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Search engine competition with a knowledge-sharing service

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ABSTRACT

This study considers the competition between an inferior search engine and a superior search engine with the option to introduce a knowledge-sharing service. This study focuses on the pure strategy Nash equilibrium of the competition between inferior and superior search engines attempting to maximize their either profits or market shares. If one search engine introduces a knowledge-sharing service, it decides whether to make its answer database accessible by the other competing search engine. This compatibility decision of each search engine is shown to be significantly influenced by whether it maximizes its profit or market share. The superior search engine should keep its answer database closed to maximize its market share, but may make its answer database open to maximize its profit unless the amount of information available on the Internet is small. The inferior search engine should keep its answer database open to maximize its market share if its search technology is far behind that of the superior search engine. Both the inferior and superior search engines should make their answer databases open to maximize their profits if the amount of information available on the Internet is large. This study also shows that equilibrium strategies for inferior and superior search engines depend primarily on the amount of information available on the Internet, the degree of searchers' patience to wait for answers, and the search quality difference.

1. Introduction

Google has been a leading search engine in the United States for several years, and its proprietary search technology is a major contributor to its huge success. Previous research on consumer choices in search engines has confirmed that most users choose a favorite search engine based on its search quality, not its additional non-search services [19,20]. Although brand awareness can influence the searchers' choices between search engines [8], this study focuses on the competition between two major search engines with only a minimal difference in brand awareness.

Yahoo, Google's main competitor, has a well-developed knowledge-sharing service called *Yahoo Answers*, which it introduced in December 2005. This online knowledge-sharing service connects people who have failed to find answers to their questions via search to answerers who have some knowledge about the topic in question [10]. In this way, Yahoo may complement its search quality by inducing its users to visit Yahoo Answers when their initial search on the Internet is unsatisfactory. Yahoo Answers had a 74% market share in the US online knowledge-sharing market as of March 2008.[1] This suggests that Yahoo sites including Yahoo Search and Yahoo Answers may have increased Yahoo's overall market share. Despite the success of Yahoo Answers, the market share of Yahoo sites in the United States has not increased at all; Google increased its market share in 2008.[2]

Naver, a dominant leader in the South Korean search engine market, uses its successful knowledge-sharing service to maintain its leading position.[3] According to the New York Times, about 80% of the information available on the Internet is written in English.[4] Compared to other popular languages such as Chinese, Spanish, Russian, German, and Japanese, the amount of online information in Korean is relatively small. Based on the limited amount of online information available in Korean, Korean searchers may use a knowledge-sharing service more frequently than searchers who use English to search the Internet. According to the Financial Times, Naver attracts an average of 44,000 questions and 100,000 answers each day, making it the world's fifth-largest portal.[5] As a result of this huge amount of knowledge-sharing,

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[1] http://www.hitwise.com/press-center/hitwiseHS2004/question-and-answer-websites.php (accessed January 28, 2008).

[2] Google's market share increased from 55.8% in January 2007 to 58.7% in February 2008. The data is provided by Nielsen, http://news.cnet.com/8301-10784_3-9903672-7.html.

[3] Sang-hun Choe, "South Koreans Connect Through Search Engine," The New York Times (accessed January 28, 2008).

[4] Seth Mydan, "Across cultures, English is the word," The New York Times, http://www.nytimes.com/2007/05/14/world/asia/14iht-14englede.5705671.html (accessed May 4, 2012).

[5] Anna Fifield, "Google left behind as Koreans Naver-gate the Internet: [USA 2ND EDITION]," Financial Times, http://www.proquest.com/ (accessed January 28, 2008).

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Naver has accumulated a large number of already-answered questions in its knowledge database. One critical policy of Naver is that its answer database is only available to users visiting Naver; other search engines cannot access the information stored in the database.

In contrast to the Naver's *closed* answer database, Yahoo has kept its answer database *open*; search engines such as Google and Microsoft Bing can access the Yahoo Answers database. For instance, Fig. 1 shows the Google search results for "Good Restaurant in Palo Alto". Google provides a link to relevant answers stored in the Yahoo Answers database.

When a search engine opens its answer database, it encounters a trade-off between attracting additional searchers who originally visited a competing search engine but were indirectly led to the search engine itself and helping a competing search engine access more information.

When a search engine introduces a knowledge-sharing service, it chooses its compatibility with the answer database created by the knowledge-sharing service. If the search engine makes the answer database open (or compatible), other search engines can access the answer database; if the search engine keeps the answer database closed (or incompatible), other search engines cannot access the answer database. When two search engines (called SE1 and SE2) introduce their knowledge-sharing services, Fig. 2 shows the possible compatibility choices made by SE1 and SE2.

When both SE1 and SE2 keep their answer databases closed, they compete on the basis of their search technology and proprietary answer database. When both SE1 and SE2 make their answer databases open, their answer databases will not increase their competitiveness as search engines. When only one search engine keeps its answer database closed, its proprietary answer database increases its competitiveness (especially when information available on the Internet is not abundant); however, it loses the traffic of searchers who originally visited the other search engine but are indirectly led to its answer database.

The different policies of Naver and Yahoo regarding their answer databases could be the results of the different online search environments in the United States and South Korean search engine markets. The amount of information available on the Internet in English is significantly larger than that in Korean. As a result of this information asymmetry, searchers in South Korea may be more willing to use a knowledge-sharing service than users in the United States. Additionally, South Korea and the United States may have different search quality variations in major search engines. Considering these search environment factors, this study investigates profit-maximizing equilibrium strategies for inferior and superior search engines if they can introduce a knowledge-sharing service with an *open* or a *closed* answer database. Table 1 shows the major search engines' compatibility choices in the United States and South Korea.

To find the profit-maximizing equilibrium strategies for the inferior and superior search engines, we find four different types of fulfilled expectations equilibria (FEEs) according to which search engine and knowledge-sharing service are expected to the first choice of searchers. The equilibrium concept we employ in this paper is similar to that applied in some two-sided-market research [7]. We also provide the equilibrium analysis if they focus on maximizing their market shares.

2. Literature review

This study makes a contribution to the literature on search engine competition by analyzing search engine competition with the option of introducing a knowledge-sharing service. To the best of our knowledge, this study represents probably the first attempt to analyze the static competition between an inferior search engine and a superior search engine when they have the option to introduce a knowledge-sharing service. Kim and Tse [11] consider the dynamic competition between an inferior search engine with a knowledge-sharing service and a superior search engine without a knowledge-sharing service. They show that the inferior search engine will benefit more from its knowledge-sharing service if the amount of online content decreases. They also suggest that an inferior search engine should generally close its answer database to increase its market share. However, they do not provide an analytical condition under which the inferior search engine should keep its answer database closed. Telang et al. [18] provide a static model of competition between an incumbent search engine and a new search engine. Their study shows that multiple search engines with different search qualities can coexist because search engines do not charge a fee to users and their performance is limited; as a result, searchers tend to *multihome*, i.e., they visit multiple search engines. Telang et al. [18] do not consider the amount of information as a part of search quality, but the proposed model explicitly includes the amount of information in the search engine's decisions regarding the development of a knowledge-sharing service and the optimal search quality. Pollock [17] suggests that Google's dominant position in many countries is likely to be strengthened when each search is performed on a single search

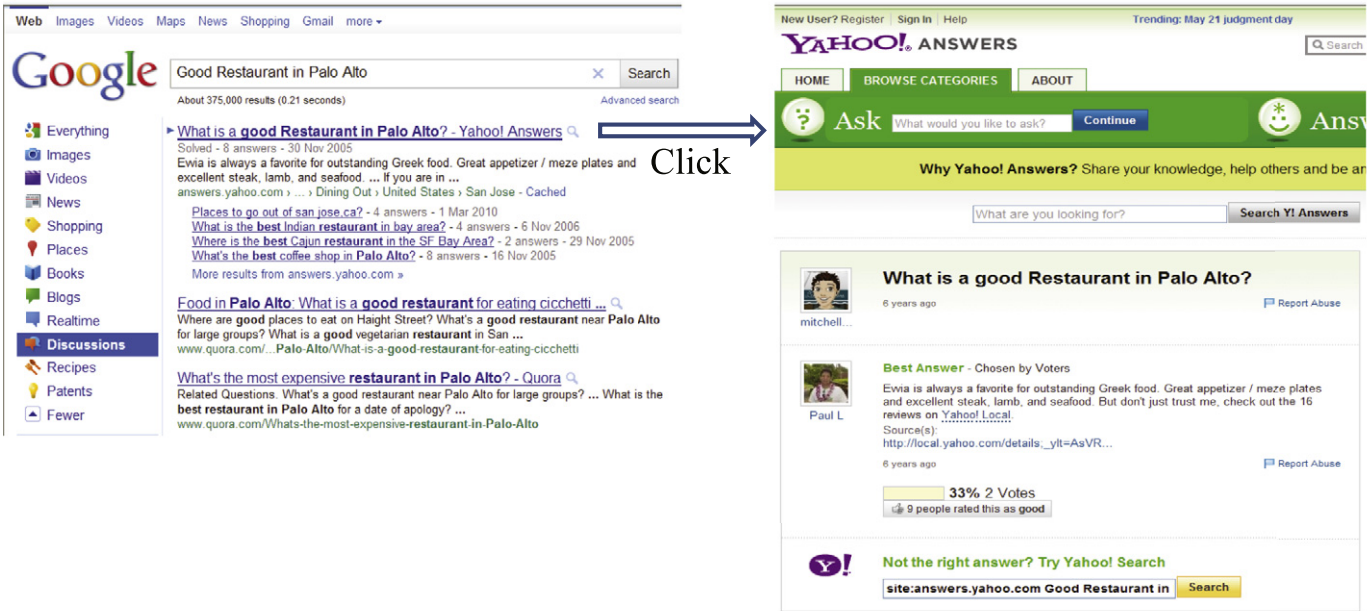

Fig. 1. Google provides a link to Yahoo Answers when "Good Restaurant in Palo Alto" is searched.