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QUALITY UNCERTAINTY AND ADVERSE SELECTION IN ONLINE SPONSORED-SEARCH MARKETS

Web-Based Information Systems and Applications

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Abstract

Sponsored-search mechanisms, where advertisers bid for better placement in the listing of search results on Yahoo! and Google, have emerged as the dominant revenue model for online search engines. Interestingly, Yahoo! and Google employ different mechanisms to determine the placement of bidders' advertisements. This provides an unprecedented opportunity to extend the research relating quality and advertising in traditional markets to the online setting, and also examine whether intervention by the search intermediary impacts the outcomes observed in these markets. Using data from online sponsored-search auctions, we examine the relationship between advertisers' quality and their advertising-intensity, indicated by their willingness to pay for search listings. We assess how this relationship differs across search, experience, and credence products characterized by differing degrees of quality uncertainty as well as across the two markets. We find significant differences in the quality-advertising relationships across the three product categories as well as across the two market mechanisms. We discuss the implications of our findings for consumers as well as intermediaries, and provide directions for future research in this emerging context.

Keywords: Sponsored-search, online advertising, quality uncertainty

Introduction

The emergence of *sponsored-search* as a viable alternative not only to *organic* (algorithmic) search but also to traditional advertising raises several issues of interest to academicians and practitioners. While this rapidly growing advertising mechanism provides significant revenues to search intermediaries such as Google and Yahoo!, the presence of paid results presents a new kind of informational problem in the digital realm. An inherent conflict of interest arises in the sponsored-search (also known as paid-placement or keyword-advertising) context, where information intermediaries deliver information about sellers and their offerings, but are paid by those same sellers they “certify” (Gaudeul 2004).

Despite the rapid growth of sponsored-search, more than 62% of online consumers are unaware of the distinction between organic and sponsored-search results (Fallows 2005). In addition, the majority believe that an advertiser ranked higher is of higher quality than those appearing lower in the sponsored-search listings (ibid.). These beliefs are also reflected in the substantially higher number of clickthroughs received, and purchases made from the sellers listed at the top of the search listings, compared to those appearing lower in the listings (DoubleClick 2006). Given

the proclivity of consumers to visit (and buy from) the advertisers appearing at the top, the highest bidders stand to gain disproportionately more than their counterparts lower down the search listings. Clearly being on top of the sponsored listings is beneficial to *all* firms. However, consumers as well as search intermediaries would benefit only if the firms listed on top are also of *higher quality*.

In prior research, seller quality has been measured as credibility or consumers' perceptions of trustworthiness (Fogg and Tseng 1999), authoritativeness or connectedness of the seller's Web site to many good hubs (Kleinberg 1999), and Web site quality such as ease-of-use and professionalism (Loiacono et al. 2002). While seller-quality is clearly a multidimensional construct, for the purposes of our study, seller quality is defined as the online seller's propensity to deliver a high quality good (or service). Thus, a low quality seller is one with a high likelihood of misrepresenting low quality goods as high quality goods, while a high quality seller is more likely to provide high quality goods.

Sponsored-search mechanisms that allow firms to buy positions on the listings can potentially introduce a bias in the search results, reducing the value of online search to consumers. Consequently, understanding the *quality-rank* correlation becomes imperative as it has significant implications for consumer welfare as well as the future of sponsored-search advertising. Given the current state of consumer awareness and beliefs, sponsored-search mechanisms that enable low quality bidders to be placed at the top of the search listings can adversely affect consumer welfare and reduce the utility of such mechanisms for consumers. On the other hand, the widespread popularity and burgeoning revenues associated with sponsored-search markets suggest that the market mechanism may be self-correcting. The performance of sponsored-search mechanisms therefore remains an empirical question that needs to be validated, and is one that we examine in this study. In particular, we examine the relationship between advertisers' quality and their advertising-intensity (or level-of-advertising) as indicated by their willingness-to-pay for search listings across both Yahoo! and Google.

Research Context

Traditionally search services have used "crawler-based" search mechanisms that maximize the *relevance* of their search results to a user's query. The perceived unbiasedness of these "organic" search results contributed to the popularity of search engines. While search engines have historically served organic listings for free, more recently, sponsored-search has been rapidly gaining significance. In 2004, sponsored-search represented a market of about \$3.8 billion, making up more than 40% of the total online advertising dollars spent by companies in the United States¹. This is projected to more than double over the next few years.

Sponsored-search Models

Google, with a U.S. market share of nearly 37%, followed by Yahoo!, at 30%, are the two premier search engines. Both search engines display sponsored listings alongside their organic search results. Advertisers that wish to be listed on their sponsored-search listings can bid on keywords related to their offerings in a continuous open-bid auction. Each advertiser pays the bid amount only for clicks received in this pay-per-click (PPC) model. The higher the bid, the higher the seller's advertisement appears in the results. Interestingly, the two search intermediaries adopt different mechanisms in ranking their sponsored-search results. Yahoo! employs a pure market mechanism where the higher the advertiser's bid-per-click, the higher her placement in the listing of sponsored-search results for a user's query. Google is a "regulated" market where the position of an advertisement/listing is a function of the advertiser's bid per-click as well as its clickthrough rate (CTR), i.e. the number of clicks the advertisement gets when displayed. If an advertisement fails to generate sufficient clicks from users, it is penalized and moved lower down the list.

Given the role that bids placed by advertisers play in determining their ranking in the search listings, an important issue of interest to consumers, search intermediaries, and advertisers is the relationship between advertising-intensity and the advertiser's quality. The existence of these different sponsored-search mechanisms, one with, and the other without intervention by the search intermediary, provides a unique opportunity to compare the efficacy of these mechanisms as well as examine their performance and welfare implications

¹ Source: "Web Search Sites See Clicks Add Up to Big Ad Dollars", New York Times, February 4, 2005

While the traditional criterion of *relevance* ensures that non-matching results are not displayed in top-ranked positions on listings, it does not guarantee the reliability and trustworthiness of the seller submitting the advertisement. Our focus in this paper is on the *quality of the bidders/advertisers* in the sponsored listings rather than the *quality of the ad*. To the best of our knowledge ours is the first empirical study to examine the relationship between advertisers' quality and advertising-intensity as indicated by their rankings on sponsored-search listings in Yahoo! and Google.

Theoretical Background

Fundamental to the sponsored-search model is the “keyword” or “query” that advertisers bid for. In the context of our study, these keywords represent the offerings from sellers that consumers search for. Given our focus on quality uncertainty, we seek to examine if sellers of products characterized by varying levels of quality uncertainty exhibit differences in their bidding behavior, manifested in the outcomes of sponsored-search auctions.

A Framework for Product Categories

Nelson's (1970) classification of products into *search*, *experience* and *credence* (SEC) goods is particularly relevant in this context, as it captures the underlying uncertainty consumers face in purchasing these products. The SEC framework has been widely used in the marketing and economics literature to examine consumer search behavior as well as firms' advertising strategies (Ekelund et al. 1995). According to the SEC framework, attributes of goods can be analyzed in terms of three properties — *search*, *experience*, and *credence* (Darby and Karny 1973; Nelson 1970). “These properties are used to categorize the point in the purchase process when, if ever, consumers can accurately assess whether a good possesses the level of an attribute claimed in advertising” (Ford et al. 1990). Search goods have characteristics that are identifiable through inspection prior to purchase. Experience goods have features that are revealed only through consumption. Finally, consumers can never be certain of the quality and value of credence goods purchased even from ex post observations and use. Typical examples of each are provided in Table 1 below².

The defining characteristic underlying this segmentation — *pre-purchase quality uncertainty* — is therefore increasing from search to experience to credence goods, as quality becomes more expensive to judge (Darby and Karny 1973).

Uncertainty and Adverse Selection

There is a significant body of research examining issues stemming from informational asymmetries between buyers and sellers and the potential for adverse selection with low quality sellers masquerading as high quality ones (Ausubel (1999) [credit-cards]; Genesove (1993) [used-cars]). The uncertainties faced by consumers in their purchase decisions are only further exacerbated in online channels due to the lack of sensory cues. In a study comparing stamp auctions in online and offline settings, Dewan and Hsu (2004) find that the lack of information regarding quality in online auctions leads to adverse selection and lower prices compared to traditional auctions. Jin and Kato (2005) find that uninformed consumers are willing to pay a premium to sellers who make vacuous overstatements of quality, leading to consumer frauds in some online auction markets. These results highlight the risks faced by online buyers. To overcome these problems of adverse selection, online markets have resorted to technology-aided mechanisms such as online reputation systems (Ba and Pavlou 2002). However, there is no consensus on the effectiveness of such mechanisms.

Our study contributes to this growing body of work that examines the effectiveness of various online markets by investigating a relatively new phenomenon on the Internet — sponsored-search. In doing so, we also seek to understand the need and effectiveness of interventions in sponsored-search mechanisms in alleviating any potential problems of adverse selection.

² It is pertinent to note here that the boundaries between these categories can be fuzzy, and the categories represent regions in a continuum.

Advertising and Seller Quality

The integration and co-evolution of *search* and *advertising* is a salient feature of sponsored-search models. Research in advertising has mostly focused on traditional media such as television and print with the general conclusion that advertising has the potential to reduce information asymmetries and help improve the efficiency of the market (Ekelund et al. 1995). While some analytical models suggest that advertising expenditures should be positively related to quality (Linnemer 2002; Nelson 1974), Schmalensee (1978) and Comanor and Wilson (1979) show that lower quality firms, under certain conditions will advertise more as compared to high quality sellers. Empirical research (e.g., Moorthy and Zhao 2000) is also inconclusive about the relationship between seller-quality and advertising-intensity. Existing work on online advertising related to our study primarily falls into two streams. The first examines the effectiveness of various measures of Internet advertising performance, including clickthrough rate (Dreze and Husserr 2003). The second stream assesses consumer attitudes towards online advertising (for a review see Hollis 2005). We add to this growing body of work by examining the relationship between seller quality and their advertising intensity in the online channel where there is greater potential for adverse selection.

Data Description and Analysis

We collect data from two sponsored-search mechanisms — AdWords and Overture — used respectively by Google and Yahoo!. Following the SEC framework we selected a total of 36 keywords, twelve each in of the three categories. The keywords representing products are adapted from Ekelund et al. (1995). For each of these product-keywords, we collected daily data on advertisers’ positions or ranks on listings from the sponsored-search results for a period of 60 consecutive days in the fall of 2004. After restricting our focus to products/keywords that had a sufficient number of advertisers bidding for keywords, and discarding bidders that bid less than 30 days, our final dataset consisted of 9 keywords in each category, as listed in Table1.

The data on advertiser’s quality was gathered from Alexa.com, which collects detailed site usage data from more than 10 millions users that contribute this information by using the online Alexa toolbar. Prior research in IS has employed Alexa data as a proxy for quality (Palmer 2002).

Table 1. Classification of Keywords as per SEC Framework		
Search	Experience	Credence
Apparel	Auto Insurance	Cosmetic Surgery
Books	Brokerages	Counseling
CD	Cruises	Home Security Systems
Cell Phones	Event Planning	Pest Control
Flight Tickets	Healthcare	Psychics
Laptops	Jewelers	Tax Services
Refrigerators	Martial Arts	Therapy
Television	Moving And Storage	Used Cars
Toys	Perfumes	Vacation

Measures

The measures are classified into three groups: a) the outcome of sponsored-search auctions or the rank obtained by firms, b) quality of the firms, and c) product-type as shown in Table2.

The *dependent variable* of interest is the ranking advertisers receive on sponsored-search lists of Yahoo! and Google. In concert with industry research studies that find that consumers typically do not search beyond the first

page of search results³, we restrict our focus to the top fifteen search listings for each keyword. Within each keyword category, advertisers are first ordered by their average rank in the listings over the period of our data collection (not including the days that they did not bid) and the top fifteen ranked firms are then selected to form a smaller subset. The ranks achieved by advertisers are depicted using AVGRANK, a continuous measure of the average position obtained by the advertising firm in the paid-search listing over all the days it bid.

The main *independent variable* of interest in the study is the QUALITY of the advertiser, measured using TrafficRank provided by Alexa. TrafficRank is a traffic measure that uses a composite score consisting of page-reach (% of Internet users who visit a given site) and page-views (the average numbers of unique pages viewed/user/day). In this manner TrafficRank tracks not only the seller's ability to attract clicks, but also the stickiness of the seller's Web site- the ability to get its customers to visit more pages on its Web site. The more visitors a Web site attracts and the longer they stay can be argued to be indicative of better seller quality. For *TrafficRank*, a lower value indicates higher quality and vice versa.⁴

SEARCH, EXPERIENCE, and CREDENCE are binary (dummy) variables that represent product types increasing in pre-purchase quality uncertainty. Finally, we collect information on the AGE of the firm from Alexa, measured as the number of days the firm has existed online.

Table 2. Measures		
Variable	Measure	Description
POSITION	AVGRANK [%]	Sample average of ranks obtained by seller during the 60-day period
PRODUCT_TYPE	SEARCH	Dummies for goods
	EXPERIENCE	
	CREDENCE	
QUALITY of advertiser or seller	TRAFFICRANK ^{\$}	Combination of page-view rank (average number of pages visited by Internet users at the site) and page reach (% of all Internet users who visit a site)
Interactions (mean-centered)	SEARCH X QUALITY	Product of SEARCH and QUALITY
	EXPERIENCE X QUALITY	Product of EXPERIENCE and QUALITY
	CREDENCE X QUALITY	Product of CREDENCE and QUALITY
Control	AGE	Days since the seller's Web site was established on the Internet

[%] Lower AVGRANK indicates top Position in the listings and vice-versa; ^{\$} Lower TrafficRank indicates higher Quality and vice-versa

Methodology and Analysis

Our primary goal is to examine the relationship between seller-quality and average ranks achieved in the sponsored-search listings. We use regression analysis to examine whether this relationship further varies across different

³ A research study by Jupiter Research and search marketing firm iProspect finds that nearly 90% of the users in their study clicked on a link in the first page. Source: <http://news.bbc.co.uk/2/hi/technology/4900742.htm>

⁴ We also collected data on two other quality measures, number of incoming links to a website and customer ratings of the seller (and website). We find that all three are correlated and produce qualitatively similar results, increasing the robustness of our findings.

product types. Interaction terms are created using centered main effects variables, QUALITY and PRODUCT_TYPE to minimize multi-collinearity. We include the simple OLS shown in [1] as a benchmark in our analysis.⁵

$$AVGRANK = \alpha_1 + \alpha_2QUALITY_i + \alpha_3PRODUCT_TYPE_i + \alpha_4QUALITY_i * PRODUCT_TYPE_i + \epsilon_i \quad [1]$$

Endogeneity: It is possible that the position of a firm in sponsored-search listings may affect its TrafficRank, the measure of seller's quality in our study. If so, it would imply that our model suffers from recursive endogeneity (i.e. TrafficRank affects position and position affects TrafficRank)⁶, and therefore OLS is insufficient. We therefore test for the endogeneity of TrafficRank using AGE as the instrumental variable. Theoretically, the age of a Web site would be correlated with its traffic, and therefore can be used to predict the latter. It is however, unlikely that AGE would have a direct impact on the position of the seller on sponsored listings. From the 2SLS analyses, we find that the first-stage F is highly significant for both Google (F(5,266)=51.34, p<0.01) and Yahoo (F(5,344)=39.62, p<0.01); and much higher than the minimum value of 10 (Staiger and Stock 1997). The corresponding AGE coefficients are significant (p<0.01) indicating that AGE is both a valid and relevant instrument. However, since neither the Wu-Hausman F test (Wu 1973) or the Durbin-Wu-Hausman χ^2 test (Hausman 1978) is rejected, we fail to reject the null that TrafficRank is exogenous. Based on these analyses, we find that OLS is unbiased, consistent and the more efficient estimator for our model.

In the next set of analyses, we control for the age of the firm in order to distinguish between lower quality and newly established firms in the online market. We specify equation [2], with normalized quality measure.

$$AVGRANK = \gamma_1 + \gamma_2N_QUALITY_i + \gamma_3PRODUCT_TYPE_i + \gamma_4N_QUALITY_i * PRODUCT_TYPE_i + \epsilon_i \quad [2]$$

It is further possible that unobserved variables relating to each keyword affect the outcomes observed in the above analyses. While the above analyses assume that the observations are not systematically correlated with the error terms, the observations, and subsequently residuals, within each keyword may not be independent. We examine three additional models to deal with this structural complexity. In model [3], we use cluster robust standard errors in a standard analysis to account for the fact that the observations are clustered into keywords and that they may be correlated within, but would be independent between keywords (Wooldridge 2002).

$$AVGRANK = \gamma_1 + \gamma_2N_QUALITY_i + \gamma_3PRODUCT_TYPE_i + \gamma_4N_QUALITY_i * PRODUCT_TYPE_i + \epsilon_i \quad [3]$$

In model 4, we conduct a Least-Squares Dummy variable (LSDV) regression by including dummies for keyword in the baseline model.

$$AVGRANK = \delta_1 + \delta_2N_QUALITY_i + \delta_3PRODUCT_TYPE_i + \delta_4N_QUALITY_i * PRODUCT_TYPE_i + \delta_5KEYWORD1 + \dots + \delta_{31}KEYWORD26 + \epsilon_i \quad [4]$$

Finally, in model 5 we also estimate a fixed-effects (FE) regression model treating keyword as the grouping variable over all sellers. We conduct split sample analyses for each of the three product types, while controlling for the fixed effects of keyword.

$$AVGRANK = \zeta_1 + \zeta_2N_QUALITY_i + \zeta_3KEYWORD1 + \dots + \zeta_{10}KEYWORD8 + \epsilon_i \quad [5]$$

Results

After accounting for missing values from the top fifteen ranked firms for the 27 keywords, our total sample for Yahoo! is 353 and for Google is 274. The results from regression analyses are presented in Table 3. It should be noted here that since the control keyword category is SEARCH, the main coefficient of QUALITY in the regression equations, represents the change in position on sponsored listings driven by one unit of change in quality for search

⁵ AVGRANK is naturally ordered as it measures the position in sponsored listings, and we therefore also repeat the analysis for an ordered dependent variable, ORDRANK using ordered-probit regressions. We obtain similar results, and only report OLS results.

⁶ While TrafficRank is not synonymous with clicks received on paid-listings, the latter certainly contributes to the traffic generated at a seller's website. For instance, being in top positions in sponsored-search listings attracts more clickthroughs, although this per-se does not determine TrafficRank. We ensure this in two ways. 1) The correlations between change in seller's ranks on paid-listings and changes in TrafficRank, page reach and page views, during 1week, 1month and 3month periods prior to data collection are highly insignificant. 2) Regressions using these alternate TrafficRank measures produce consistent results.

goods. The two interaction terms between quality and experience, and, quality and credence goods then are a measure of how much this relationship changes for experience and credence goods, compared to search goods.

We first compare the corresponding baseline models across Yahoo! and Google depicted in Table3. Across Y1, Y2, G1 and G2, we find that QUALITY is positively correlated with average position obtained by the firm in the paid-search listings. Additionally and more interestingly, we find that the coefficients of the interaction terms are negative and significant in these models for Yahoo!, but not for Google. These findings suggest that the relationship between seller-quality and positions achieved in listings are different for experience and credence goods, as compared to search goods for Yahoo!. The negative sign of the interaction coefficients in all cases implies that the relationships are less positive for experience and credence goods. There appears to be no significant differences across the three product categories for Google. The findings in models 3 and 4 reinforce the results of the simpler models 1 and 2.

Table 3. Regression Analyses

Model	Yahoo!				Google			
	Y1: AVGRANK	Y2: AVGRANK	Y3: AVGRANK	Y4: AVGRANK	G1: AVGRANK	G2: AVGRANK	G3: AVGRANK	G4: AVGRANK
Constant	8.60 (0.23)***	8.60 (0.23)***	8.57 (0.20)***	8.22 (0.71)***	4.80 (0.15)***	4.73 (0.15)***	4.74 (0.13)***	4.01 (0.55)***
QUALITY	0.55 (0.25)**				0.35 (0.13)***			
N_QUALITY		0.47 (0.24)*	0.47 (0.21)**	0.62 (0.28)**		0.40 (0.15)***	0.40 (0.15)**	0.48 (0.18)***
EXPERIENCE	-0.28 (0.26)	-0.25 (0.26)	-0.25 (0.25)	-1.33 (0.79)*	0.01 (0.18)	-0.05 (0.17)	-0.05 (0.18)	0.74 (0.60)
CREDENCE	-0.13 (0.27)	-0.16 (0.27)	-0.16 (0.23)	-0.06 (0.81)	-0.12 (0.18)	-0.18 (0.18)	-0.18 (0.16)	0.15 (0.68)
QUALITY * EXPERIENCE	-0.50 (0.29)*	-0.50 (0.29)*	-0.51 (0.29)*	-0.48 (0.33)	0.13 (0.15)	0.12 (0.17)	0.12 (0.19)	0.19 (0.20)
QUALITY * CREDENCE	-1.30 (0.27)***	-1.30 (0.27)***	-1.29 (0.17)***	-1.24 (0.29)***	0.07 (0.15)	0.05 (0.17)	0.05 (0.18)	0.14 (0.20)
N	353	350	350	350	274	272	272	272
F	5.73***	5.53***	13.89***	1.56**	1.84	1.89*	2.74**	0.75
R ²	0.076	0.075	0.0745	0.1242	0.033	0.034	0.0343	0.0824
Adj. R ²	0.063	0.061		0.0448	0.015	0.016		0.0276

* indicate significance at 0.1 level, ** at 0.05 level and *** at 0.01 level; parentheses contain standard errors

While the results in Table 3 highlight the *relative* differences between product categories, in order to determine the extent of adverse selection, it is important to examine the *absolute* relationship between QUALITY and POSITION to establish the presence of adverse selection. Adverse selection is present if we observe a negative relationship between quality and positions obtained by sellers. We test for such a relationship across all three product types using tests of linear combinations as depicted in Table4 for Yahoo! and Google.

These *absolute* results for Yahoo! (Y1-Y4) and Google (G1-G4) in Table 4 are in concordance with the above findings. For Yahoo!, they suggest that the coefficient for quality is positive and strongly significant for search goods. On the other hand, the coefficient for credence goods is negative and significant in three of the models. The corresponding coefficients for experience goods, are very close to zero, and lie in between those of search and credence. Different outcomes are evident for Google. The coefficients for all three product-types are positive and significant in all models. The fixed effects model shown in [5] above with split samples also provide consistent

results for both Yahoo! and Google (not shown). However, since the Hausman (1978) null is not rejected, the random effects model is a better choice for our setting⁷.

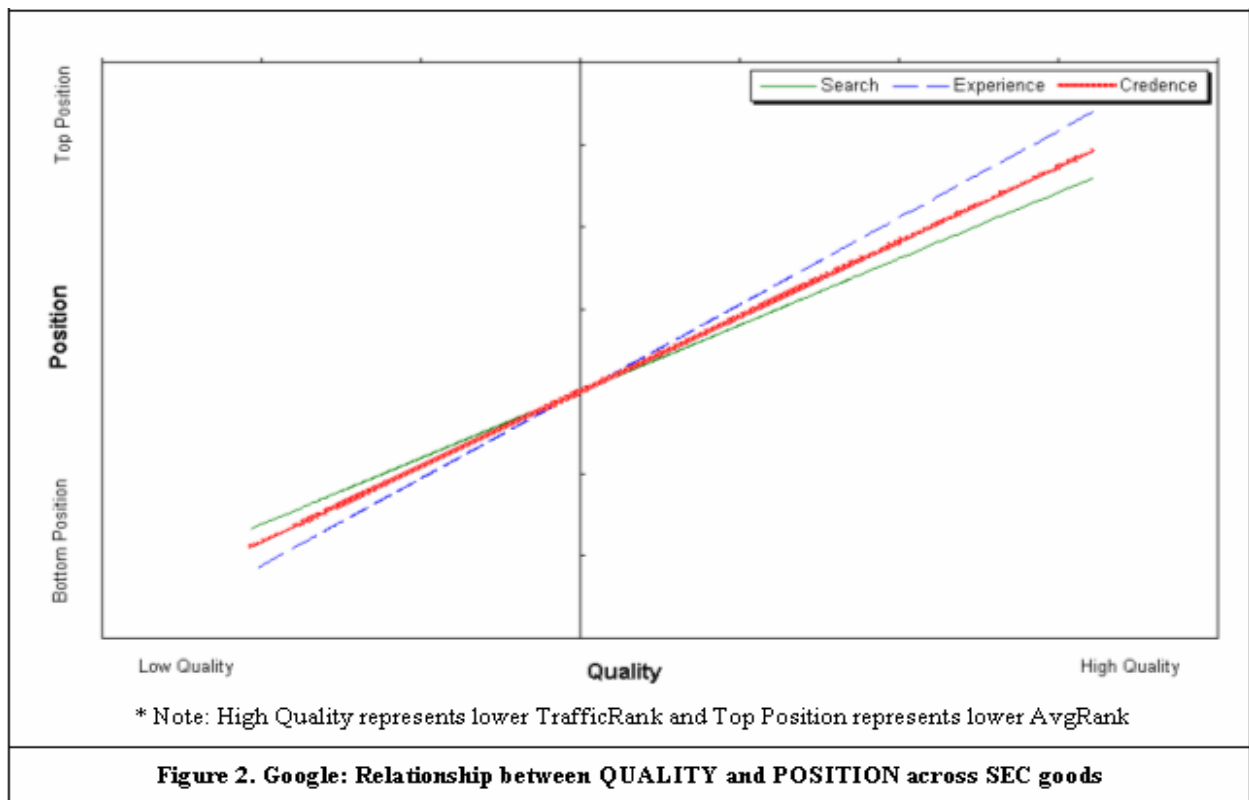
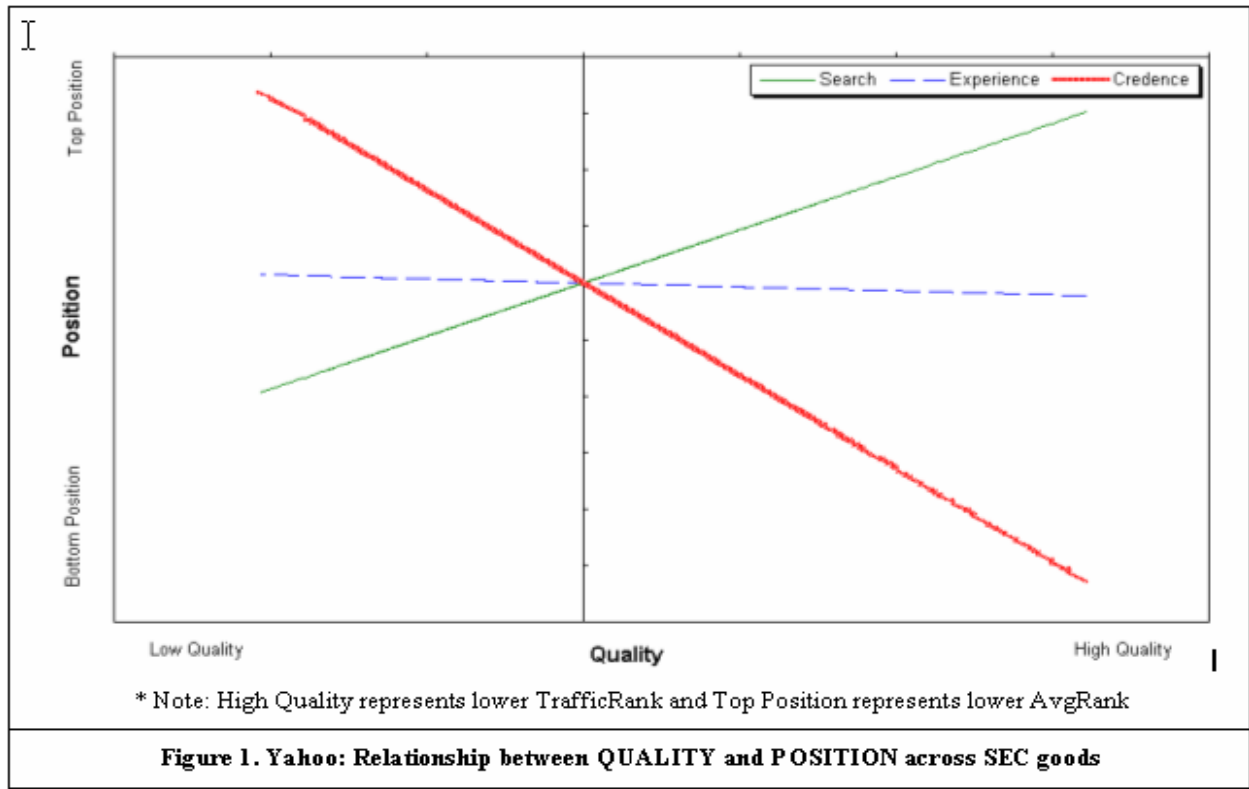
Table 4. Test of the Absolute Quality Coefficient across Product Types

Type	Yahoo!				Google			
	Y1: AVGRANK	Y2: AVGRANK	Y3: AVGRANK	Y4: AVGRANK	G1: AVGRANK	G2: AVGRANK	G3: AVGRANK	G4: AVGRANK
Search	0.52 (0.25)**	0.44 (0.24)*	0.47 (0.21)**	0.62 (0.28)**	0.35 (0.13)**	0.40 (0.15)***	0.40 (0.15)**	0.48 (0.18)***
Experience	0.02 (0.40)	-0.05 (0.40)	-0.03 (0.43)	0.14 (0.48)	0.48 (0.21)**	0.53 (0.23)**	0.53 (0.20)**	0.67 (0.28)**
Credence	-0.78 (0.37)**	-0.86 (0.37)**	-0.82 (0.24)***	-0.62 (0.41)	0.42 (0.21)**	0.46 (0.22)**	0.46 (0.19)**	0.62 (0.27)**
F-test for equality of interaction coefficients	9.55***	9.21***	20.59***	8.09***	2.45*	2.66**	3.23**	2.60*

* indicate significance at 0.1 level, ** at 0.05 level and *** at 0.01 level; parentheses contain standard errors

These results, depicted graphically in Figure 1 for Yahoo! and Figure 2 for Google, show that the two mechanisms produce significantly different results. It appears that intervention by the search intermediary (Google) helps keep adverse selection in check. However, there seems to be significant evidence of adverse selection in Yahoo! for experience and credence goods, but not for search goods. The sponsored-search mechanism fails mainly in situations where its success would have been the most beneficial for consumer welfare — in the case of experience and credence goods, where consumers have high levels of pre-purchase quality uncertainty.

7 The Hausman test examines the hypothesis H0: the difference in coefficient across FE and RE is not systematic. In our data, it is not rejected, suggesting that there are no significant group or keyword effects in the model, and the criteria of efficiency suggests that we estimate a random effects model.



Discussion and Implications

While online markets improve consumer welfare by lowering search costs, the presence of quality uncertainty can lead to adverse selection. Thus, it is possible that the higher costs of adverse selection counteract the benefits of lowered search costs for consumers (Fabel and Lehmann 2002). The sponsored-search market provides an excellent test-bed to examine these issues. While adverse selection was almost non-existent in the market for search goods, the unregulated sponsored-search mechanism used by Yahoo! suffered from problems of adverse selection for experience and credence goods. However, Google's intervention mechanisms (by moderating the advertiser's willingness to pay with its performance measured by clickthrough-rates) seem to be capable of circumventing the problem of adverse selection.

Our findings also add to existing work examining the efficacy of online markets for different product categories. Our study also contributes to the literature on advertising by testing traditional theories in emerging channels. Just as eBay and Amazon resort to user-feedbacks and reviews to alleviate adverse selection problems, our findings suggest that online sponsored-search mechanisms may be able to decrease the negative impacts of adverse selection by providing additional signals of quality about advertisers. Experience and credence are product categories that lack adequate quality information, and consequently, they are also goods for which the presence of reliable signals of seller quality would maximally benefit consumers.

Our findings are particularly relevant for the providers of search services. Sponsored-search listings that are biased can not only reduce consumer welfare, but also drive out higher quality firms, and eventually, reduce the profitability of the intermediary as well. Our study provides preliminary evidence of the ability of relevant market intervention mechanisms to help reduce adverse selection. In particular, search intermediaries would do well to provide better information regarding their sponsored-search mechanism and to incorporate reputation mechanisms to aid consumers in their decision-making for online purchases. In particular, provision of additional quality information such as ratings and reviews from Bizrate.com and Epinions.com alongside the search listings can help reduce the risk faced by consumers and improve efficiency.

Limitations and Ongoing Research

We discuss some limitations of our study here. Our primary measure of seller quality is the traffic rank of the seller's Web site, and is calculated by aggregating the traffic generated by a subset of online consumers that have installed the Alexa toolbar. Our measure of quality is therefore only accurate to the extent that this sample is representative of the broader online population. The use of alternate measures of seller quality, namely the number of incoming links and ratings provided by a subset of online consumers provides us with triangulation of our findings. Second, while our classification of keywords draws from existing literature, in reality the boundaries are fuzzy as all goods have search, experience and credence attributes, albeit to varying extents. Third, our model is correlational at best. We cannot make any causal claims unless we observe the quality-position link longitudinally.

While our preliminary results highlight some interesting aspects of the sponsored-search mechanisms, we are in the process of refining and extending our analyses. First, we seek to examine if non-linear models can provide additional insights into the quality-rank relationship. Preliminary analyses suggest that while the results are consistent with the linear model for search and credence goods, for experience goods, the relationship is markedly curvilinear with medium quality firm achieving the highest positions. Second, it would also be useful to examine the bidding patterns for keyword combinations as well as for keywords representing brands (such as "Sony Vaio" or "Dell Inspiron") rather than generic products. In addition, future research could examine how consumers respond to sponsored-search using laboratory studies designed to analyze the differential search strategies they adopt across different search formats.

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