Online Sponsored Search Advertising as a Quality Signal and its Impact on Consumer Behavior

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ONLINE SPONSORED SEARCH ADVERTISING AS A QUALITY SIGNAL AND ITS IMPACT ON CONSUMER BEHAVIOR

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Abstract

The advent of sponsored search advertising raises many interesting questions regarding consumer’s behavior, seller’s advertising strategy, and the ensuing market dynamics. Online markets are characterized by significant information asymmetries and consumers rely on a number of informational cues or signals to infer the seller’s quality. Of the various quality signals, advertising and price have been identified as being the two most important cues used by consumers in traditional markets. However, online sponsored search markets have a number of unique characteristics which may affect consumer search and purchase behavior. This study employs theories from IS, marketing, and economics to understand the impact of sponsored search advertising on consumer behavior in a market that exhibits information asymmetry. We conduct a lab experiment and find that the availability of relative advertising expenditure -- observed by the position of the sellers on the sponsored search listings has a significant impact on consumer purchase behavior.

Keywords: Sponsored Search Advertising, price, quality, signal, quality uncertainty, experiment, consumer behavior.
Introduction

Recent reports suggest that Internet advertising, especially in the sponsored search format, is growing at unprecedented rates and is expected to become a dominant form of customer acquisition for traditional firms. Indeed, sponsored search advertising has very rapidly become an important and significant forum for advertisers, accounting for 40% of all advertising spending online (PricewaterhouseCoopers, 2005). Sponsored search (also known as “paid search” or “pay-for-placement” or “keyword”) advertisements are text-based advertisements that are displayed alongside “organic” (algorithm-based) search results, in response to a user’s search query. The sponsored search model employs an auction mechanism for pricing the placement/position of an advertisement in the sponsored search listing for each keyword. Advertisers bid on keywords relevant to their product or service, for enhanced placement (i.e., higher rank) of their advertisements in sponsored search results. The higher the bid, the higher the advertiser’s message appears in the sponsored search list, which should typically lead to more sales-leads (click-throughs), and consequently greater sales.

Given the various advantages of sponsored search advertising over traditional approaches, including the ability to precisely target messages to potential customers who are actively searching for sellers, and enabling sellers to more directly relate advertising expenditures to outcomes, the rapid growth of sponsored search is not surprising. Despite the phenomenal growth and increase in overall spending, however, research on the implications of this new form of advertising is scarce. Specifically, consumer behavior in the context of online sponsored search advertising is surprisingly unexplored, with few notable exceptions (Hoque and Lohse, 1999; Jansen and Resnick, 2006).

It is well known that search engine results have a significant influence on consumer’s purchase decisions. Recent studies show that consumers tend to focus on the top results in these search listings and are more likely to select a seller listed higher (DoubleClick, 2006). Yet, more than 62% of consumers are not knowledgeable about why a seller is listed higher, i.e., the allocation mechanism (Fallows, 2005). Unaware that sellers pay to appear on higher positions, a large proportion of consumers (36%) believe that that a seller appearing higher in search results is more prominent than those appearing at lower ranks (iProspect, 2006). How would consumer behavior change if consumers knew about the underlying auction driving sellers’ positions in the listing? This question becomes especially important in the markets where consumers cannot easily distinguish the quality of the sellers prior to purchase. Extant research suggests that consumers may rely on indirect cues or signals to infer the quality of sellers in such markets that exhibit quality uncertainty (Kimani and Wright, 1989). While the importance of advertising and price as signals of quality have been well established in traditional markets (Gerstner, 1985; Kimani and Wright, 1989; Milgrom and Roberts, 1986; Peterson, 1970), the unique informational environment created by sponsored search advertising calls for an investigation of the impact of these signals on consumer behavior in the context of sponsored search markets.

An examination of the quality signaling role of sponsored search advertising becomes especially important due to the prevalence of large quality variations among sellers selling seemingly homogenous products on the Internet (Baylis and Perloff, 2002). In particular the nascent nature of online sponsored search markets and the lack of geographical limitations exposes consumers to new firms and less known sellers. The pay for performance and self-service nature of sponsored advertising further aggravates this problem by dramatically lowering the barriers to entry for smaller firms to advertise nationally. This further diminishes the role of brand name in consumer decision making, and increases the reliance on other indirect information cues such as advertising and price charged by the sellers. Given the extent of information asymmetry in online markets, consumers using these markets may rely on a number of informational cues or signals to infer the quality of the sellers in these markets – advertising and price being the two most important among them. As a result of the underlying rank allocation mechanism based on auctions for specific keywords that ensure a higher placement for sellers, sponsored search markets provide indirect information about seller’s advertising intensity to the consumers. Therefore, they have the potential to influence consumer’s search and purchase behavior, especially in a market with information asymmetry (i.e., quality uncertainty). In this study we examine the extent to which sponsored search markets provide indirect quality cues to consumers and the resulting impact on consumer behavior. Specifically, we examine the impact of informational cues (about the relative advertising expenditure of the firms) on consumers’ search behavior as well as purchase decisions in online sponsored search setting. The research questions addressed in this paper are: 1) Can sponsored search advertising serve as a signal of quality and if so, under what circumstances?, 2) How do perceptions about the correlation between a seller’s advertising expenditure and quality affect consumers’ search and purchase behavior?,

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and 3) How do price signals influence consumers’ reliance on advertising quality signals in their purchase decisions?

![Figure 1. Research Model](image)

The research model is presented in Figure 1. The rest of the paper is organized as follows. We present a brief review of the sponsored search literature and other relevant literature from information systems, marketing, and economics that has studied consumer search and purchase behavior under quality certainty. Next we present research hypotheses, research methodology, and results. Finally, we provide a discussion of the findings and their implications.

**Related Research**

Given the growth in the sponsored search industry, it is not surprising that researchers and practitioners have focused their attention on understanding this online advertising phenomenon. Much of this research approaches the phenomenon from an auctions lens, such as the design of more optimal better rank allocation mechanisms from the perspective of the search intermediary (Aggarwal, et al., 2006; Asdemir, 2006; Edelman, et al., forthcoming; Feng, et al., forthcoming; Lahaie, 2006; Varian, forthcoming), optimal bidding strategies for advertisers (Borgs, et al., 2006; Kitts and Leblanc, 2004; Rusmevichientong and Williamson, 2006) and the underlying market dynamics in sponsored search auctions (Animesh, et al., 2006; Edelman and Ostrovsky, forthcoming). Surprisingly, there is limited research examining consumer search behavior in this context. Jansen and Resnick (2005), in one of the few scholarly studies on consumer behavior in the sponsored search context, examine the perception of searchers towards sponsored search listings and find that consumers are skeptical of sponsored search results and trust them less as compared to organic search listings. Our study adds to this stream of research by highlighting the importance of understanding consumer search behavior in these markets and its implications for the effectiveness of various sponsored search advertising strategies.

Information Systems researchers have extensively examined the impact of online markets on the availability of price and quality information and how online provision of such information affects consumer welfare (Bakos, 1997; Bakos, et al., 2005; Baye and Morgan, 2002; Baylis and Perloff, 2002; Brynjolfsson and Smith, 2000; Smith, 2001; Smith and Brynjolfsson, 2001). As compared with a robust body of research on consumer behavior in online settings (e.g., Gefen, et al., 2003; Jarvenpaa, et al., 2000; Koufaris, 2002; Pavlou, 2003), work examining the influence of online advertising on consumer behavior is considerably more limited (for exceptions see Gao, et al., 2004; Hong, et al., 2004; Wu, et al., 2005). As a consequence of recent growth in online advertising, information system researchers have also started to study the impact of the informational environment created by online advertising medium on firms’ strategies as well as consumers’ behavior. In one of the few IS studies on online advertising, Gao et al. (2004) examine the impact of animated versus pop-up advertisements on consumers’ perceptions and find that the online format and presentation of information significantly affects consumers’ perceptions and attitudes. We extend this stream of research by examining the impact of sponsored search advertising on consumer’s perceptions and shopping behavior.

Our specific focus is on the consumers’ perceptions of the quality of firms appearing within a sponsored search listing and we investigate the impact of online information environments on consumer decision making. Extant
research suggests that subtle changes in information presentation formats can influence consumer choice behavior (Payne, et al., 1993). In an online setting, Mandel and Johnson (2002) found that even simple website design factors such as background pictures and colors can significantly influence the external search effort and consumer choice. Likewise, Lynch and Ariely (2000) show that website design of online stores can be used to influence the search cost of gathering price versus quality information. This differential search cost in turn influences the price sensitivity of the consumers. Mazursky and Vinitzky (2005) compared consumer search behavior in 2-dimensional versus 3-dimensional online shopping interfaces and found that the type of interface affects the consumer search intensity and sequence of search. Hoque and Lohse (1999) also show that subtle changes in the user interface design can influence the information search costs and subsequent choice behavior. Based on the findings, they suggest that unlike traditional yellow pages, online yellow pages should charge advertisers based on their rank in the advertising list. They recommend that since online media exhibits different relationships than print media for some variables, researchers should strive to understand the consumer information processing and decision making processes. Our study on sponsored search advertising is similar in spirit, but focuses on the quality signaling aspect of the ranking in the sponsored search listings, and more specifically, its impact on consumer behavior.

In addition to the above mentioned research, two other streams of literature that are relevant to understanding consumer behavior in the sponsored search context are those related to consumer search, and quality signaling in markets with asymmetric information. Researchers have examined consumer search behavior in markets that exhibit price dispersion. A broad conclusion that emerges from the analytical as (Bakos, 1997; Stigler, 1961) as well as empirical work (Ratchford and Srinivasan, 1993; Schotter and Braunstein, 1981; Zhang, et al., 2006) is the salience of the reservation price in consumer purchase behavior. Consumers use the existing price dispersion in the market and their unit search cost to compute a reservation price and choose the first seller who meets this reservation price. Assumptions implicit in this work is that either quality is not important, or that quality can be ascertained by the consumer prior to a purchase decision. In markets where quality is not easily identifiable, it is not immediately clear how consumer price search behavior would change.

Quality signaling research on the other hand deals with markets that exhibit quality uncertainty but ignores consumer search for price or other information. This stream of research suggests that effective quality-signaling mechanisms are required for the functioning of markets with information asymmetries. A signaling mechanism refers to indirect cues provided by a seller that reveal her true quality. Various external cues (i.e., cues not directly related to product performance) – such as advertising, warranty, brand name and product price – have been identified as the signals of quality (Grossman, 1981; Milgrom and Roberts, 1986). In the context of sponsored search, the role of advertising expenditure in providing quality cues becomes especially relevant. In traditional settings, researchers have found that consumers associate higher advertising expenditure with higher quality (Kirmani and Wright, 1989). However, unlike traditional media, a consumer can relatively easily get more accurate information about the relative advertising expenditure of all the sellers in the consideration set whereas the consumer has to incur search effort to obtain price information. Therefore, it becomes important to understand how consumer’s price search behavior may be affected by the presence of the advertising signal. This study is among the first to examine these issues in the online sponsored search context.

**Hypothesis Development**

**Sponsored-Search Advertising Mechanism: Advertising as a Signal of Quality**

Consumers may use sellers’ advertising expenditure as a signal of quality when they cannot infer the sellers’ service/product quality prior to purchase. Results from experiments show a positive association between advertising expenditure and quality in the consumer’s mind (Kirmani and Wright, 1989). Sponsored search listings provide a ranked list of sellers, sorted on the basis of their advertising intensity. Thus, lacking adequate signals of quality, the relative advertising information contained in the advertisement allocation mechanism can be used as a signal of quality in sponsored search markets. In particular, consumer’s awareness of the advertisement allocation mechanism provides enough information to consumers to infer relative quality of the sellers on the list. Based on the insights from research in traditional media, we posit that:

**H1:** Consumers who are aware of the ranking mechanism will perceive a positive rank-quality correlation (i.e. perception that sellers ranked higher on the list are higher quality sellers).
Impact of Price Information on the Effect of Advertising as a Signal of Quality

In addition to signals like advertising expenditure, consumers may rely on price as a quality signal (Milgrom and Roberts, 1986). Results from empirical studies point to a robust (although moderate) price-quality relationship (Rao, 2005). Further, we argue that availability of additional information, direct or indirect, would reduce consumers’ reliance on price as the signal of quality as consumers will also use other pieces of information to infer quality. Specifically, presence of advertising expenditure information, in addition to pricing information, will lower the weight attached to price information in inferring quality (Broniarczyk and Alba, 1994). Thus we posit that:

**H2a:** Consumers will perceive a positive price-quality correlation (i.e., sellers charging a higher price are of higher quality).

**H2b:** Consumers who are aware of the ranking mechanism will have weaker belief in positive price-quality correlation as compared to the consumers who are unaware of the ranking mechanism.

Advertising as a Signal of Quality

While the above mentioned hypotheses relate advertising intensity (inferred from the advertiser’s rank in the search listings) to consumers’ perceptions of advertiser’s quality, these beliefs are likely to influence consumers search behavior, as well as their purchase decisions. For instance, earlier studies (Roedder, et al., 1986) find that consumer’s prior beliefs about the price-quality correlation affect their search patterns. In such a scenario, provided that the quality dispersion is sufficiently high compared to price dispersion, the consumer would prefer to buy from the topmost sellers on the list, thus leading to high rank premium enjoyed by the sellers.

Due to consumer’s strong preference to buy from one of the topmost sellers on the sponsored list, she would face a constrained set of alternatives to chose from. Consequently, the search intensity to find the highest price offer will decrease and overall search effort will be lower as compared to the situation where consumer is unaware of firms’ relative advertising expenditures. Finally, consumers who have strong belief in price as a signal of quality would search for the highest price (in the expectation of getting the best quality) and pay a high price premium. However, a consumer who has a strong belief in advertising as a signal of quality will only focus its price search among the top few sellers (i.e., constrained search) and thus will not be able to find or buy from sellers who are selling at higher prices (who might appear at lower ranks given that there is not correlation between price and advertising intensity). As a result the price premium paid by subjects with stronger advertising belief will be lower.

Based on these arguments, we posit that:

**H3a:** The stronger the consumer’s belief in advertising signal (i.e., positive rank-quality belief), the lower will be the price premium paid by the consumer.

**H3b:** The stronger the consumer’s belief in advertising signal (i.e., positive rank-quality belief), the lower will be the consumer’s search intensity (i.e., number of alternative sellers visited).

**H3c:** The stronger the consumer’s belief in advertising signal (i.e., positive rank-quality belief), the larger will be the rank premium enjoyed by the seller (i.e., a consumer’s propensity to buy from sellers appearing higher on the list).

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1 In order to isolate the relative weight attached by the consumers to price versus advertising signal, we focus on a market environment where price and advertising are not correlated. Given such market environment (i.e., market where prices charged by sellers do not systematically decrease/increase as we go down the rank in the listing), consumers who believe in both price and quality signal can either act on the price as signal belief or advertising as signal belief. The tradeoff between price and advertising belief will be determined by the relative strength of the signaling beliefs.

2 It is important to note here that quality signaling would exist only when there is quality dispersion in the market. The experimental design ensures that quality dispersion is greater than price dispersion in a market.
Price as a Signal of Quality

Given a consumer’s belief that higher price signals higher quality, she will attempt to search for the higher price as long as the benefits from higher quality are greater that the benefits from lower price (i.e., price dispersion is smaller than quality dispersion). However, to find the price charged by a seller, a consumer has to incur a search cost in visiting that seller’s website. Given there is sufficiently high quality dispersion vis-à-vis price dispersion, stronger a consumer’s perception about positive price-quality correlation, higher will be the marginal benefit for an additional price search. Consequently, the search intensity to find the highest price offer will increase and overall search effort will be higher as a function of the consumer’s belief in positive price-quality correlation.

Finally, consumers relying on price as a quality signal will be less sensitive to the rank of the sellers on the sponsored list. As a result, unlike consumers who rely on advertising as a signal of quality, consumers relying on price signal will not systematically purchase from the seller’s appearing higher on the sponsored list. Based on these arguments, we posit that:

H4a: The stronger the consumer’s belief in the price signal (i.e., positive price-quality belief), the higher will be the price premium paid by the consumer.

H4b: The stronger the consumer’s belief in the price signal (i.e., positive price-quality belief), the higher will be the consumer’s search intensity (i.e. number of alternative sellers visited).

H4c: The stronger the consumer’s belief in the price signal (i.e., positive price-quality belief), the smaller will be the rank premium enjoyed by the seller (i.e. a consumer’s propensity to buy from sellers appearing higher on the list).

Interaction between Price and Advertising Signals

Researchers have called for the need of studying the interactions among various signals of quality (Kirmani and Rao, 2000; Purohit and Srivastava, 2001). This takes on added significance in the context of sponsored search as a consumer has access to not only relative advertising expenditures but also relative pricing information of competing firms. However, the tradeoff between these different signals of quality has not been studied in the context of online shopping and purchase. In prediction tasks, it has been found that consumer’s reliance on price signal is much stronger than her reliance on advertising signal (Broniarczyk and Alba, 1994). We argue that the effect of a signal on the associated action taken by consumers will weaken in the presence of additional quality signals. In our context, a consumer acting on both price and advertising signal beliefs would prefer to buy the highest priced product from the top seller. However, since these signals are not correlated in our experimental setup, a consumer would have to compromise on one of the decision attributes (i.e., price signal or advertising/rank signal). Thus, we hypothesize that:

H5: The stronger the consumer’s belief in advertising signal (i.e., positive rank-quality belief), the weaker will be the impact of price signal (price-quality belief) on price premium.

H6: The stronger the consumer’s belief in price signal (i.e., positive price-quality belief), the weaker will be the impact of advertising signal (rank-quality belief) on rank premium.

Methodology

Extant research on advertising signals and consumer search behavior has primarily used an experimental approach as it is the most appropriate method for achieving a clean test of theory (Lynch and Ariely, 2000; Schotter and Braunstein, 1981; Srivastava and Lurie, 2001; Zwick, et al., 2003). Therefore, we employ an experimental methodology to test the above hypotheses.

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3 Even if the consumers believe that high price denotes high quality, still they have to incur search effort and search the listing to find the seller with the highest price.
Experiment Design

The experiment employs a one factor (knowledge of sponsored search mechanism) between-subjects factorial design where one group of subjects is informed that sellers are ranked in descending order on the sponsored search listing according to how much they pay-per-click (treatment group), and the other group of subjects is informed that all sellers in the market are randomly assigned a rank on the directory listing (control group). The subjects are presented one set of general instructions and a set of specific instructions for their assigned experimental condition (See Appendix B1 for details). The control group has 38 subjects, each of whom is informed that sellers are ordered randomly on the listing, while the treatment group consists of 42 subjects, each of whom is informed that sellers are ordered in the listing based on their relative advertising expenditures. As is common in such experimental settings, undergraduate students in a large northeastern business school were recruited for this experiment. The subjects participate for course credits. In addition they are provided performance-based monetary incentives.

Experiment Overview

The experiment consists of 3 parts: (1) A Shopping Task in which subjects make search and purchase decisions (See Appendix B2), and (2) A Follow-Up Survey (See Appendix B3) in which subjects are asked questions about their beliefs about the price and advertising as signals of quality.

Shopping Task: The shopping task requires subjects to conduct 10 shopping trips using a simulated online yellow pages directory. In each shopping trip, subjects query the directory for a particular product. The online directory presents a list of 10 sellers (identified by fictitious names) along with a link to visit their websites, in a rank-ordered listing. The information provided to consumers about the ordering of the sellers in the directory listing differs across different experimental treatments. The subjects are also informed about the price dispersion and the quality dispersion among the sellers in each market. The quality dispersion (i.e., range of seller quality in a market) is 4 times the price dispersion (i.e., range of prices in a market). Subjects can observe the price being charged by a seller but they have to incur a specified search cost to visit a seller’s website and obtain the price being charged by that seller. The search cost at any point in time in a shopping trip is displayed on the top panel of the computer screen. Information about seller quality is not revealed to the subjects in any treatment at any time during the experiment. Subjects, however, can use advertising and/or pricing information to infer a seller’s quality. We do not provide feedback about the quality of the sellers after each shopping round as the rationale behind using multiple shopping rounds was to compute aggregated measures to get a dependable/consistent measure of subject’s behavior in the given shopping environment rather than testing the learning behavior. Another important point to note is that the price charged by the sellers and the rank at which they appeared on the listing were un-correlated to isolate the relative weight attached by the consumers to price versus advertising signal.

Subjects are asked to maximize their payoffs by buying from the highest quality seller at the lowest price while minimizing the total search cost. The payoff function given to subjects is to maximize: \( U = Q - P - n \cdot c \) (where “Q” is the quality of the product purchased, “P” is the price paid for the purchased product, “c” is the cost to discover a seller’s price and “n” is the total number of sellers searched). This utility function is similar to Diehl, Kornish et al. (2003), except that it explicitly includes search cost in the utility function. Price, seller quality, and search cost are all expressed in experimental dollars. The subjects are provided monetary incentives based on their performance in maximizing their payoff function (i.e., utility derived from the purchase).

Measurement and Data

Knowledge of the sponsored search advertising mechanism is included as a dummy variable that is used to identify those subjects who have different sets of information. This variable is manipulated by providing information about the existence of sponsored search advertising mechanism to the subjects in the treatment groups before they make search and purchase decisions. Subjects in the control group, on the other hand, are informed that the ordering of

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4 Appendices are available online at http://www.box.net/shared/h8id9lcrdj

5 The rationale for having higher quality dispersion is to make the quality attribute - the key outcome of interest - more salient in the decision making process.
sellers in the listing is random. This categorical variable is then, used to examine whether sponsored search advertising mechanism can act as a signaling mechanism.

After completing the shopping task, the subjects state their beliefs about the correlation between seller’s price and seller’s quality as well as seller’s rank on the listing and seller’s quality. Since the relative advertising expenditures of sellers are determined by their rank in the sponsored search listing (in the treatment sample), we use the term rank-quality as being synonymous with advertising-quality. Perceived advertising-quality (HRHQ) and price-quality (HPHQ) correlation is measured using a self reported measure, the items for which are adapted from existing literature (Kirmani, 1997; Kirmani and Wright, 1989). We used a 7-point Likert scale for assessing the strength of advertising-quality and price-quality beliefs where 7 represents “strongly agree that there is a positive correlation” and 1 represent “strongly disagree that there is a positive correlation”. A composite of 3 items was used to create advertisement-quality belief scale – HRHQ (cronbach’s alpha=0.86) and a composite of 2 items was used to create price-quality belief scale – HPHQ (cronbach’s alpha=0.86). The items are presented in the Appendix B3.

The dependent variables -- search intensity, price premium, and rank premium – are calculated based on observed behavior, and are recorded using click-stream data. Search intensity (SearchIntensity) is measured as the total number of sellers visited by a subject in a given shopping trip. Price premium (Price Premium) is the difference between the price at which the subject purchased the product during a shopping trip and the lowest price in that market. The rank premium (RankPremium) is the rank of the seller from whom the subject made the purchase. It is reverse coded variable where 1 represents highest rank (i.e. top rank on the list), and 10 represents lowest rank (i.e. the bottom rank on the list). Thus, a lower value of RankPremium represents a higher rank premium (i.e., indicating a bias towards selecting a seller from the top of the listing). We create aggregated measure of rank premium, search, price premium and search intensity by taking the average over the 10 shopping rounds. The descriptive statistics and correlations are presented in Table 1 and Table 2, respectively.

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<th>Table 1: Descriptive Statistics</th>
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<th>Table 2: Correlation Coefficients</th>
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p values are reported below the correlation coefficients
Results

Manipulation Check

Our manipulation was to provide relative advertising expenditure information to the treatment group but not to the control group. To achieve this objective, subjects in the treatment group were told that seller’s are ranked in the order of their advertising expenditures whereas the control group was told that the order of seller’s on the listing is random. In the follow-up survey, subjects were asked two questions about the ranking of the sellers in the listing to test whether the treatment manipulation was successful or not. These two questions were “in your opinion, did the seller on the third rank incur a higher advertising cost than the seller on the fourth rank on the list?” and “in your opinion, did the seller on the first rank incur the highest advertising cost than the rest of the sellers on the list”. Subjects answered on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). We create a “AdvertisingExpenditure” variable using these two items (cronbach’s alpha=.91) and conduct t-test to examine if the two groups differ in terms of the knowledge about relative advertising expenditure.

We find that subject’s belief about the seller ordering differs significantly. Mean score for treatment group was 5.93 whereas mean score for control group was 3.54 (p<0.001). This implies that the subjects in both the groups did read and understand the instructions, especially regarding the manipulation. Thus, we find that as desired the control group and treatment group differ in terms of the knowledge about the seller’s relative advertising expenditure.

Findings

We compare the distributions of seller quality beliefs in control and treatment group to test the hypothesis (H1) that awareness of the sponsored search allocation mechanism will lead consumers to believe that sellers higher on the listing are of higher quality (i.e., positive advertisement-quality beliefs), and find support for our assertion. Results from a t-test show that the advertisement-quality belief (HRHQ) for the treatment group is significantly greater than 4 (mean=4.60, p<0.01) whereas the mean score for the control group is significantly lower than 4 (mean=2.44, p<0.01). The results imply that a large proportion of consumers use information about relative advertising expenditure to infer the relative quality of sellers.

For subject’s price-quality beliefs, both groups score high on the scale measuring the price-quality correlation belief (HPHQ) (mean of 4.97 and 4.90 for control and treatment group, respectively). Both these means are above 4 (p<0.01) which is the midpoint of the Likert scale suggesting a neutral belief. Thus, results support hypothesis 2a. Further, we compare the mean price-quality scores across groups to test if presence of the advertising signals lowers the belief in price signal. Results from a t-test suggest that the strength of price-quality belief does not differ across groups (p=0.90). Thus, we reject hypothesis 2b.

Next, we examine the shopping behavior (i.e., search intensity, price premium, and position premium) of subjects in the control and treatment conditions. For search intensity, the subjects do not appear to be different across control and treatment groups. Approximately 50% of the subjects in both groups visit only 1 or 2 sellers. The distribution of the price premium paid shows that subjects in the treatment group pay a much smaller price premium as compared to the subjects in control group. Only 25% (approximately) subjects in treatment group pay more than 34 units in price premium whereas around 50% subjects in control group pay more than 34 units in price premium. The distribution of the rank of the sellers from where subjects bought the product shows that subjects in the treatment group bought from sellers towards top on the listing as compared to subjects in the control group. However the difference between ranks is very small. Percentile scores show that 25% subjects in the treatment group bought from sellers ranked 3 or less whereas only 10% subjects in the control group bought from sellers ranked 3 or less.

We tested the hypotheses related to consumer search and purchase behavior using a set of three regression equations as specified below:

\[ \text{SearchIntensity}_i = \alpha_1 + \alpha_2 \times \text{HRHQ}_i + \alpha_3 \times \text{HPHQ}_i + \alpha_4 \times \text{HRHQ}_i \times \text{HPHQ}_i + e_i \]  -- Equation (1)

\[ \text{PricePremium}_i = \beta_1 + \beta_2 \times \text{HRHQ}_i + \beta_3 \times \text{HPHQ}_i + \beta_4 \times \text{HRHQ}_i \times \text{HPHQ}_i + e_i \]  -- Equation (2)
RankPremium\(_i\) = \(\gamma_1 + \gamma_2 \ast HRHQ_i + \gamma_3 \ast HPHQ_i + \gamma_4 \ast HRHQ_i \ast HPHQ_i + e_i\) \hspace{1em} \text{-- Equation (3)}

where \(i\) stands for the subjects.

Results of the Breusch-Pagan test show that the error terms are correlated across the equations (chi\(^2\)[3] = 21.296, \(p<0.01\)). We use a seemingly unrelated regression (SUR) estimation technique\(^6\) to account for this correlation. SUR generates the same regression coefficients as ordinary least square (OLS) model as the independent variables across the equations do not change, but is more efficient for correlated errors. Results of the SUR analysis are in Table 3.

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<th>Table 3: Quality Beliefs and Shopping Behavior*</th>
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<td>c_HPHQ(^2)*c_HRHQ</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Constant</td>
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\(z\) statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

\(^{\dagger}\) These variables are mean centered to avoid multicollinearity.

Surprisingly, we find that subjects relying on different types of signals (i.e. price and/or advertising) do not differ in terms of search intensity. Neither the overall model nor any of the coefficients are significant in explaining search intensity. Thus, we reject both the hypotheses -- H3b, and H4b -- related to search intensity.

We find some interesting results for price premium and rank premium which appear to depend on the type and intensity of quality beliefs held by the subjects. Subjects having stronger price-quality beliefs pay a larger price premium. A unit increase (from the mean levels) in the strength of the price-quality belief leads to a 5.87 unit increase in the price premium paid by the subjects. By contrast, subjects who believe in the rank-quality signal pay lower price premium. A unit increase (from the mean levels) in the strength of the rank-quality belief leads to a 3.98 unit decrease in the price premium paid by the subjects. Thus we find support for hypothesis H3a and H4a. The interaction between price-quality and rank-quality beliefs is not significant, suggesting absence of moderation effects of rank-quality signal (i.e., advertising signal) on the relationship between price-quality signal and price premium paid by the subjects. Thus, we reject hypothesis H5.

The rank premium regression suggests that subjects with stronger rank-quality beliefs tend to buy from sellers higher on the list (i.e., closer to the top). Thus we find support for hypothesis H3c. Further, we do not find a direct effect of the price signal on rank premium, or a significant moderating effect for the price signal on the relationship between the advertising signal and rank premium. This leads us to reject hypothesis H4c and H6. The summary of the results is presented in Table 4.

\(^6\) We also conducted multivariate regression and the results are consistent with SUR analysis.
Table 4: Results Summary

| H1          | Awareness of ranking mechanism (i.e., top sellers pay more) leads to positive rank-quality correlation | Supported |
| H2a         | Consumers have positive price-quality beliefs | Supported |
| H2b         | Consumers who are aware of the ranking mechanism will have weaker belief in positive price-quality correlation as compared to the consumers who are unaware of the ranking mechanism | Not supported |
| H3          | The stronger the consumer’s belief in advertising signal: | |
| a           | the lower will be the price premium paid by the consumer | Supported |
| b           | the lower will be the consumer’s search intensity | Not Supported |
| c           | the larger will be the rank premium enjoyed by the seller | Supported |
| H4          | The stronger the consumer’s belief in price signal: | |
| a           | the higher will be the price premium paid by the consumer | Supported |
| b           | the higher will be the consumer’s search intensity | Not Supported |
| c           | the smaller will be the rank premium enjoyed by the seller | Not Supported |
| H5          | The stronger the consumer’s belief in advertising signal (i.e., positive rank-quality belief), the weaker will be the impact of price signal (price-quality belief) on price premium. | Not Supported |
| H6          | The stronger the consumer’s belief in price signal (i.e., positive price-quality belief), the weaker will be the impact of advertising signal (rank-quality belief) on rank premium | Not Supported |

Discussion

Results from this study highlight interesting dynamics between advertising and price as signals of quality, as well as the importance of understanding consumers’ attitudes towards risk. While the awareness of the sponsored search advertisements does not change the overall click-through rates, the click-through as well as conversion rates tend to increase at higher listing ranks.

We also find that consumers who have knowledge of the sponsored nature of the search results (advertising signal) pay a smaller price premium, compared to the control group. We find that consumers who have stronger belief in price as a signal of quality pay a higher price premium and consumers who have stronger belief in advertising as a signal of quality pay a higher rank premium (i.e., are more likely to buy from firms appearing on the top). However, the advertising signal seems to weaken the price signal. Advertising signal belief leads a consumer to pay a lower price premium. Price signal belief, on the other hand, does not impact the rank premium. This finding is contrary to the extant findings which suggest that price signals strongly dominate advertising signals (Broniarczyk and Alba, 1994). This interesting difference can be attributed to the directional nature of the sponsored search format and unique characteristic of the sponsored search advertising medium which informs consumers about the relative advertising intensity/expenditure of all the firms within a market.

Our results also indicate that consumer behavior in online markets is distinct from that in traditional markets; likely due to due to the unique informational environments created by the online medium. As argued in prior work, changes in the content and format of online information, as well as consumer knowledge about online market mechanisms are likely to influence perceptions and attitudes. Our results add to this body of work. To the extent that consumer beliefs and perceptions are key drivers of behavior in online settings, it is important to understand their antecedents. This is especially true in emerging contexts such as sponsored search because the revenues and strategies of both advertisers and intermediaries are dependent on consumer search and purchase strategy as reflected in the click-through and conversion rate at various ranks in the sponsored search listing. Our results
suggest that making consumers aware of the allocation mechanism where sellers are ranked based on their advertising intensity is likely to be of value to the search engines and advertising intermediaries. Though the number of clicks may not increase, the advertising signal beliefs of consumers may increase the conversion rates at top ranks. This increased competition for top slots in the sponsored search auctions would lead to better monetization of the online real estate.

This study also opens up promising avenues for future research in the sponsored search advertising field. It would be interesting to study the effect of different rank allocation mechanisms on consumer advertising-quality beliefs and consequent behavior. As noted earlier, search intermediaries employ different allocation mechanisms. Yahoo ranks firms based on how much a firm is willing to pay per click whereas Google ranks firms based the past traffic generated by a firm in addition to its willingness to pay. Search intermediaries have also tried or are testing other allocation mechanism such as allocating ranks based on based on willingness to “pay per action” or willingness to “pay per impression” (Lee, 2002; Newcomb, 2005). These mechanisms differ in the type of information that they convey about the firms ranked higher on the listing and therefore may differ in the terms of the indirect cues they can provide about firms’ quality. We expect that the strength of consumers’ belief sin a rank-quality correlation and reliance on rank (i.e., higher rank premium) while making a purchase will increase as we move from “pay per action” to “pay per click” to “pay per impression”. It would further be interesting to see the signaling effect of Google’s allocation mechanism that also takes into account the past click-through rate (i.e., “market share adjusted pay per click”) obtained by a firm and thus may act as a proxy of a firm’s market share.

Conclusion

The sponsored search advertising format is unique in that the position of a seller’s advertisement in the search listings for a keyword is indicative of the advertising expenses borne by a seller, relative to other sellers/advertisers in the same list. Simply put, consumers who are aware of the mechanics of sponsored search auctions can infer that sellers appearing closer to the top of the search listing have bid higher than those appearing lower down. This provides us a unique opportunity to examine theories relating to advertising signals and consumer behavior in the online context, but there is limited empirical work to date. A key contribution of this study is that it is among the first to investigate how consumer knowledge about advertising mechanism in a sponsored search setting influences purchase behavior, mediated by quality perceptions. It is also one of handful of studies that investigate how consumer behavior is shaped by interactions among different informational signals. Finally, by virtue of the fact that we measure behavioral outcomes related to search intensity, price sensitivity, and actual purchase behavior, this study extends the literature on advertising as a signal of quality that has typically used perceived quality as an outcome variable.

Sponsored search advertisers and online intermediaries responsible for providing sponsored search listings can gain useful insights from our findings. Our results suggest that as more consumers become aware of the sponsored search mechanism, consumers may buy from a seller on a higher rank even if the price is higher/lower than other sellers. Thus, profit maximization for sellers must simultaneously address pricing and advertising decisions. For online intermediaries, a recommendation that emerges is the need to align the sponsored search allocation mechanism with consumers’ beliefs and behaviors such that it remains consistent with the consumer’s advertisement-quality signal. Failing to do so creates a potential risk in that over time, the auction mechanism could collapse because consumers do not click and buy at the top ranks. Finally, we believe that the investigation of consumer behavior in online sponsored search markets will enable researchers to develop more realistic normative models.

Future research can extend this study by examining the interactions between advertisers and consumers strategies over multiple periods and adaptation due to learning in a dynamic market setting. Another fruitful avenue for research may be to examine the impact of organic search results and presence of sellers with known quality in the sponsored listing on consumer behavior. Further, researchers can also examine consumer behavior in markets with correlated price and advertising variables. Analytical models may also be developed to predict the optimal search in a market with quality uncertainty where a consumer has to rely on quality signals.
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