embedded in all commonly used internet browsers (see e.g. Figure 3). This enables web surfers to start a search without having to call the search engine's web site first.

Figure 3: Example of toolbars for Google and Yahoo! search in Firefox



Source: DIW econ.

Some web sites also offer search functions that are operated by web search engines. For example, the energy policy website of the EU Commission redirects users who wish to search the Commission's website to Google (Figure 4).

Figure 4: Use of Google as search provider on a website of the EU commission



Source: http://ec.europa.eu/energy/index_en.htm – assessed June 25, 2009.

- Finally, providers also differentiate their search engines by providing **specific features** such as search in images, maps, books, groups or news, or other additional features such as email, picture management, video portals or general internet portals.

2.2 Search-based advertising

The online advertising market can be separated into search-based and non-search-based advertising markets (EU Commission 2008). Whereas search-based ads are displayed next to organic search results on a given provider's interface, non-search ads are placed on a specific publisher's⁵ site. Advertisements can also be differentiated into contextual and non-contextual ads. In contrast to non-contextual ads, contextual ads are matched to the specific context of a web site, the specific interest of a user, or both. Furthermore, ads are distinguished according to their appearance as "text" or "display" (for example banner ads). The following table clarifies the common classification structure of online advertisements:

Table 1: Structure of the online advertisement market

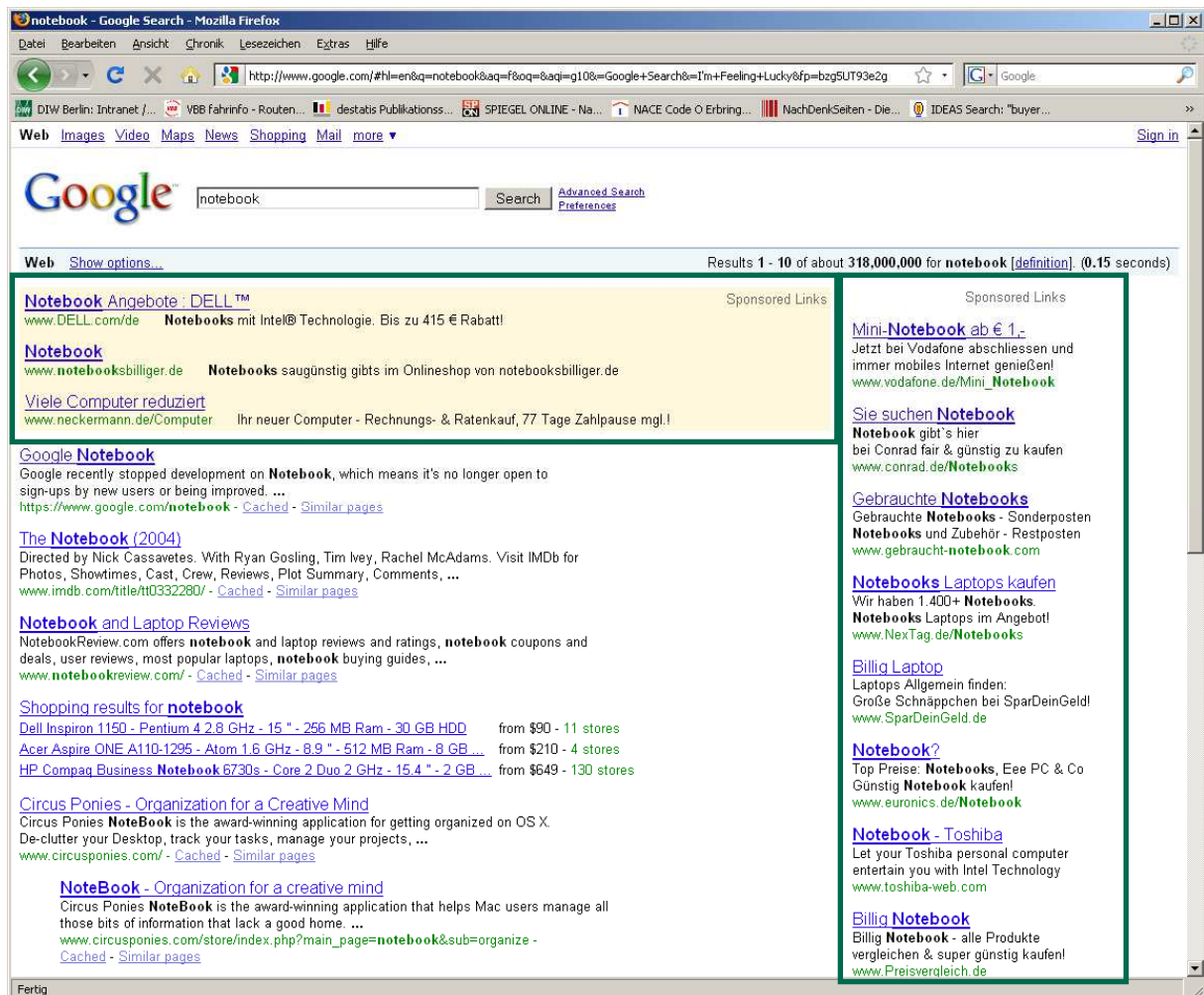
Search-based ads	Non-search-based ads		
contextual	contextual		non-contextual
text	text	display	display

Source: DIW econ, based on EU Commission (2008b).

Search-based advertising links are almost exclusively contextual ads. Search engine providers match advertisements with certain keywords that users submit in their queries. Such keywords can be single words or a list of words, such as "notebook" or "notebook repair". Advertisements matching these keywords are then shown to the user together with the organic search results, as Figure 5 illustrates for the example of "notebook".

⁵ We use the term publisher to define those who generate web content.

Figure 5: Search advertisements for the search query “notebook”



Source: Google.com – assessed June 2009.

In contrast to organic web search, search-based advertising is not provided for free. Instead, advertising slots for display with certain key words are sold in auctions where advertisers submit bids for keyword combinations. Each such bid indicates the willingness of an advertiser to pay for every time that users click on an ad. The underlying pricing model is therefore known as *Pay-per-Click (PPC)*.⁶ The bids are also decisive for the location of the advertisement on the result page, with a higher bid usually leading to a more prominent advertising slot. However, the revenue that a search engine provider receives from a specific slot depends not only on the price that an advertiser pays but also on the number of times

⁶ While pricing of search advertisements has converged to PPC, other segments of online advertising use different models such as pay per transaction or pay per dollar of revenue (as e.g. used by Amazon.com). The dominant pricing scheme in print media – Pay-per-Impression – also remains popular, e.g. for display ads on Internet portals such as yahoo.com, msn.com or aol.com (Edelman et al. 2007).

that users click on the respective ad. Hence, slots are allocated to advertisers not only based on their bids but also depending on the number of times that users are expected to click on the displayed advertisement, the relevance of the ad to keyword and search query, and the landing page's quality, which is measured by specific *quality scores* (Google, 2009, p.19). It is finally the product of the advertiser's bid and the quality score that determines in which position an advertisement appears (Varian, 2008). Estimating this quality score as precisely as possible helps search engine providers maximize revenue. Moreover, it also makes advertising with a specific search engine more attractive for advertisers who run popular campaigns and benefits users who value relevant advertisements. Thus, the ability of a provider to estimate the quality score as good as possible is important for increasing the competitiveness of a web search engine compared to its competitors. Hence, the underlying algorithms and procedures constitute valuable business secrets.

All leading web search engines run continuous auctions in which advertisers can change their bid frequently to displace their competitors (Evans, 2008, p.13; Fain und Pedersen, 2006). It is expected that average bid prices increase in the number of advertisers who bid on a given keyword (Evans, 2008a, p.371). Moreover, advertisers' willingness to pay increases with the quality of the ad matching algorithm, as advertisements that are matched more closely to specific keywords are expected to attract more attention from search engine users and thus, more value for advertisers.

The evolution of auction mechanisms under which advertising slots in internet search are sold has attracted substantial economic research (see Edelman et al., 2007; Varian, 2007). The scheme that emerged as most superior is a *Generalized Second-Price (GSP)* auction, where the advertiser who submits the highest bid wins the best slot but pays only the second-highest bid. Likewise, the second highest bidder wins the second-best slot and pays the third-highest bid price, etc. Since payments of all bidders do not depend on the level of their own bids, this auction scheme generates higher revenue for the search engine provider than previously used mechanisms based on the *first-price* principle. However, shifting from the *first-* to *second-price* principle has also benefited advertisers since it no longer encourages them to invest into bidding robots to game the system, and it causes less volatile prices and fewer allocative inefficiencies (see Edelman et al., 2007).

Due to the crucial role of advertising for the economic viability of web search operations, as well as the increasing sophistication of online auctions, all major providers have established

their own ad networks in order to intermediate in the online advertising market. These ad networks were first designed to facilitate the sale of search providers' own search-based ads to advertisers. Subsequently, search providers have expanded the purpose of their ad network to include the intermediation between publishers with website space available for ads and advertisers looking for ad space. Search providers have been extremely successful in this second form of intermediation. First, they benefit from access to a large base of advertisers who place search-based advertisements. Secondly, they benefit from a specific competence in providing the technical "ad tools" which place the right contextual advertisements at the right time at the right place.

2.3 Cost structure of search engines

A distinct feature of the search engine industry is that providers face significant and highly specific fixed costs, while variable costs for answering an additional search query or placing an additional advertisement are negligible and likely to equal almost zero. Fixed and specific costs in the search engine industry are caused by two main factors:

- **Research and development (R&D):** Substantial expenditure for R&D is necessary to maintain and constantly improve the quality of search and advertising tools. This is essential for remaining competitive in a highly innovative and fast developing market environment. In 2007, Google invested 2.12 billion USD, equivalent to 12.8 percent of its revenue, in R&D (Google, 2008, p.36) while its closest competitor Yahoo! invested 1.08 billion USD or 15.6 percent of its revenues (Yahoo!, 2008, p.60).⁷
- **Server infrastructure:** Being able to operate a responsive search engine, to closely match advertisements to search queries and to constantly crawl and index the internet requires search engines to install and operate a significant server infrastructure. Since the requirements are highly specific, this infrastructure cannot be build up based on off-the-shelf servers but requires tailor-made solutions. The size of the servers required to operate a search engine is very large. Google, for example, is considered to be the fourth largest server manufacturer after Dell, Hewlett-Packard and IBM (Hansell and Markoff, 2006). Since manufacturing of computer servers is a fast developing business

⁷ These figures are high by international standards. In the G7 countries for example, an average company in manufacturing allocated only 2.7 percent of its annual production value to R&D in 2002 while the respective share for medical, precision and optical instruments – the sector with the highest relative R&D expenditures – amounted to 13.2 percent (OECD, 2005).

where capital goods depreciate quickly, the costs of installing and operating a sufficient server infrastructure can be largely regarded as sunk.

2.4 Key findings on industry structure

The previous description of the web search industry shows that all major providers have structured their main activities – web search and search-based advertising – as two-sided markets, and that they perform both activities in rather similar ways. Nevertheless, there are significant differences in the quality and accessibility of different web search engines. In particular, these differences reflect different levels of regional and temporary web coverage as well as a varying depth of information on past user behavior and personal preferences of individual users. Both are major factors to determine the quality of web search engines. In addition, the specific cost structure of the industry (with substantial levels of fixed costs for R&D as well as for maintaining the necessary server infrastructure) is likely to cause significant differences in the performance of different search engines. In the next chapter, we will discuss the relevance of these observations of differences among search engines for the type and level of competition in the web search industry.

3. Competition in the web search market

Given the two-sided market structure, a meaningful competition analysis needs to consider both sides of the market: organic web search as well as search-based advertising. As a starting point, section 3.1 will describe how both sides have developed during the last years and how the market shares of the biggest players have changed. In the subsequent sections 3.2 and 3.3 we will provide an economic explanation for the observed level of competition, based on the industry characteristics discussed in the previous chapter.

3.1 Market shares and industry structure

Since the first web search engines started their operations in the early 1990s, the market for search engines has maintained strong levels of growth. In 2004, 30 percent of US internet users already used search engines on a typical day. By 2007, this share had increased to 49 percent. Today nearly 600 million search queries are submitted every day (Rashtchy et al., 2007, p.155) and an estimated 98 percent of all internet users use web search engines (iProspect, 2004).

Market shares in web search

Geographically, the web search market can be separated into different countries and language areas. Table 1 shows market shares of the biggest providers in organic web search in selected countries. All markets are highly concentrated. With the exception of Russia, the largest provider in each market has secured a share of between 60 and 90 percent, while the fourth-largest provider accounts for only between one and four percent.⁸ Google is the market leader in most countries including the US, the UK, France and Germany. However, markets in countries such as China, Russia, Japan or South Korea are dominated by other providers including Baidu in China and Yandex in Russia, which benefit from a large regional base but do not operate globally.

Table 1: Market shares by search queries in selected countries

Country	USA (May 2009)	UK (May 2009)	France (April 2009)	Germany (June 2009)	China (Sept. 2008)	Russia (Feb. 2008)
Share by search queries (in%)	Google (65.0)	Google (91.3)	Google (89.8)	Google (86.6)	Baidu (60.9)	Yandex (47.4)
	Yahoo! (20.1)	Yahoo! (2.8)	MSN+Live (2.9)	MSN+Live (6.0)	Google (27.0)	Google (31.2)
	MSN+Live (8.0)	Ask (1.7)	Yahoo! (2.5)	Yahoo! (2.7)	Sogou (3.1)	Rambler (9.7)
	Ask (3.9)	Live (0.9)	AOL (1.7)	T-Online (1.8)	Yahoo! (2.4)	Mail.ru (7.0)

Sources: USA (ComScore, 2009), UK (Hitwise UK, 2009), France (At Internet Institute, 2009), Germany (Webhits, 2009), China (China IntelliConsulting, 2008), and Russia (ComScore, 2008b).

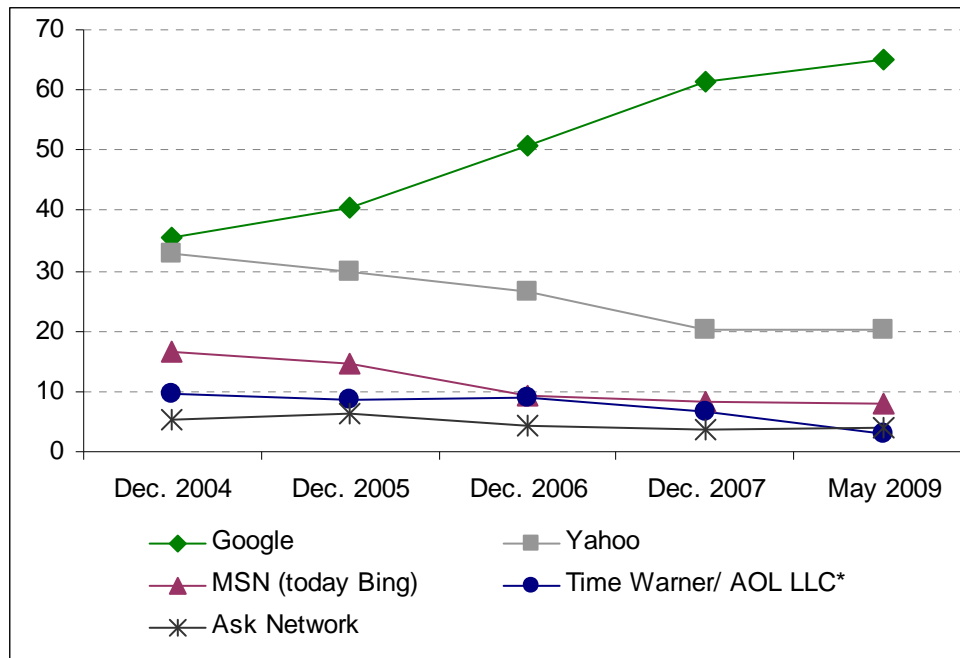
Given the short history of the industry, these strong concentration levels have materialised very recently and in a rather short period of time. In fact, Figure 6 demonstrates this for the US market, where the two biggest providers, Google and Yahoo!, occupied comparable market shares of around 35 percent in 2004.⁹ Since then, however, Google has managed to expand its share by more than 35 percent while Yahoo! has seen its market share decline by more than half. This high level of concentration is also reflected in a Herfindahl-Hirschman Index (HHI) level of more than 3,000 (Evans, 2008a, p.366).¹⁰

⁸ In the Russian market, the two largest providers account for a combined share of almost 80 percent.

⁹ The strong growth of Google started in 2001, when it became the third-biggest search engine provider in the US. At that time, Google also provided search results for Yahoo, the market leader. In 2002 Google outplayed Microsoft to become number two in the US market and in 2003 even overtook Yahoo, who just launched its own search engine in this year.

¹⁰ The HHI is an indicator for the level of competition among firms in a market. It can take values between 0 and 10,000 where the former indicates perfect competition and the latter a monopoly.

Figure 6: Development of market shares by search queries in the US

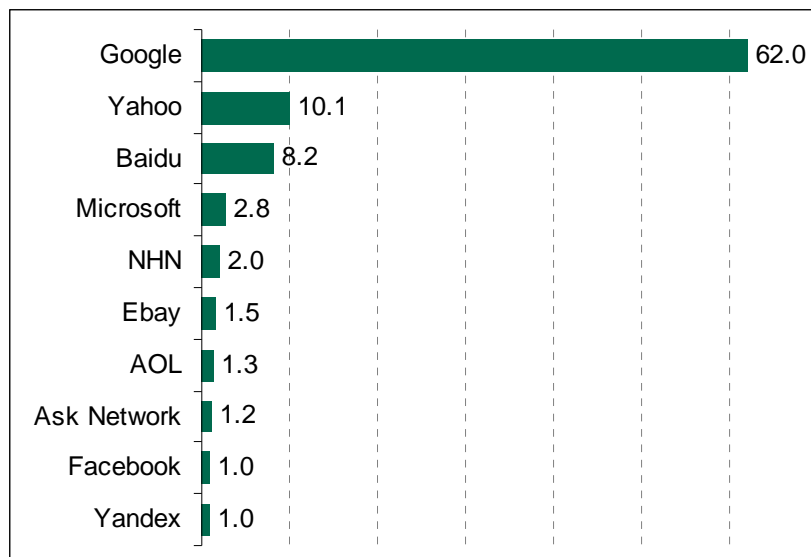


Source: Data from Dec. 2004 until Dec. 2007 from Evans (2008a, p.367) on basis of data from ComScore; data for May 2009 from ComScore Press Release on U.S. search engine rankings May 2009 (ComScore, 2009).

* In January 2008, Time Warner Network was split into two distinct properties: AOL LLC and Time Warner Network excluding AOL, with AOL LLC representing the core search business. Data on May 2009 are only displayed for AOL LLC.

Similar developments have taken place in all relevant national markets. Google has managed to gain dominant positions in most of them (see Table 1). In fact, the company today operates the world's biggest search engine and occupies a share of about two third (62 percent) of the global web search market, followed by Yahoo! (10.1 percent), the Chinese provider Baidu (8.2 percent) and Microsoft (MSN/Bing) with a share of 2.8 percent (Figure 7).

According to the Federal Trade Commission, a level above 1,800 indicates a sufficiently concentrated market Evans (Evans, 2008a, p.367).

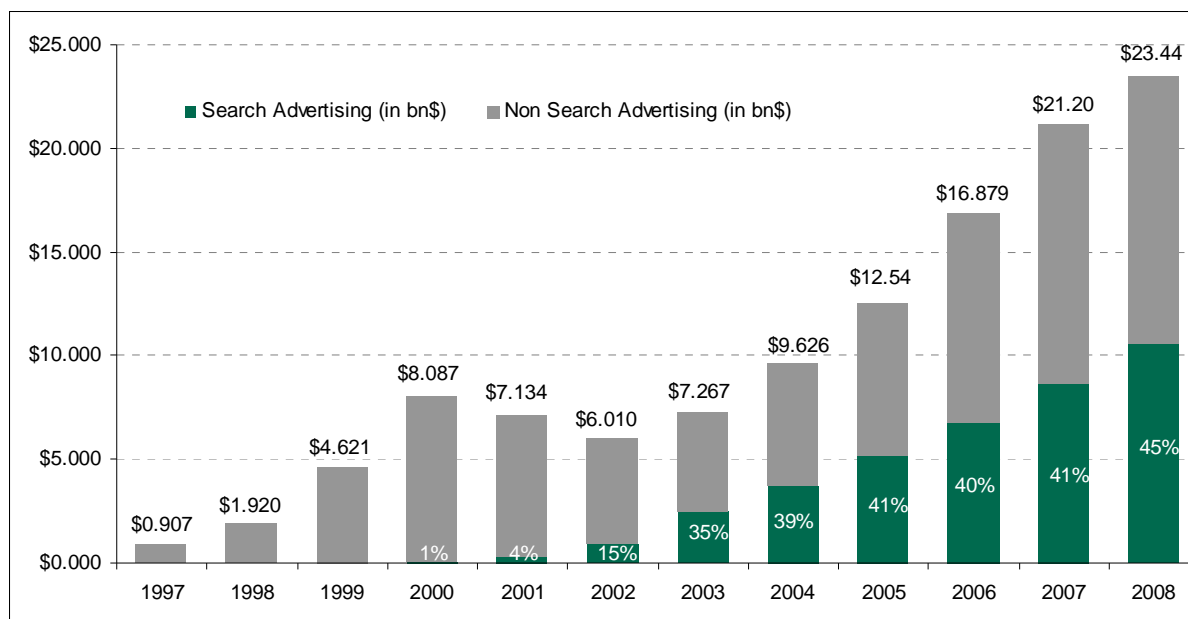
Figure 7: Share by search queries worldwide March 2008 until March 2009

Source: ComScore from Wirtschaftswoche (2009).

Advertising

In line with the rise of the internet, the online advertising market has shown enormous growth. In the US, the largest market, annual online advertising revenues have increased from less than a billion USD in 1997 to more than 23 billion USD in 2008 (Figure 8). While search-based advertising was already realised as early as 1995, it was not a significant segment in online advertising until 2001. This changed drastically in 2002, when Google launched its own ad network where it sold keywords based on *Generalized Second-Price (GSP)* auctions (see section 2.2). Since then, search-based advertising has become the fastest-growing segment in the booming online ad market. In the US, for example, annual revenues from search-based advertising account for 10.5 billion USD or 45 percent of total online advertising revenues in 2008, up from only 15 percent in 2002 and four percent in 2001 (Figure 8).

Figure 8: Annual online advertising revenues in the US (in billion USD)



Source: DIW econ on basis of IAB internet advertising revenue reports (2002, 2004, 2006, 2007, 2009).

Similar to web search, the online advertisement segments in which search engines operate are also highly concentrated. Worldwide, Google accounts for the largest market shares in both, with 49 percent in search-based and 56 percent in contextual advertisements, while the second-largest operator, Yahoo!, controls 25 and 43 percent, respectively. In total, this implies that Google and Yahoo! account for more than 80 percent of the combined search- and contextual market while Microsoft, the third-largest operator, controls only 12 percent (Table 2). A similar pattern can be found for different regions. In the US, 72.3 percent of the respective advertising expenditure in the first quarter of 2009 was spent on ads on Google while Yahoo! received 19.4 percent and MSN/Bing 3.5 percent (Efficient Frontier, 2009). In the European Economic Area¹¹, Google has a leading position in both search-based advertising as well as ad intermediation (of mainly contextual ads), with market shares between 60 to 70 percent in the former and 40 to 60 percent in the latter, respectively (EU Commission, 2008a).

¹¹ The European Economic Area is comprised of all member states of the European Union and Iceland, Lichtenstein, and Norway.

Table 2: Revenue shares of worldwide search and contextual advertising segments (2006)

	Search	Contextual	Search and Contextual
Google	49%	56%	51%
Yahoo!	25%	43%	31%
Microsoft	17%	na	12%
AOL	4%	na	3%

Source: calculated based on Hahn and Singer (2008).

Industry structure

The strong concentration process in organic web search as well as in search-based advertising in the US has also substantially altered the structure of the industry, as a comparison provided by Bruceclay (2009) demonstrates. Back in 2000, 26 different companies were active in the market, each of them either operating a search platform, or providing search results, or both. Altogether, nine different companies provided search results based on proprietary algorithms while the operators of search platforms could select from a variety of different web search providers. Today, only four companies (Google, Yahoo!, Bing, and Ask) provide their own search results and out of a total of ten notable market players, seven receive their organic and/or paid search results from either Google or Yahoo!.

3.2 Drivers of market concentration

In this section we will argue that the strong concentration process in both web search as well as search-based advertising can well be explained by the technical features of the industry as described in chapter 2. Overall, two main industry characteristics are particularly strong drivers for the observed concentration process:

- The cost structure of the search engine business; and
- The prevalence of network effects on both sides of the market.

Cost structure

As described in section 2.3 the cost structure in the search engine market is characterized by high fixed costs for R&D as well as hard- and software infrastructure, while the variable costs of providing services to searchers and advertisers are almost zero. Moreover, these fixed costs can be largely regarded as sunk. A major implication of such a cost structure is that operators exhibit economies of scale because average unit costs decrease with the size of

operations. This is generally typical for utility providers that supply water, energy or communication services to consumers based on capital-intensive, fixed infrastructure. In such markets, the potential for competition is limited because once two competing providers operate parallel infrastructure, services will be provided at higher average costs. Hence, financial resources will be inefficiently allocated, and such markets are generally characterised by high levels of concentration.

Network effects

In economic theory, a network effect (or network externality) describes a situation where the value of a good or service for individual consumers changes with the total number of consumers. For the case of web search, there are positive network effects for both users as well as advertisers as Evans (2008a) discusses in detail. The following discussion summarises the main points of this analysis.

One might assume that users do not benefit from the number of other users that a search engine attracts, based on the assumption that users do not value platforms with many or few users as long as the sought-after information is obtained. This view, however, does not take into account that the quality of search results rises with the amount of search queries submitted to a search engine. As discussed in section 2.1, search engines improve their search results based on past user behaviour and personalised information. Obviously, the more search queries have been submitted to a specific search engine, the more information about past user behaviour can be assessed to continuously improve the quality of search results, which in turn increases the user benefit.

Similarly, prevalence of network effects for advertisers appears to be limited at first glance. Advertisers pay if a user clicks on their ad and value each click independently from the behaviour of other users. Hence, advertisers should be indifferent to the size of the ad network as long as they generate a positive net value from the ad. However, this view does not take into account that the probability for a close match (which generates value for the advertiser) between an ad-keyword and a search query clearly increases with the number of users who submit different queries. Moreover, advertisers incur two types of quasi-fixed costs for running a campaign on a specific ad network:

- First, the costs for accessing the network, including activation fees, software installation etc., and

- Second, the costs of running a campaign on that network, which include the costs of determining the bidding levels as well as monitoring costs.

Due to the existence of these quasi-fixed costs, advertisers need to generate a minimum volume of sales from the campaigns they run on an ad network.

The presence of positive network effects for both users and advertisers creates a positive feedback loop in which a search engine/ad network becomes more valuable to users and advertisers as more users join. To illustrate this imagine two identical platforms A and B that handle the same amount of search queries. Now assume that platform A's traffic increases by a significant percentage, perhaps because the platform has managed to considerably improve its search quality with the implementation of a superior search algorithm. This increase in traffic increases the expected revenue from advertising on platform A. Subsequently, advertisers who have not advertised on this platform before because the expected revenue was lower than their fixed costs start doing so. Moreover, current advertisers on platform A find it valuable to increase the number of ad campaigns they run. In addition, due to the higher volume of users on platform A, more information about past user behaviour can be assessed by the search engine, which improves the quality of search results on platform A even further. Therefore some users of platform B switch to A, as long as the quality increase outweighs their switching costs. The now greater number of users makes platform A again more attractive for advertisers as well as for users. Hence, a positive benefit on one side of the market multiplies through feedback loops into additional benefits on both sides.¹²

Platform A's revenues benefit from network effects and feedback loops not only through increases in the number of advertisements, but also through higher bids for keywords due to the increased demand for its advertising slots. In turn, Platform A's greater financial means enable the platform to invest in further improvements of its search quality and accessibility in order to draw even more searchers to its service. Thus, network effects and the resulting positive feedback loop are likely to create a *winner-takes-it-all competition* in the web search industry, where a single firm will eventually win the market. Therefore, once a provider has managed to take the lead, it will get increasingly difficult for its competitors to catch up and a near-monopoly structure is likely to evolve.

¹² Likewise, the same feedback effects unfold if the platform initially benefits from an increase in advertising, for example because of an improved matching algorithm that produces more relevant combinations of ad-keywords and user queries. This is also emphasised by Evans (2008a).

A possible way for smaller search engine providers to catch up to the leader could be to buy additional traffic from other sites. In fact, this is common practice and all leading search engines generate a substantial part of their overall traffic from publisher sites as well as from other search engines (Evans, 2008a). For example, Google spent nearly 5 billion USD or 30 percent of its revenues on traffic acquisition in 2007 (Google, 2008, p.45), whereas its competitor Yahoo! spent about 2 billion US-Dollar or 27 percent of its revenues (Yahoo!, 2008, p.43). Assuming that the additional revenue per search that a small search engine obtains from an increase in traffic is larger than that of a big competitor, it is possible that the small engine could outbid its opponent for (sufficiently small) additional traffic and thus regain that additional market share. However, once the revenue per search that the small search engine generates is sufficiently lower than that of the big one, the former will no longer be able to outbid its competitor. Evidence reported by Evans (2008a) suggests that Google is already able to outbid its competitors for the most lucrative contracts.

With network effects and bidding dynamics in mind, it appears to be natural that Google – with its highly praised search quality – has experienced a fast rise towards its currently dominating position on most of the major international markets. Whether or not the company will continue to gain market shares from its competitors remains to be seen. In general, Evans and Schmalensee (2005, p.18) have observed that despite their theoretical implications, network effects in multi-sided markets do not necessarily result in pure monopolies in practice. Instead, smaller platforms can typically manage to defend market shares by sufficiently differentiating themselves. On the other hand, Evans (2008a) argues that for the web search industry, the positive feedback loops on both sides of the platform as well as the leading firm's advantage in accumulating additional financial strength – which in turn enables it to continuously improve its search algorithms and advertising tools – increases the probability that a monopoly structure will emerge.

3.3 Increasing non-contestability

While the previous discussion points out that high concentration levels in the web search industry are a natural consequence of the relevant industry characteristics, this does not automatically imply that the dominant provider can successfully extract rents by abusing its position. In fact, even a monopolist cannot extract rents as long as any abuse could be punished by market entry of other firms which supply at competitive prices. Hence, the ability of a firm to abuse its market power requires that its dominant position cannot be contested by

other firms. Whether or not this is the case depends on the existence of sufficient barriers to entry into the market, as well as on the extent to which smaller firms are able to regain market shares. In this section we will argue that the specific characteristics of the industry and the forces that drive the concentration process also impose significant entry barriers and diminish the chances for smaller firms to catch up with their leading competitor. It therefore seems that a dominant position in the web search industry is increasingly non-contestable.

The first and most obvious barrier to entry of new firms is fixed costs, in particular if they are sunk. For the search industry, we argued in section 2.3 that both the required server infrastructure as well as R&D activities cause substantial fixed and largely sunk costs to providers. Industry experts estimate the minimum value to start a search engine business to serve both sides of the market at about 1.5 to 2 billion USD. Given the overall growth of internet traffic and bandwidth demand, expenditures for both server infrastructure and R&D are also likely to grow in the future. Moreover, a dominant firm can also invest “strategically” in R&D to improve its quality while increasing the entry barrier for possible entrants.

However, fixed costs are not the only barrier to market entry and competition in the web search industry. A second important factor is the costs which users and advertisers incur if they switch to another search engine. In fact, these switching costs can be regarded as an “inverse” measure of competition in the sense that the higher they are, the less likely a consumer is to switch to another search engine even if his platform provides a lower quality than the competitor. For web search, it can be assumed that once consumers have decided to switch, the network that experiences an increase in users becomes more attractive for advertisers, too (see section 3.2). Hence, the relevant question to assess is whether or not switching costs for users of web search engines are likely to be significant. Typically, users cannot fully assess the quality of search results and use search engines without deep understanding of how its search algorithm works (Hargittai, 2008; Machill et al., 2007, p.28 ff). Instead, they mainly trust a search engine’s choice and believe in its quality. Web search can therefore be considered a *credence good*,¹³ since users need to develop trust based on the reputation of a search engine as well as on their previous experiences. For such goods

¹³ Economists refer to products whose quality is difficult to assess even after they are consumed as credence goods. Other examples of credence goods are services provided by doctors, car repair, or legal consulting.

and services, brand reputation is crucial because it signals a specific level of quality.¹⁴ For users, switching to another search engine means losing the brand reputation of their previous provider. Since Google and Yahoo! are listed among the most valuable global brand names (Interbrand, 2008)¹⁵ it can be assumed that the costs of switching away from one of the major web search engines are very high. In practice, the full switching costs are likely to be even higher due to the various additional features like image or map search, or email and video portals that search engines provide (see section 2.1) and to which users get accustomed.

Another requirement for contestability of a dominant position is that smaller firms are able to regain market shares once the dominant firm starts abusing its position. For web search, the possibilities for smaller search engines to catch up with a dominant competitor are fundamentally constrained by the combination of network effects and feedback loops as described in the previous section. The constraint becomes even stronger, the bigger the difference between a small and a large search engine. Moreover, once a certain size difference has been achieved, network effects can even further accelerate. For example, a firm that clearly dominates the market also sets industry standards. This implies that more and more website publishers will try to optimize their page structure according to the leading search engine's indexing algorithm in order to improve their "visibility" vis-à-vis this search engine. In turn, this creates an additional advantage in search quality for the leading provider.

Finally, the dominant position in a highly innovative market environment can also be contested through new innovations. In fact, Google's uptake against Yahoo!, MSN and Alta Vista demonstrates how a small search engine can outperform its competitors based on a superior innovation. Google's search algorithm, which first incorporated web site popularity by taking into account the number of links pointing to a site, brought a significant increase in the quality of search results. This enhanced search results, and Google's positive brand image enabled it to overcome switching costs and even beat the hitherto market leader Yahoo! within a few years.

¹⁴ Empirical research on the effect of brand awareness on the subjective evaluation of search engine performance supports this argument. Jansen, Zhang et al. (2007) for example show that established search engine brands have a significant competitive advantage. Based on average relevance ratings, they found a 25 percent difference between the most highly-rated search engine and the lowest, even though search engine results were identical in both content and presentation.

¹⁵ In 2008 Google was ranked as number 10, Yahoo! as number 65.

To sum up, given that Google already accounts for more than 65 percent of all search queries in the US and the main Western European markets (see Table 1), it seems difficult to imagine that this position can still be contested. Also, search quality, accessibility, and advertising technologies have significantly improved since Google itself managed to outperform its competitors. It therefore appears to be unlikely that another small provider will manage to be similarly successful. A promising alternative to the current web search seems to be the so-called Web 3.0 or Semantic Web, which could offer an opportunity for small providers to gain market share.¹⁶ However, the necessary restructuring and preparing of online contents worldwide requires R&D expenditures, human capital and a server infrastructure to an extent that a start-up will most likely not be able to pay for. Industry experts therefore expect that the necessary human capital and server capacity will most likely be supplied by an established provider (Schmidt, 2009). The promising “new era” of web search is therefore likely to be developed by the already leading search engines equipped with the necessary capacities and the financial means to do so.

3.4 Key findings on concentration and contestability

Today’s web search industry is characterised by very strong levels of concentration. The discussion in this chapter demonstrates that this development can be explained by fundamental economic forces. Both the cost structure of operating a search engine as well as several network effects on both sides of the market are likely to create a winner-takes-it-all competition where a single firm eventually wins the market. This development is even strengthened by an over-proportional rise in revenue of the dominant firm, enabling it to invest significantly larger amounts in R&D and server infrastructure and thereby further strengthening its dominant position. Furthermore, this dominant position is increasingly non-contestable. Significant fixed costs for entrants as well as switching costs for users impose significant entry barriers, while network effects diminish the chances for smaller firms to catch up with their leading competitor.

With strong concentration and low contestability in the search engine market, abuse of market power is a realistic threat. To develop a better understanding of the consequences

¹⁶ While the World Wide Web connects the world’s data, the Semantic Web aims to understand web content and thus is able to relate information on the web to another. A forerunner of Semantic Web, the search engine “Wolfram Alpha”, just went online in May 2009.

this is likely to have, the following chapter analyses the various channels through which a dominant search engine provider could extract rents from users and advertisers.

4. Potential for abuse of market power

This section provides a tentative overview of the major ways with which a dominant search engine can abuse its position and harm users as well as advertisers. The analysis starts with a brief definition of the markets on the users' and advertisers' side where market power can be exerted (section 4.1). The following two sections discuss different examples of possible abuse for organic web search and for advertising.

4.1 Relevant markets

Generally, defining relevant antitrust markets in a two-sided framework requires the use of special methods that consider the externalities between the two sides of the market (Evans, 2008b). In particular, one needs to take into account the effects of a one-sided hypothetical price increase on each side of the market. This analytical exercise should be carried out separately for hypothetical price changes on each side of the market.

It is often noted in economic literature that in two-sided markets it is the structure of prices on both sides that matters, not the particular price level on each side. However, search engines do currently not charge users for search and it is unlikely that this practice will change in the foreseeable future. Therefore, the effect of the price structure seems to be of little relevance. It appears reasonable to instead consider the substitutability of search engines from the perspective of users and advertisers in order to define the relevant antitrust markets.

In this section we discuss what is likely to constitute a relevant antitrust market in the web search industry. While our discussion is not meant to substitute for formal antitrust market delineation, we can still highlight major substitutability patterns. Since these seem to be relatively straight forward, we believe that a formal analysis is unlikely to lead to substantially different results than those presented here.

The users' side

Users rely on the use of search engines to get access to ordered web content. Since there is no alternative way for users to access a wide range of organized web content on a global scale, it is therefore reasonable to assume that web search is not substitutable by other online or offline services. Hence, online web search constitutes a relevant antitrust market from the perspective of users. Geographically, this market is to a certain extent divided along linguistic borders. As the market shares presented in Table 1 (section 3.1) show, all major national markets are dominated by a single provider, which for most countries happens to be Google.

The advertisers' side

Advertising can be online and offline. The online advertisement market can be divided into search-based and non-search advertisement. As described in detail in section 2.2, advertisers in the search-based market buy ad-space from web search engines to place targeted advertisements to consumers. In the non-search market, advertisers place ads on publisher websites, which are either related to the context of the website (contextual advertisements) or not (non contextual advertisements). Here, web search engines and their respective ad networks typically act as intermediaries for contextual ads between advertisers and publishers, where they can use similar ad-matching tools as in search-based advertisement.

The definition of relevant markets for advertisers depends mainly on the degree to which advertisers can substitute search-based ads by other types of online or even offline advertisement. Antitrust authorities in the US and the EU have already been concerned with this issue (EU Commission, 2008b; US Federal Trade Commission, 2007). A common conclusion is that advertisements in offline markets like print media, TV, or radio are substantially different from online advertisements, since advertisers cannot target their campaigns as precisely and effectively as they can with online advertising. Hence, both EU and US antitrust authorities see online and offline advertisements as no or very limited substitutes. However, they arrive at different conclusions with respect to the substitutability of search-based and other online advertisements. As the US Federal Trade Commission (FTC) states, "all online advertising does not constitute a relevant antitrust market. Advertisers purchase different types of ad inventory for different purposes, and one type does not significantly constrain the pricing of another" (US Federal Trade Commission, 2007, p.7).

Rather, the FTC suggests that search- and context advertisements form a broad segment of the online advertising market that includes all ads sold by intermediaries. The remaining segment, high-value display ads which are marketed directly to advertisers by web publishers, is not part of this market.

On the contrary, the European Commission (2008b) argues that all search and non-search advertisement are to a certain extent substitutable because their key difference – the targeting of ads to specific users – is increasingly diminishing due to technological progress (EU Commission, 2008b, §109). This implies that the relevant market comprises the full online advertising market, including display ads.

Concerning the geographical separation, both the FTC as well as the EU Commission base their analysis on market shares in their respective region, which is similar to the geographical separation of markets previously described for the users side. The EU Commission considers the market for the supply of online advertising space to be divided along national or linguistic borders while the market for the provision of intermediation services to advertisers is at least Europe-wide. This conclusion is shared by Hahn and Singer (2008) who suggest that the relevant geographic market for the provision of intermediation services is likely worldwide. However, since the patterns of concentration are similar in main advertising markets such as the US and Europe (see section 3.1), this distinction does not appear to be critical.

The bottom line is that antitrust authorities define a relevant antitrust market within a range. The range surely includes search-based ads, but is not larger than the overall online advertising market. It is also unlikely that authorities apply a narrow market definition that includes only one type of online advertising, such as search-based ads (Hahn and Singer, 2008). Moreover, it can even be expected that the boundaries of a relevant antitrust market in online advertising change over time, depending on technological developments or changes in marketing strategies such as the type and relevance of targeting for brand-awareness campaigns. With a flexible definition of the relevant antitrust market, the existence of a dominant position on the part of one player cannot be established with certainty. For example, Google is likely to have a rather dominant position with market shares of at least 40 percent if the combined search- and contextual ad segment (in other words, the market for ads sold by intermediates) is considered to be the relevant antitrust

market (for the US, the EU or both).¹⁷ In contrast, if the online advertising market as a whole is used as the definition of the relevant antitrust market, then Google will account for a smaller, although still significant share.¹⁸ The currently weak concentration of the overall advertising market, however, does not preclude Google from becoming the dominant player in that market in the future. Search-based advertising, the central advertising competency of the search-engine, is gaining prominence in the overall online advertising market. It already accounts for 45 percent of all online ads in the US (Figure 8), for example. The growing presence of search engines in the overall online ad market is further reinforced by the increasing importance of one of the search engine's key competencies – intermediation – in contextual (and increasingly also in display) advertisements, which comprise a large portion of overall online ad demand. Since we have argued that a non-contestable dominant player is likely to emerge in the search-based segment, the emergence of an un-contestable dominant player in the overall online ad market is likely not far behind.

4.2 Abuse in organic search

With search services being free of charge, searchers are primarily interested in the quality of the results they receive. Hence, we focus on the incentives of a dominant search engine to not provide the best-possible search results, even if doing so would be costless. We identify two channels through which the under-provision of quality allows a firm to extract rents by abusing its dominant position:

- Higher revenues from advertising, and a
- Stronger market position of its own products.

As discussed in section 3.3, organic search results have a *credence good* character in the sense that their objective quality is difficult to assess for users. This gives rise to information asymmetries. While users do not know which web page contains the most relevant information for their search queries, the search engine knows the available web content well and decides based on a secret algorithm which information to display. However, the level of

¹⁷ For example, the “guidance on the Commission's enforcement priorities in applying Article 82” states a rule of thumb that firms with a market share of above 40 percent is to be considered as dominant (EU Commission, 2008a, §14).

¹⁸ For example, the calculations by Hahn and Singer (2008) imply that Google accounted for a market share of 36 percent worldwide. Similarly, (Friederiszick, 2008) refers to a global market share of Google in online advertisement expenditure of 38 percent in 2006.

information asymmetry in the search market is not given exogenously but rather depends on the following circumstances:

- If users conduct searches for the same query using different search engines, they are able to compare the results across search engines. The larger the share of users who conduct searches at different search engines (multi-homing) the less severe the information asymmetries. However, multi-homing in web search seems to be rare.
- If users view search results critically they are less likely to suffer from the negative consequences that could arise from information asymmetry. However, users seem to be rather naive and appear to trust the quality of search results. For example, more than two third of the users in the US (68 percent) state that search engines are a fair and unbiased source of information while only 19 percent claim not to trust search engines (Fallows, 2005).
- Users who search for generally known information such as navigating to a certain web site or institution are able to judge the quality of their search results well. Hence, the larger the share of users looking for unknown information the higher the level of information asymmetry. According to a study of Jansen et al. (2007), more than 81 percent of all search queries in the US are looking for unknown information.

Given the high level of informational queries, the trust of searchers in the quality of search results and the small share of searchers using more than one search engine, the information asymmetries between searchers and search engine are likely to be significant. Clearly, a dominant search engine could misuse this and distort search results without having users realize that they are provided with suboptimal search results. In the following, we discuss the benefits that a search engine provider could realise by doing so.

Higher revenues from advertising

Search engines earn money every time a user clicks on an ad. In order to generate higher revenues from advertisers a search engine could lower the quality of search results so that users click more often on advertisements to find what they are looking for. The underlying incentive structure is well-known in economic research. Hagiu and Jullien (2009) for instance analyze the incentives of an intermediary who directs consumers to specific stores in exchange for a financial reward. They show that the intermediary has an incentive to direct consumers first to their least-preferred store, expecting that he will be asked to show another store as well, which would increase his profit. Hence, although fewer consumers are likely to utilize the intermediary's service, those who do will generate higher profits. For the web

search industry with its two-sided market structure, these results suggest that a dominant firm has incentives to either:

- Lower the quality of organic results for informational queries in order to stimulate clicks on advertisements, or to
- Place sponsored links for informational queries in a suboptimal manner so that the most relevant ones do not receive the top positions.

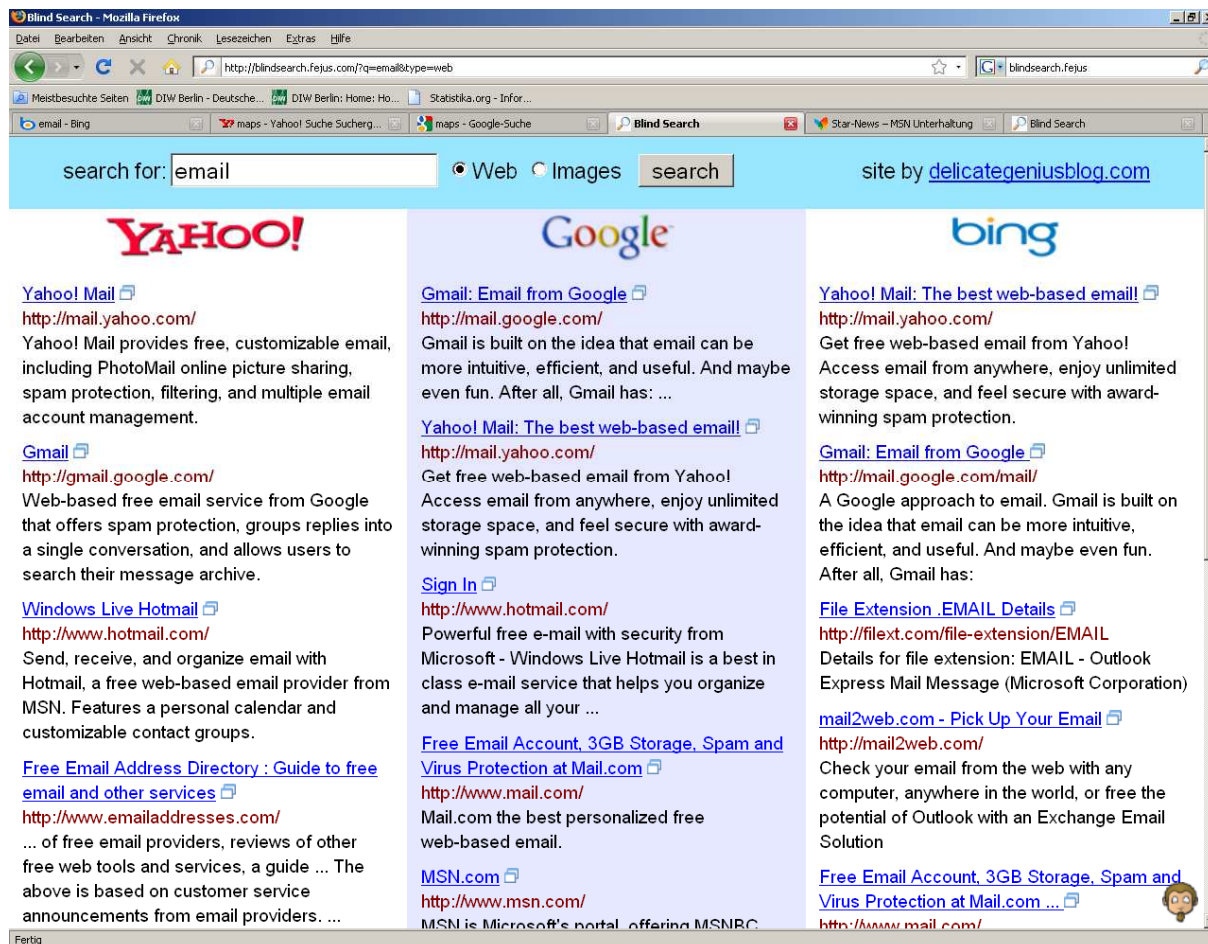
Stronger market position of own products

Given the ability of web search engines to allocate users' attention to sponsored links, search engines generally have an incentive to advertise their own products more prominently. Since searchers perceive certain ad slots (such as the top three of all sponsored links) as a sign of the quality of the search result, traffic to the search engine's own product sites could be increased by placing own product ads in top spots. With more traffic, the search engine's market position strengthens.

There is thus far no empirical evidence suggesting that the manipulation of ad placement is common practice among web search engines. However, results from an ad-hoc experiment suggest that it may well be applied in practice. Figure 9 shows a comparison of search results for the query "email" obtained from the three search engines Google, Yahoo! and Bing, which all operate free-of-charge email services as well. The first link on Google directs to its Gmail and the first one on Yahoo! to Yahoo! Mail, while the second link directs to the respective service of the other provider. On the contrary, Bing – the smallest of the three search engines – does not display a link to its own email service hotmail, but provides links to Yahoo! Mail and Gmail on the first two positions.¹⁹ Queries for other commonly provided features such as "maps" lead to similar results.

¹⁹ This experiment has been conducted by using <http://blindsearch.fejus.com>, the quality of which is unknown. However, the results in Figure 9 have been double-checked by comparing them with those of query submitted directly to the three search engines.

Figure 9: Comparing search results for the search term “email”



Source: <http://blindsearch.fejus.com> – accessed June 2009.

4.3 Abuse in advertising

We now turn to study the incentives for a search engine to abuse its dominant position at the expense of advertisers. We show that search engines might have an incentive to abuse its market power by inhibiting competitors from advertising on their platform or by leveraging into other online advertisement markets.

Inhibit competitors from advertising

Although the major search engine providers sell their ad-slots in auctions, they nevertheless maintain substantial impact on prices by controlling relevant parameters (Edelman, 2008) which can be adjusted for strategic reasons. For example, advertisement slots are allocated to advertisers based on their bid price as well as on a quality score (see section 2.2). The quality score is meant to reflect the number of times that a user is expected to click on an ad.

In this way, a search engine can improve the efficiency of its auction process, thereby maximising its revenue and distinguishing itself from its competitors. However, a dominant firm can also adjust the quality score – which is proprietary information and unknown to advertisers – for strategic reasons, for example to block ads from its competitors.²⁰

In fact, some advertisers have already claimed that Google abuses its dominant position in this way. Sourcetool, for example, is a B2B search engine that allows enterprises to find suppliers for various purposes. In February 2009 TradeComet, which owns Sourcetool, filed a lawsuit against Google accusing it of driving Sourcetool (a competitor) out of business (Reuters, 2009). Sourcetool claimed that by assigning them an implausible low quality score Google raised its bid price for an advertisement slot overnight by 10,000 percent. As a result, Sourcetool could no longer afford to place advertisements on Google search.²¹ Since most of Sourcetool's traffic was generated by its advertisements on Google, traffic dropped down to one percent of its original volume. The case was finally settled by mutual agreement between the parties.

Leveraging market power into other markets

As described in sections 2.2 and 4.1, major web search engines also operate ad networks which offer intermediation services for non-search-based advertising, in particular context advertising. A search engine provider with a dominant position in search-based advertisement can therefore also abuse its market power by leveraging into other online advertising markets in order to strengthen its position in that market. For example, to raise demand for the services provided by its own ad network, the firm can punish advertisers who also use a competitor's ad network. A possible instrument for doing so is to alter the quality score of those advertisers to increase the price they have to pay when placing an ad on the search engine's own website. Alternatively, the search engine can also reward advertisers who use its ad network or the services it provides by assigning them a better position for their search-based ads. The search engine can also offer product bundles that combine ad space

²⁰ Edelman (2008) argues that not only the quality score can be used for strategic reasons. He states for example that "Google's restrictions on export and copying of advertisers' campaigns, further hinder competition in Internet advertising-without any countervailing benefit whatever".

²¹ Sourcetool was told by Google that the bad quality score was a result of the low quality of its landing page. It tried to improve its landing page quality according to some of Google's suggestions, but its quality score did not change. Instead of telling Sourcetool precisely what was wrong, a Google executive wrote the company: "Your landing pages will continue to require higher bids in order to display your ads, resulting in a very low return on your investment. [...] Therefore AdWords may not be the online advertising program for you." (New York Times, 2008).

and services for search and non-search advertisements. As long as advertisers see search-based and non-search advertisements as imperfect substitutes, this allows the dominant search engine provider to also strengthen its market share in other markets such as contextual advertisements or intermediation services and to further promote the use of its own ad network.

4.4 Key findings on abuse of market power

The analysis in this chapter shows that a dominant search engine provider has clear incentives to abuse its market power at the expense of both users and advertisers. Due to significant information asymmetries, organic search results might be distorted and users' attention be redirected to revenue-enhancing advertisements without users being able to realise this. Furthermore, competition might be distorted by prominently displaying links to the search engine's own product sites within the organic search results. Overall, this gives rise to concerns about the informational integrity of a web search provider that has established a dominant position. In addition, a dominant search engine might also prevent competitors to advertise on its sites and leverage its market power into other market segments such as ad intermediation and provision of ad tools for contextual advertisement. Given this result, it seems that policy makers and regulators should start developing strategies of how to constrain the market power of the dominant firm and to prevent possible abuses.

5. Policy options

In response to the highly concentrated market structure and incentives for market abuse described above, policy makers and regulators must follow a well-balanced approach: On the one hand, they need to consider the great contribution on the part of search engines to the improved accessibility of information available on the internet. In fact, without the use of search engines' algorithms to sort web content, the economic and non-economic benefits of the internet would be severely constrained. Since web search is a capital- and innovation-intensive activity, any policy intervention needs to carefully consider its impact on the incentives for web search providers to further improve the quality of their services. On the other hand, it is unrealistic to assume that a dominant firm will simply generate valuable services for internet users and advertisers without abusing its position if it is profitable for

them. Given the possibilities for sorting and shaping the information that users can discover on the web, the accumulation of power in the hands of a commercial search engine without policy-based mitigation is likely to cause harm to both users and advertisers. Hence, policy makers should seek to gradually improve transparency in the industry and to limit the potential benefits to search engines from market abuses while maintaining the strong incentives for further growth and innovation that have characterised the industry for the past two decades. This section discusses several measures that could be implemented as part of a well-balanced approach, ordered by increasing scope of the suggested interventions.

Promoting further research on competition in the web search market

Any form of policy interventions should be based on sound theoretical and empirical evidence. The economics of online advertising and the web search industry has increasingly attracted the attention of economic scholars. However, given that the industry itself is very young and relevant data are not readily available, a number of relevant questions need to be further investigated. For example, very little is known about the incentives of search engines to provide high quality search results and the question has received surprisingly little attention in competition policy. Antitrust investigations involving search engines have so far focused strongly on the advertisers' side of the market while the users' side has remained largely neglected. Since antitrust traditionally focuses on preventing price increases, the lack of attention to the users' side may be due to the fact that search engines typically provide search results free of charge to users. Academic and legal research must address this imbalance.

Given the bottleneck role that search engines play in reaching information, we also believe that much more attention should be paid to the quality of search results. We advocate promoting research on the factors influencing the incentives of search engines to provide high quality search results as well as on the question of how competition between search engines is likely to affect search quality.

Another issue requiring further and in particular empirical research include the incentives and benefits that the various auctions and pricing schemes used in the online advertisement business create for advertisers and platform providers.

Regulations to clearly separate advertisements from organic search results

Imposing mandatory rules on how organic search results and sponsored links have to be separated from one another could be a first and rather modest regulatory intervention in line with general consumer protection policies. While this will not per se prevent a dominant provider from strategically altering the overall quality of search results or from displaying certain results more prominently, it could still increase transparency for consumers and would especially benefit inexperienced and less educated users, who may have trouble distinguishing organic content from paid results.

Obliging providers to reveal the determinants of their quality score

As discussed in section 4.3, an obvious means of abusing market power against direct competitors and advertisers is to adjust the quality score that – together with an advertiser's bid price – is used to allocate advertisements to available ad slots. Since the algorithm and procedures that determine this quality score are proprietary information, it is generally not possible to assess if an assigned score simply reflects fundamental characteristics or if it has been altered for strategic reasons. The proprietary nature of the proceedings underlying the quality score is reasonable as long as markets are sufficiently competitive. In the sufficiently competitive case, unreasonable quality scores are punished by competitors. However, once the nature of competition has turned to an (almost) monopoly, abuses cannot be punished any more as the dominant firm maintains a firm competitive position. To limit the possibilities of abuse through strategic adjustments of the quality index, the dominant provider could be obliged to reveal the criteria and procedures it applies to compute the quality score to an independent third party such as an accounting firm or a regulator. To maintain the proprietary nature of this information, the third party should be obliged to maintain strict confidentiality, while it could still react on allegations by advertisers and investigate into the correctness of assigned quality scores.

Mandatory third party auctions of ad inventory

As described in section 2.2, web search engines do not determine the prices for their online ad inventory, selling it through auctions instead. However, providers still maintain a certain impact on the outcome of these auctions through several crucial parameters which they control. For example, a provider could adjust the quality score to prevent another firm from placing ads on the provider's website. This clearly gives rise to strategic behaviour. As a remedy, the provider could be obliged to sell a part of its ad inventory through separate

auctions which are conducted by a third party. For example, the regulator could order the provider to sell selected ad-slots among the displayed search results for selected keywords that typically attract high bidding prices. These ad-slots could be sold through auctions which a third party conducts under the regulator's supervision. The outcome of this auction would be under the control of the regulator, ensuring advertisers equal access to the leading provider's search platform.

Similar schemes are already practiced in other industries to prevent the abuse of market power. For example, several EU countries use Virtual Power Plant (VPP) auctions to sell electricity generation capacity to the competitors of dominant power generators. These VPPs are call options that grant their owner the right (but not the obligation) to draw power at a specified price during previously specified periods (Armstrong and Galli, 2009).

Mandatory sharing of data about past user behaviour

As discussed in section 2.1, the consideration of available past user behaviour leads to significant improvements in the quality of search results. In turn, this creates the network effects and feedback links which drive the concentration process, as argued in section 3.2. To counter this development and to stimulate competition, search engine providers could be obliged to pool at least a fraction of the available data on past user behaviour in a database that would be managed by an independent authority. Access to this data would be guaranteed to all players in the search engine market so that they would be able to refine their search results. Effectively, this would shift the provider's attention towards developing the best search and ad-matching algorithms and hence, stimulate competition based on innovation.

As with the previous policy suggestion, such a scheme to pool and share relevant information among competitors is already used by other industries. For example, banks voluntarily share information on customer credit ratings.

Unbundling of server infrastructure

So far, all suggested remedies do not fundamentally alter the structure of a dominant provider's business. However, provided there is evidence of ongoing abuses, an intervention could be made that addresses the fundamentals of the market. This intervention could be based on schemes that are typically used to regulate operations of *natural monopolies* such

as energy utilities or the providers of transportation and telecommunication services. In these sectors, the necessity to provide services based on expensive infrastructure, which cannot easily be duplicated, imposes a significant barrier to entry to new competitors and generates market power for the incumbent firms. As a remedy, regulators typically unbundle the operation and maintenance of infrastructure from the provision of services. While the former (e.g. the operation of an energy grid or a rail network) is performed under strict regulation to ensure that all interested parties have access to the infrastructure at equal terms, firms can freely compete on service provision (e.g. energy retailing or transportation services).

Similarly to *natural monopolies*, the costs of building up a server infrastructure to regularly crawl and index the web also constitute a high entry barrier into the web search market (see section 3.2). Hence, competition between different search engines could be stimulated by separating the server infrastructure from the remaining operations of a web search engine and to operate it under a scheme that provides indiscriminating access to this “computing grid” at regulated prices. In turn, search engine providers could still compete based on the quality of their algorithms, ad-matching tools and other ad-intermediation services, ideally also benefiting from unrestricted access to data on past user behaviour as suggested above.²²

In addition to stimulating competition, this scheme would also enhance efficiency because the different search engines would no longer require their own gigantic server park in order to index web content. However, as with all the interventions suggested in this sector, policy makers must also consider the costs the interventions are likely to impose. In particular, operating the server infrastructure under regulated returns to capital might decrease investment incentives and reduce dynamic efficiency. In fact, the experiences from different utility industries suggest that negative effects are likely to be significant in innovation-driven sectors where regulatory schemes typically fail to catch up with technological developments. Hence, this suggested remedy needs to be considered and implemented in the search engine market with great care in order to avoid similarly negative results.

²² In fact, this also resembles the core of the recent disputes between the EU Commission and Microsoft. With its Windows operating system, Microsoft provides the infrastructure based on which different applications such as media players or internet browsers can operate and compete with one another. Hence, the Commission requires Microsoft to provide access to the Windows code to other software firms or even to unbundle certain applications from the operating system.

6. Conclusion

Since its birth in the early 1990s, web search has become one of the most popular internet services. Today, about half of all internet users visit search engines on a typical day to conduct nearly 600 million searches. This rise in web search has been made possible by a strong expansion of search-based advertisements, which has allowed web search providers to finance their activities. The ad networks assembled by major search engines through their search-based advertising activities have provided an important source of demand as search engines extend their intermediation services into the overall online advertisement market. Altogether, web search and online advertisements have become a billion dollar business with Google and Yahoo! – the two leading providers – listed among the most valuable brand names worldwide.

Along with the growth and expansion of search engines, the web search market has become highly concentrated. Google answers more than two thirds of search queries worldwide and accounts for half of the global revenue in contextual and search-based advertising. The analysis in this paper has shown that these already high concentration levels are likely to increase even further due to network effects with feedback loops, high fixed costs, and high switching costs for both users and advertisers. These factors make it ever less likely that the current competitors can regain considerable market share. They also constitute substantial barriers to entry that increasingly hinder new players from entering the market. In other words, the Google's strong position is becoming increasingly hard to contest.

Although web search itself is typically provided free of charge, this paper has demonstrated that a dominant provider has clear incentives to abuse its position by extracting rents from both users and advertisers. For example, the provider can take advantage of substantial information asymmetries by providing a lower quality of search results, directing users' attention to sponsored links. Similarly, the provider can place links to its own services more prominently within the organic search results, such as in the case of a search for "email". Moreover, a dominant firm can hinder competitors from advertising on its site and leverage its market power into other markets such as ad intermediation or display advertisements.

Given the strong concentration forces in today's markets and the many possibilities for market power abuse, policy makers and regulators should consider potential preventive measures. Competition authorities in the EU and US are already examining cases of abuse

on the advertisers' side of the market, while the users' side has remained largely neglected. However, given the control that search engines have over sorting and shaping the information available on the web, we cannot assume that the accumulation of power in the hands of a dominant commercial search engine will not be abused. Increasing public concern about Google's informational integrity as well as the ongoing discussion on the competition impact of the *Google Book Settlement* – an agreement between Google and several publisher and author groups that is meant to regulate the inclusion of copyright-protected books in Google's book search²³ – demonstrate the need for a public discussion about how policy makers should react to the company's ever-increasing impact.

While this paper's analysis has suggested that the accumulation of market power in the hands of a dominant search engine should not be left unanswered, policy makers must proceed carefully. Web search is a capital- and innovation-intensive business that has greatly improved the economic and non-economic benefits of the internet, and the implications of any competition-related policy measure on innovation are important to consider. Policy makers must find a well-balanced strategy to address market concentration that gradually improves transparency in the industry and limits potential benefits from market abuses, while still maintaining the strong incentives for further growth and innovation that have characterised the industry for the past two decades.

This paper has offered a selection of reasonable policy options. In addition to further research on the dynamics of the search engine market, we have suggested concrete intervention schemes that include mandatory information sharing and third party auctions of ad inventory. As a more drastic measure, policy makers can encourage the unbundling of Google's computing grid. Similar to the way in which the break up of dominant firms has stimulated competition in network industries such as energy and telecommunications, the unbundling of the search engine market could stimulate better competition among web search providers. The choice now lies in the hands of policy makers, and the final decision will require more detailed research and policy formulation. However, the analysis conducted in this paper implies that policy intervention in the search engine market is a question of timing and scope; the need for intervention is no longer in doubt.

²³ Most controversially, the proposed agreement protects Google from copyright infringement from authors of so-called "orphan" books who abandoned their books by not registering in the settlement's books database. On July 2nd, the US Justice Department confirmed that it was conducting an antitrust investigation into the *Google Book Settlement* (New York Times (02.07.09): *U.S. Inquiry Is Confirmed Into Google Books Deal*).

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