

Theory and Evidence...

Search Advertising in Electronic Markets:
A Study on the Impact of Keyword Wordographics

by

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An honors thesis submitted in partial fulfillment

of the requirements for the degree of

Bachelor of Science

Undergraduate College

Leonard N. Stern School of Business

New York University

May 2008

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Search Advertising in Electronic Markets: A Study on the Impact of Keyword *Wordographics***Abstract**

As marketers are facing an ultra-competitive ad world, online marketing has grown tremendously in the past decade—a trend likely to continue. Managers have been dually investing in paid search and search engine optimization, two of the largest components of online marketing. Using a unique panel dataset of several hundred keywords collected from a large nationwide retailer that advertises on Google, we empirically model the relationship between keyword demographics, *wordographics*, and metrics such as click-through rates, conversion rates, bid prices and keyword ranks. Unlike prior research, we include both paid and natural results in order to better understand the decision consumers face when searching in Google. We use a random-effects regression model to estimate the impact of keyword attributes on consumer search and purchase behavior as well as on firms' decision-making behavior on bid prices and ranks. We find that the presence of retailer-specific information in the keyword increases paid click-through and paid conversion rates, and the presence of brand-specific information in the keyword increases conversion rates for both paid and natural listings. Our analysis provides some evidence that advertisers are not bidding optimally with respect to maximizing the profits by choosing to prioritize search spending to either paid search or search engine optimization, though our evidence suggests it is worthwhile to invest in both simultaneously. Finally, we demonstrate that Google does not appear to manipulate organic search results; Google appropriately rewards websites that are relevant and/or popular to the search.

I. Introduction

The advertising world has come a long way in the past ten years. Ten years ago, firms relied heavily upon television, magazines, direct mail, and even radio. But today, marketers face

a catch-22 with customers. Aware that consumers ignore traditional ads (Tivo allows consumers to fast forward commercials), marketers have been investing in new interactive advertisements such as advertisements in New York City taxi cabs¹. However, they still worry that consumers will become immune to even their most innovative ideas. In the past few years, marketers have embraced the Internet with search engine marketing, social media networks, interactive websites, etc. In fact, in the past year alone, online advertising expenditures grew 26% to total \$21.4 billion². Over the next five years, the eMarketer projects that online ad spending will double (Table 1). Though there are many innovative ways firms can advertise online, the bulk of online advertising consists of two main forms: display ad (banner) advertising and paid search advertising (sponsored ads that appear on the search results pages of search engines). Consumers perceive display ads as annoying and obtrusive, though they still represent a significant proportion of online advertising (approximately 22%). Paid search advertising represents 40% of online advertising expenditures, and has grown 32% in the past year alone. What has fueled this growth? Customer satisfaction has become a significant component in marketing. That is, paid search advertising is perceived to be non-intrusive and relevant. Not only do consumers click on paid search ads with greater frequency, but also marketers are spending more for their clicks. Additionally, paid search advertising, as compared to display advertising, have more transparent ways to measure a return-on-investment.

Companies find it impossible to track display advertising as they translate to sales; they are used primarily to foster brand awareness. However, as companies are showing more willingness to advertise on the internet, a recent survey conducted by McKinsey indicates that

¹ Helm, Burt. "Attention-Deficit Advertising". BusinessWeek Online. 24 April 2008. <http://www.businessweek.com/magazine/content/08_18/b4082050967724.htm?chan=magazine+channel_what%27s+next>.

² Hallerman, David. "Search Engine Marketing: User and Spending Trends." EMarketer. January 2008.

marketing executives still worry over the lack of metrics³. In the past, marketers sought to increase the number of page views for their website. Now, these executives want more concrete metrics which relate more directly to profitability.

Currently, search engines, like Google, MSN, and Yahoo, offer the most measurable form of advertising metrics; they can provide estimates on click-through rates and average bid prices for every possible keyword. Unlike organic listings also provided by search engines, sponsored advertising can offer some guarantee that a company's logo or website will be seen with various searches, as long as they abide by the search engines' bidding rules⁴. While managers recognize the importance of paid advertising, many companies have also begun investing heavily in search engine optimization (SEO) to improve their organic search results. Table 2 shows the breakdown of search advertising expenses over the next five years. In 2007, search engine optimization accounted for 18% of all search engine marketing expenditures and is expected to grow as SEO is generally less expensive than paid search⁵. A survey conducted by the eMarketer revealed that 46% of online retailers found that SEO performed best, compared to 37% of retailers who preferred paid-per-click advertising.

Nevertheless, the question still remains for companies about which keywords will give them the best return-on-investment. For paid search, managers seek to find keywords that will result in high click-through rates as well as conversion rates. In organic search, this is the same, but since search engine optimization occurs by keyword, their marketing dollars could also be tailored to focus on searches with a high rate of click-through and conversion.

³ Green, Heather. "Stumbling Blocks for Online Advertising." BusinessWeek. Online. <http://www.businessweek.com/the_thread/blogspotting/archives/2007/09/stumbling_block.html?chan=search>.

⁴ Google puts companies on probation when advertisements for certain keywords do not meet a minimum threshold for click-throughs. Google wants to ensure that customers do not become frustrated by the search process, and thus monitor their advertisements extensively.

Rutz, O., R. E. Bucklin 2007. "A Model of Individual Keyword Performance in Paid Search Advertising." Unpublished Mimeo, UCLA.

⁵ Hallerman, David. "Search Engine Marketing: User and Spending Trends." EMarketer. January 2008.

Most recently, Rutz and Bucklin (2007) have studied *wordographics*, or keyword demographics to determine the cost-per-reservation for hotel chains when they advertise⁶. Their study focused on the presence of specific components within the keyword: location, brand name, and the word 'hotel'. This paper seeks to more broadly determine what type of *wordographics* may increase the likelihood of customer profitability.

Thus, in this study, we will examine how the specificity of a keyword affects purchase behavior, sponsored advertisement bid pricing, and search engine ranking systems through both paid advertising and naturally appearing websites. We define specificity to include a brand name or retailer information. For example, a keyword may have five words full of adjectives, but still is not specific to a particular product brand name or retailer name. In today's search era, customers have the option to search for whatever products they may desire. Most internet users are knowledgeable enough to understand what kinds of keyword searches will yield more targeted results for online shopping. It is our hypothesis that a customer has the option of controlling the length of the keyword search in order to indicate some level of specificity in a search. And it is precisely this control that shows their willingness to purchase; shorter, less specific keyword searches are more likely to indicate a willingness to browse and 'window' shop than buy.

The remainder of this paper is organized as follows. Section 2 discusses prior work in this area. Section 3 gives an overview of the data used in this study. In Section 4, we will study the dynamic relationship between paid search and organic search in the context of keyword *wordographics*. In Section 5, we will discuss the implications of these findings on advertising managers and conclude the paper.

⁶ Rutz, O., R. E. Bucklin 2007. "A Model of Individual Keyword Performance in Paid Search Advertising." Unpublished Mimeo, UCLA.

II. Prior Work

Much of the existing academic work (e.g., Cho, Lee and Tharp 2001⁷, Gallagher, Foster and Parsons 2001⁸, Dreze and Hussherr 2003⁹) on advertising in the online world has focused on measuring changes in brand awareness, brand attitudes, and purchase intentions as a function of exposure. This is usually done via field surveys or laboratory experiments using individual (or cookie) level data. Sherman and Deighton (2001)¹⁰ and Ilfeld and Winer (2002)¹¹, show using aggregate data that increased online advertising leads to more site visits. In contrast to other studies which measure (individual) exposure to advertising via aggregate advertising dollars (e.g., Mela, Gupta and Jedidi 1998¹², Ilfeld and Winer 2002), we will use data on individual search keyword advertising exposure. Manchanda et al. (2006)¹³ look at online banner advertising. Because banner ads have been perceived by many consumers as being annoying, traditionally they have had a negative connotation associated with it. Moreover, it was argued that since there is considerable evidence that only a small proportion of visits translate into final purchase (Sherman and Deighton 2001, Moe and Fader 2003¹⁴, Chatterjee, Hoffman and Novak 2003¹⁵), click-through rates may be too imprecise for measuring the effectiveness of banners

⁷ Cho, C., J. Lee, M. Tharp. 2001. "Different Forced-Exposure Levels to Banner Advertisements." Journal of Advertising Research, 41(4), 45-56.

⁸ Gallagher, K., K. D. Foster, J. Parsons. 2001. "The Medium is not the Message: Advertising Effectiveness & Content Evaluation in Print & The Web". Journal of Advertising Research, 41(4), 57-70.

⁹ Dreze, X., F. Hussherr. 2003. "Internet advertising: Is anybody watching?" Journal of Interactive Marketing, 17(4), 8-23.

¹⁰ Sherman, L., J. Deighton. 2001. "Banner Advertising: Measuring Effectiveness and Optimizing Placement." Journal of Interactive Marketing, 15(2), 60-64.

¹¹ Ilfeld, J., R. Winer. 2002. "Generating Website Traffic." Journal of Advertising Research, 42, 49-61.

¹² Mela, C., S. Gupta, K. Jedidi 1998. "Assessing Long-Term Promotional Influences on Market Structure." International Journal of Research in Marketing, 15, 89-107.

¹³ Manchanda, P., J. Dubé, K Goh, P. Chintagunta. 2006. "The Effect of Banner Advertising on Internet Purchasing." Journal of Marketing Research, 43(1), 98-108.

¹⁴ Moe, W., P. S. Fader. 2003. "Dynamic Conversion Behavior at E-Commerce Sites." Management Science, 50(3), 326-335.

¹⁵ Chatterjee, P., D. Hoffman, T. Novak. 2003. "Modeling the Clickstream: Implications for Web-Based Advertising Efforts." Marketing Science: 22(4), 520-541.

served to the mass market. These studies therefore highlight the importance of investigating the impact of other kinds of online advertising such as search keyword advertising on actual search and purchase behavior.

Despite all of this work, very little empirical work exists in online search advertising. This is primarily because of the difficulty for researchers to obtain such advertiser-level data. Existing work has so far focused on search engine performance (Telang, Boatwright, and Mukhopadhyay 2004¹⁶, Bradlow and Schmittlein 2000¹⁷). Moreover, the handful of studies that exist in search engine marketing have typically analyzed publicly available data from search engines. Animesh, Ramachandran and Viswanathan (2006)¹⁸ look at the presence of quality uncertainty and adverse selection in paid search advertising on search engines.

The most advanced research to date on *wordographics* has been conducted by Rutz and Bucklin (2007)¹⁹ and Ghose and Yang (2007)²⁰. The first pair looked at specific demographics to determine the optimal cost for a hotel chain manager to bid on keywords based on its return on investment through a reservation. This study focused on specific components within the keyword: location, brand name, and the word 'hotel'. The two created a model for keyword selection that proved to be more cost effective for the companies of study. Ghose and Yang analyzed the impact of wordographics on paid advertising alone: the length and specificity of the keyword as it pertains to brand name and retailer information. They focused on retailer and brand name wordographics in order to better understand the marketing mix decision online managers

¹⁶ Telang, R., P. Boatwright, T. Mukhopadhyay 2004. "A Mixture Model for Internet Search Engine Visits." *Journal of Marketing Research*, Vol. XLI (May), 206-214.

¹⁷ Bradlow, E.T., Schmittlein, D.C. 2000. "The Little Engines That Could: Modeling the Performance of World Wide Web Search Engines." *Marketing Science*, 19(1), 43- 62.

¹⁸ Animesh A., V. Ramachandran, S. Viswanathan. 2006. "Quality Uncertainty and Adverse Selection in Sponsored Search Markets." Working Paper, University of Maryland, College Park.

¹⁹ Rutz, O., R. E. Bucklin 2007. "A Model of Individual Keyword Performance in Paid Search Advertising." Unpublished Mimeo, UCLA.

²⁰ Ghose, Anindya, S. Yang. 2007. "An Empirical Analysis of Search Engine Advertising: Sponsored Search and Cross-Selling in Electronic Markets." *NET Institute*.

face. For example, a search for a particular retailer can be considered navigational in nature; the consumer hopes to find that particular retailer's website conveying a sense of loyalty²¹. A search for a particular brand name, however, can be considered as competitive in nature; the consumer searches for a brand name and after viewing all potential retailers that carry such brand, the consumer may actively *choose* this particular retailer. Ghose and Yang (2007)²² found compelling results which supported this theory. A consumer who includes retailer information in his/her search has a higher likelihood to click-through the website and a consumer who includes brand name information in his/her search has a higher likelihood to purchase.

While Ghose and Yang's research will certainly prove helpful for online marketing managers to come, this paper hopes to extend their study to incorporate more comprehensively the choice consumers have when searching through Google. Their findings were limited to paid search only; however, we will include information regarding the natural listings on a results page. The bottom line is that consumers have a choice when they search online. The information in which they may or may not indicate with the keyword they search with may not always hold true in the presence of organic search listings. This paper will investigate the impact of wordographics on paid search in the presence of organic listings, as well as study the impact of wordographics on organic search alone. On a firm level, we will examine the impact of natural search listings on paid search advertisement bid prices. This section of the study aims to determine whether or not managers alter their maximum bid prices when organic listings are present. Finally, on a search engine level, we will study how organic search rankings are affected by specific keyword searches.

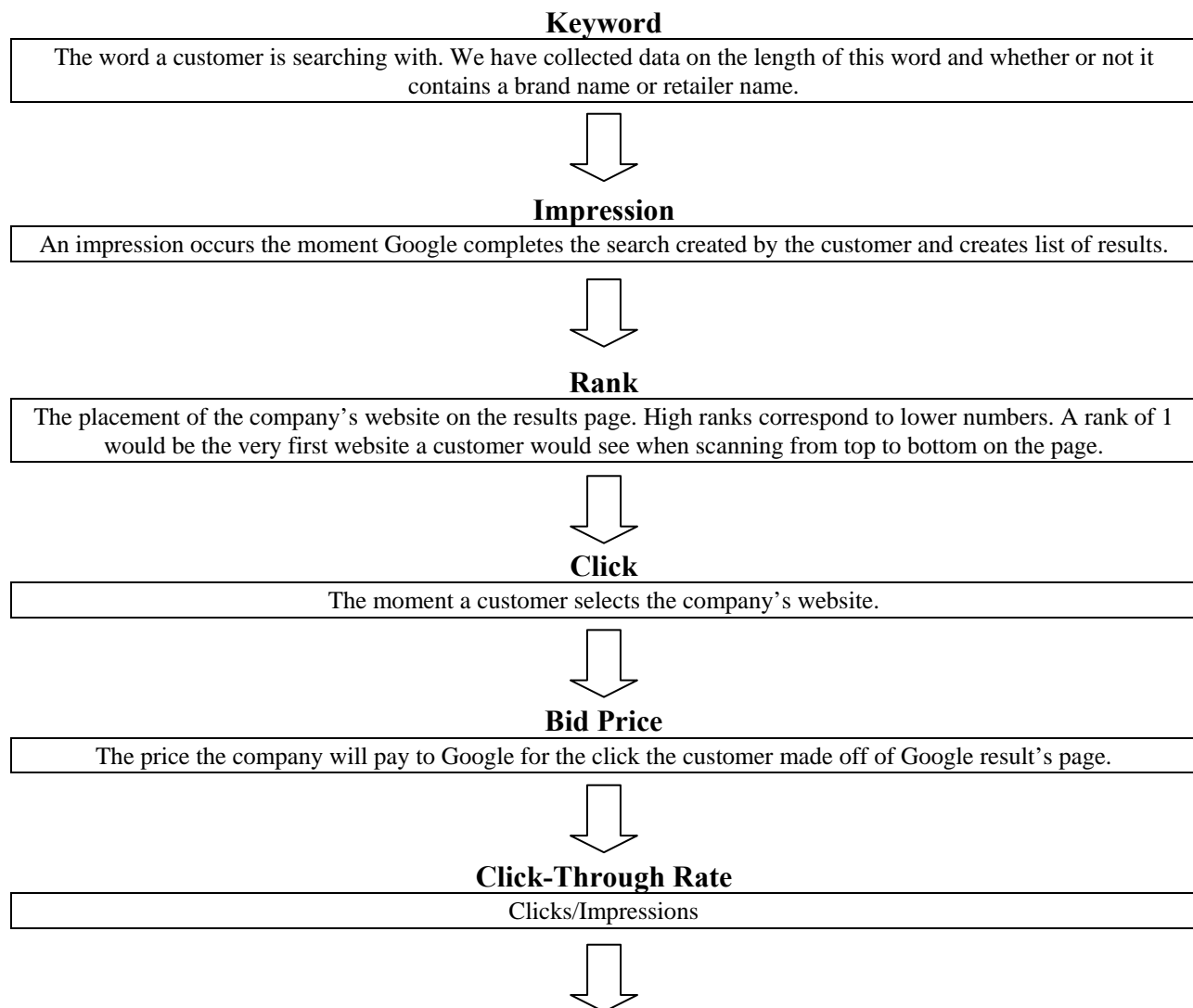
²¹ Kaufman, A. 2007. "PPC and Your Good Name." <[www. searchengineland.com](http://www.searchengineland.com)>.

²² Ghose, Anindya, S. Yang. 2007. "An Empirical Analysis of Search Engine Advertising: Sponsored Search and Cross-Selling in Electronic Markets." [NET Institute](#).

III. Data

In order to study the impact of the aforementioned wordographics on click-through and conversion rates, bid prices, and rank, we will analyze data from a Fortune 500 company that carries six distinct product categories: bed, bath, home décor, kitchenware, seasonal items, and electrical appliances. The company also carries a number of licensed brands within each category. In order to fully understand how paid advertising data is compiled, a flow chart has been included below. All of the data has been collected per fiscal week.

Data Process of Collection



Landing Page Quality

The weighted average quality of the company's website based on a 10 point scale of relevancy, navigability, and transparency.



Order

The moment a customer purchases a product. Revenue data has also been collected per fiscal week.



Conversion Rate

Orders/Clicks

Though the process for data collection is exactly the same for organic search, the picture below provides a snapshot of a search engines' results page to show the difference between the two.

Organic Search vs. Sponsored Links

The image shows a Google search results page for the query "top business schools". The search bar at the top contains the text "top business schools" and the search button is labeled "Search". The results page shows "Results 1 - 10 of about 9,350,000 for top business schools (0.14 seconds)".

Red arrows point to different sections of the page:

- Two arrows point to the top of the page, labeled "Sponsored Links". One arrow points to a yellow sponsored link for "Business School Rankings" from topmba.com. The other arrow points to a sponsored link for "Top 20 Business School" from UGA.
- A large red arrow points to the bottom of the page, labeled "Organic Search Results". This arrow encompasses several organic search results, including:
 - "Top MBA Programs & Business School Rankings BusinessWeek"
 - "The Best Business Schools - Forbes.com"
 - "Best Business Schools - Forbes.com"
 - "Best Graduate Schools - Education - US News and World Report"
 - "Best 290 Business Schools | Ranking | Top MBA Programs on The ..."

Paid search listings are along the top and the side of the results page, while organic search listings fill the main body of the page. Impressions, click-throughs, and conversions are all defined in the same manner for organic search listings. Table 6 shows the summary statistics for this data set. In this dataset, we have 924 observations for 325 keywords. On average for this retailer, impressions are approximately 5322 per keyword followed by a click-through rate of .1 for paid advertisements, roughly three times that of organic listings which have a click-through rate of .03. Conversion rates for paid ads (.065) are double that of conversion rates for organic search (.032). For this particular dataset, we needed to control for the landing page quality of the organic search listings. In order to do that, we simulated Google's quality rating system by evaluating each landing page on a scale of 1-10 on three metrics: relevancy, navigability, and transparency. Unlike paid ads where a company can control the exact website link which is displayed, organic searches may result in broken links, dead-end pages, and/or products which are completely irrelevant to the initial inquiry. Thus, in order to make any accurate comparison between the two, we added a weighted average landing quality variable. Table 6 contains descriptions of all the variables used in this study.

IV. The Effect of Keyword Wordographics on the Interaction of Sponsored Paid Advertisements and Natural Search Listings in a Search Engine

When a consumer searches on a search engine, he/she has a choice to click on a paid advertisement or an organic link. In section 4a, we will model paid click-through and conversion rate behavior against the independent wordographics variables, while including natural listing variables. This will allow us to better understand the impact of wordographics on consumer click and purchase behavior as the inclusion of natural variables simulates more accurately the decision a consumer generally faces.

We will also analyze the impact of wordographics on natural search variables alone. As search engine optimization encompasses a greater proportion of total search advertising spend, wordographics could play an important role in helping minimizing SEO costs for managers. By understanding which keywords generally have higher placement and/or click-through rates, managers may not need to invest in optimizing search for such keywords.

In section 4b, we will study the impact of wordographics and natural listings on paid search bid prices. We suspect that the presence of natural listings may affect a manager's willingness to pay. Finally, in section 4c, we will study the impact of wordographics on a search engine's ranking mechanism. We expect search engines to reward more relevant websites with lower ranks in scale (the most specific search would have the highest organic rank and so on).

IVa. Consumer Decisions

In Ghose and Yang's prior study, specificity certainly seemed to indicate intention; the presence of brand names, retailer names, and even descriptive words proved to be positively associated with higher click-through and conversion rates for a consumers. In this section, we will add natural search variables (natural rank, natural click-through, and landing page quality) to test if the presence of natural search listings increases the likelihood of click-through and purchase behavior through a sponsored advertising link. We suspect that consumers take in information from the organic listings of a webpage before they choose to click on a paid link. Thus, when search engines naturally list websites of the same retailer simultaneously to paid advertisements, a consumer may perceive both websites to be of higher quality. However, we still control for landing page quality differences in natural listings. While a retailer may control the link which appears on a sponsored ad, it may not be able to determine with any precision the

link that appears for organic search, despite any effort in Search Engine Optimization. In order to control for this variance, we have replicated Google's rubric and evaluated each landing page for relevancy, navigability, and transparency in order to create a weighted average quality variable.

We will study paid search advertising click-through behavior now including the natural search listing variables mentioned above with the following model:

$$\begin{aligned} \text{Paid Click-Through Rate} = & \alpha_1 \text{ Natural Click-Through Rate} + \alpha_2 \text{ Natural_Rank} + \alpha_3 \text{ Paid Rank} + \\ & \alpha_4 \text{ Brand} + \alpha_5 \text{ Retailer} + \alpha_6 \text{ Natural Landing Page Quality} + \alpha_7 \text{ Squared Paid Rank} + \\ & \alpha_8 \text{ Squared Natural Rank} + \alpha_9 \text{ M2} + \alpha_{10} \text{ M3} + \alpha_{11} \text{ Natural Rank*Quality} + \alpha_{12} \text{ Paid Rank*} \\ & \text{Retailer} + \varepsilon \end{aligned}$$

Tables 7a and 7b summarize all of the rationale and variables we will include. We hypothesize that the impact of wordographics will be equal to or greater on paid advertisements when natural listings are present. Thus, we do not expect the two components, natural and paid, to have a cannibalizing effect on one another. Rather, we believe organic listings will improve click-through behavior. Additionally, we expect that variables indicating specificity would still be significant in models combining natural and paid variables to the same extent they were significant in paid search alone.

Model 1A (see column 6) contains the random-effects output which contains compelling evidence to refute the cannibalization theory. Natural landing page quality has a coefficient of +.56 with paid click-through rate indicating that for every point gained in the quality variable, paid click-through rates are expected to increase by .0056. To put this number in perspective, click-through rates average at .10 for this particular data set; for every quality point gained, paid click-through increases by approximately five percent. As consumers view high-quality organic listings, they seem to believe a paid advertisement of the same retailer to be of higher quality,

thus increasing their click-through behavior. Natural click-through rate has a significant coefficient of 2.45, indicating that a .01 increase in the natural click-through rate is associated with a .0245 increase in the paid click-through rate, or approximately twenty-four percent. The magnitude of this coefficient indicates just how important a natural listing can be on sponsored links. Retailer is associated with a +.039 increase in paid click-through, which means that whenever a retailer name is present in the keyword, paid click-through is expected to be .039 higher (or approximately 40%). This can be compared to a +.44 increase in paid-click through when organic listings are not included in the model (see Model output 2A, column 6). The close magnitude indicates that organic listings have very little negative effect on wordographics influencing paid advertisement click-through rates.

Though our findings mostly disprove the cannibalization theory, some evidence still exists to confirm it. Natural rank has a coefficient of +.27 with paid click-through rates. This indicates that a worse rank position for natural links contributes to higher paid click-through. The upward impact is mitigated, however, by the interaction effect between natural rank and landing page quality which is negative. This means that when the organic listing is of high-quality, a low rank has less of a negative effect on paid-click through. Therefore, it appears that consumers still place greater value on a retailer's paid advertisement when the retailer also has strong organic results.

For paid conversion rates, we find similar results. Tables 8a and 8b describe the variables and rationale used in the following model:

$$\begin{aligned} \text{Paid Conversion Rate} = & \alpha_1 \text{Natural Click-Through Rate} + \alpha_2 \text{Paid Click-Through Rate} + \\ & \alpha_3 \text{Brand} + \alpha_4 \text{Retailer} + \alpha_5 \text{Paid Rank} + \alpha_6 \text{Natural Rank} + \alpha_7 \text{Natural Landing Page Quality} + \\ & \alpha_8 \text{Squared Paid Rank} + \alpha_9 \text{Squared Natural Rank} + \alpha_{10} M2 + \alpha_{11} M3 + \varepsilon \end{aligned}$$

We did not include natural conversion rates because a conversion rate for a natural listing should be irrelevant to a consumer who clicks on a paid advertisement. A positive conversion calculation occurs after the point of click-through. Thus, when modeling the behavior of a consumer who may purchase from a paid advertising link (and thus has never clicked-through to purchase from a naturally listed website), natural conversion rate would not be important. Model 3A (see column 5) contains the output.

Though brand name did not appear to be significant in the paid click-through rate model, brand names are associated with a positive increase in paid conversion rates. In fact, when a brand name is included, paid conversion is expected to increase by .039. Considering that the average conversion rate is .065 for any given impression, brand names increase paid conversion rates by approximately fifty-percent.

As with paid click-through, the retailer *wordographic* still proves to be significant. When consumers include a retailer name in their search, paid conversion rates increase by .121. All else held equal, when a consumer searches for a particular retailer, he/she is three times more likely to buy from that particular retailer. This can be compared to an increase of +.119 when organic listings were not included, which again shows that consumers do not appear to be negatively affected by the presence of organic listings (see Model output 4A, column 5). This supports Kaufman's theory on competitive searches and navigational searches as a "branded" search means the consumer is evaluating the market and subjected to many competitors²³. If the advertiser wins the click and the order, that implies they have taken market share away from a competitor. On the other hand, retailer-specific keywords imply a certain degree of 'loyalty'. Our analysis indicates that 'retailer' keywords yield a much higher return on investment by

²³ Kaufman, A. 2007. "PPC and Your Good Name." <[www. searchengineland.com](http://www.searchengineland.com)>.

increasing conversion rates, as they too generally cost less (see firm effects analysis in section 4b).

Unlike with paid click-through rates, organic listings appear to have no negative impact on paid conversion. In fact, for every 1 position increase in natural rank, paid conversion rates are expected to increase by .0027, or roughly 2.7%. This upward effect is mitigated though by a negative coefficient in squared natural rank which indicates there is some saturation effect—paid conversion can only increase to a certain maximum. Nevertheless, the positive association found in this model shows clearly that a consumer's likelihood to purchase is improved when retailer's have strong organic results.

The evidence from the paid click-through and paid conversion rate models indicates that managers who invest in both paid search as well as search engine optimization for the same set of keywords will benefit greatly. Online marketing managers will find that their paid advertisements perform better when organic listings appear to have high quality or low rank positions. Additionally, it appears that managers who invest in cheaper, more specific keywords will be rewarded with higher conversion rates thus yielding a very high return-on-investment.

The next set of models analyzes the impact of keyword wordographics on natural click-through and conversion rates. Though we previously had stated studying just paid or just sponsored links paints an incomplete picture, we felt that understanding the impact of these wordographics on click-through and purchase behavior may be helpful to managers when investing in Search Engine Optimization.

Tables 9a and 9b summarize the variables and rationale used in the following equation tested in Model 5A:

$$\begin{aligned} \text{Natural Click-Through Rate} = & \alpha_1 \text{Natural Rank} + \alpha_2 \text{Brand} + \alpha_3 \text{Retailer} + \alpha_4 \text{Paid Click-} \\ & \text{Through Rate} + \alpha_5 \text{Natural Landing Page Quality} + \alpha_6 \text{Squared Natural Rank} + \alpha_7 M2 + \alpha_8 M3 \\ & + \varepsilon \end{aligned}$$

Unfortunately, for this dataset, we do not have access to keyword length data as Ghose and Yang did. Thus, specificity will solely be determined by whether or not the keyword contains a brand name and/or retailer. We have included paid click-through rate in this analysis in order to control for any uncaptured variability in keyword heterogeneity. Our presumption is such that paid click-through rates should vary directly with natural click-through rates for a given keyword.

The results have been summarized in the Model 5A output (see column 5). The most interesting result from this model pertains to the ‘retailer’ wordographic. Retailer has a negative, significant coefficient of -.012 indicating that consumers are less likely to click on an organic listing when retailer information is included. The average click-through rate for an organic search listing is .03, so when retailer information is included, click-through rates drop by approximately thirty-three percent. This contradicts our theory regarding specificity: the more specific search actually results in less intention to click-through. However, we hypothesize that consumers who search for a particular retailer, given their established ‘loyalty’, prefer sponsored advertisements to organic search listings.

For natural conversion rates, we test a similar model to natural click-through:

$$\begin{aligned} \text{Natural Conversion Rate} = & \alpha_1 \text{Natural Rank} + \alpha_2 \text{Natural Click-Through Rate} + \alpha_3 \text{Brand} + \alpha_4 \\ & \text{Retailer} + \alpha_5 \text{Paid Conversion Rate} + \alpha_6 \text{Natural Landing Page Quality} + \alpha_7 \text{Squared Natural} \\ & \text{Rank} + \alpha_8 M2 + \alpha_9 M3 + \varepsilon \end{aligned}$$

Tables 10a and 10b contain the variables and rationale used for this study. Model 6A (see column 5) contains the output.

The only variable of significance for this model is the brand name *wordographic*. Brand name has a positive, significant coefficient of +.03 with natural conversion rates. Natural conversion rates have an average of .032 for this data set, so when brand names are included, natural conversion rates double. This again, supports the competitive search theory. If a consumer chooses a retailer's website after viewing several others, he/she is far more likely to actually purchase from the retailer's website than one who searches with no specificity.

The results from these models highlight some key findings for managers. Though a manager may believe retailer-specific keywords to be a poor investment for Search Engine Optimization, the results for Model 2A indicate that consumers will click on paid-advertisements more frequently if they see strong organic search results. Thus, retailer specific keywords may not be worthwhile for natural search alone, but it certainly proves to be an important investment for paid advertisement conversion. On the other hand, investing in SEO for 'brand name' keywords proves to be doubly worthwhile. Not only will strong organic results increase paid conversion rate, it is also expected to double natural conversion rates. Thus, the overall analysis shows that managers should invest in both sponsored advertisements & search engine optimization for the same set of keywords in order to maximize click-through and conversion behavior.

IVb. Firm Decisions

Model 7A studies the effect natural search listings on bid prices with the following equation:

$$\begin{aligned} \text{Average Cost Per Click (Bid Price)} = & \alpha_1 \text{ Previous Natural Click-Through Rate} + \alpha_2 \text{ Previous} \\ & \text{Paid Click-Through Rate} + \alpha_3 \text{ Brand} + \alpha_4 \text{ Retailer} + \alpha_5 \text{ Paid Rank} + \alpha_6 \text{ Natural Rank} + \alpha_7 \\ & \text{Squared Paid Rank} + \alpha_8 \text{ Squared Natural Rank} + \alpha_9 M2 + \alpha_{10} M3 + \varepsilon \end{aligned}$$

Tables 11a and 11b summarize the variables and rationale used in this study. Unlike in the consumer effects model where natural websites and paid sponsored ads seem to bolster one another, we expect the opposite for firms who are concerned with bid pricing. It is our hypothesis that firms will be less likely to pay high prices for keywords when their websites appear naturally in a low rank position. Though this does not support our findings from Section 4a (it is worthwhile for companies to invest in both), we believe few companies actually act on those results.

Model 7A (see column 5) contains the output which confirms three main results: *wordographics* lower the cost per click, firms pay less when organic results are strong, and firms pay more when their sponsored advertisements have been successful. Confirming the first result, we observe negative coefficients for both brand name and retailer. ‘Brand name’ keywords lower average bid prices by approximately six cents (average bid price for all data points is twenty-one cents) and retailer keywords lower average bid prices by approximately twelve cents. In Section 4a, we showed that retailer has a higher coefficient in predicting paid conversion rates. With a lower average price as well, we see a much higher return on investment for these particular keywords. Why do we observe lower prices for these more specific keywords? Bid prices are determined by demand, and specific keywords appeal to less retailers. Thus, competitor retailers will find it unappealing to bid against a firm whose consumer has a high interest in them and/or the brand name searched (if they do not carry such brand), thus driving down the bid price.

Confirming the second result, we observe a negative coefficient of -.58 of previous natural click-through rate with bid price. This indicates that when organic listings perform well in the past, firms are willing to pay less for paid advertisements in the present. In fact, for every .1 increase in previous natural click-through rate, firms are willing to pay twenty-seven percent less (or 5.8 cents) per bid. Additionally, we find natural rank to have a coefficient of +.003 with bid prices. This means that for every 1 position improvement for an organic listing, we observe firms willing to pay 1.4% less per bid (or .003 cents).

Finally, to confirm the last result, we observe a positive coefficient of +.19 of previous paid click-through rate to current bid price. Firms who have had high rates of click-through in the past are willing to currently pay approximately 10% more (1.9 cents) for the paid advertisement.

The results of this study actually highlight a key potential advantage for online marketing managers. It appears few companies invest their marketing dollars in a manner consistent with attracting the most consumer attention. Firms are willing to pay less when their natural search listings appear; they should be willing to pay more. Managers should try to maximize **both** paid advertising expenditures and their search engine optimization strategy.

IVc. Search Engine Decisions

The final model in our study analyzes the effectiveness of search engine's natural ranking mechanism. Tables 12a and 12b describe the variables and rationale under study in the following equation:

$$\text{Natural Rank} = \alpha_1 \text{Brand} + \alpha_2 \text{Retailer} + \alpha_3 \text{Previous Natural Click-Through Rate} + \varepsilon$$

We expect that keywords which show specificity should result in low natural rankings for the retailer which the keyword is specific to. Additionally, we expect that search engines rewards

websites with a previously high rate of click-through with a low ranking. Model 8A (see column 1) contains the output.

Both *wordographic* variables have as expected, negative coefficients. Retailer, the more specific *wordographic*, is associated with eight rank position improvements while brand name is associated with two rank position improvements. This makes intuitive sense as websites which are most relevant to the keyword searched should be rewarded with the highest position. It is comforting to find that Google does not appear to unfairly manipulate organic search results!

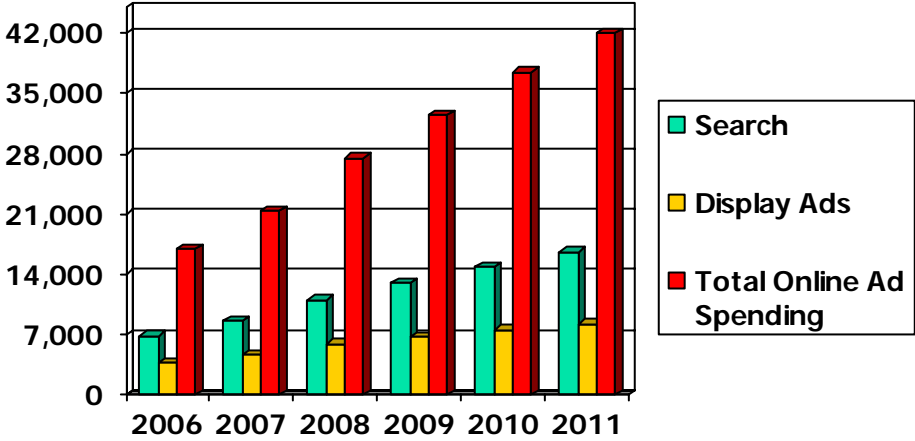
Finally, previous click-through has a significant, negative coefficient of -48. An improvement of .1 in a previous click-through rate is associated with an approximate improvement of five rank positions. Thus, Google does appear to effectively reward a retailer's website when it is relevant and popular to the initial search.

V. Manager Implications and Conclusion

The most important take-away from this study is simply that managers need to be cognizant of their search spending and be careful in diversifying their investments in both paid search and search engine optimization. Organic listings do not appear to have a cannibalizing effect on paid advertisements. In fact, we find that for specific keywords, investing in both forms of 'advertising' can result in higher click-through rates and purchase behavior, though they have the cheapest cost. Specificity can result in a greater keyword return-on-investment for managers. Specifically, we observe 'retailer' keywords to have the greatest positive impact on paid conversion rates (though they do decrease organic conversion) at a significantly lower cost (approx. twelve cents less per keyword) maximizing the return-on-investment for managers. Brand names, too, appear to be worthwhile investments, and may simultaneously help companies attract consumers away from competitors, thus increasing their market share. Thus, online

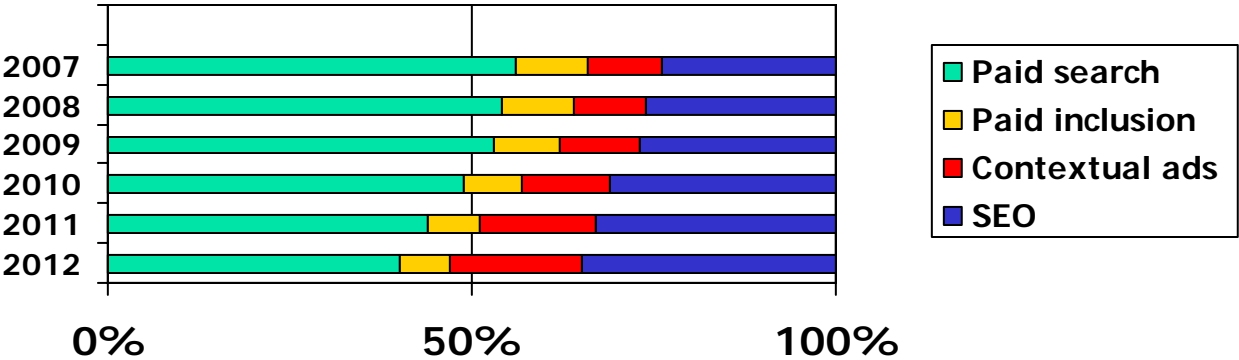
marketing managers who realize the added value of natural listings on paid conversion rates for brand names can create a competitive advantage for themselves.

Table 1: Online Search Trends



Source: January 2008 eMarketer

Table 2: Search Advertising Breakdown



Source: January 2008 eMarketer

Table 5: Summary Statistics

| Summary Statistics | | | | |
|---------------------------------------|----------|-----------|-------|----------|
| Variable | Average | Std. Dev. | Min | Max |
| Paid Rank | 4.128 | 6.237 | 1 | 63 |
| Paid Conversions | 2.385 | 19.254 | 0 | 527 |
| Natural Conversions | 0.117 | 0.615 | 0 | 12 |
| Natural Rank | 9.483 | 14.873 | 1 | 100 |
| Total Searches | 5322.045 | 18700.497 | 7 | 165361 |
| Paid Clicks | 168.363 | 1370.622 | 0.999 | 37530 |
| Natural Clicks | 26.038 | 161.318 | 1.000 | 4204.999 |
| Cost Per Click | 0.209 | 0.166 | 0.003 | 1 |
| Natural Click-Through Rate | 0.030 | 0.048 | 0.000 | 0.571 |
| Paid Click-Through Rate | 0.100 | 0.174 | 0.000 | 0.988 |
| Paid Conversion Rate | 0.065 | 0.226 | 0 | 1 |
| Natural Conversion Rate | 0.032 | 0.162 | 0 | 1 |
| Retailer | 0.201 | 0.401 | 0 | 1 |
| Brand name | 0.675 | 0.469 | 0 | 1 |
| Relevancy | 7.507 | 3.299 | 1 | 10 |
| Transparency | 9.856 | 1.194 | 0 | 10 |
| Navigability | 8.476 | 3.310 | 1 | 10 |
| Landing Page Quality Weighted Average | 8.634 | 2.174 | 4 | 10 |

Table 6: Master List of Variable Descriptions

| Variable | Operationalization |
|---|---|
| Keyword | Company provided data where the keyword is organized as an advertisement ID per fiscalweek |
| Retailer | Whether (1) or (0) the brand is included in the advertisement ID |
| Brandname | Whether (1) or not (0) the retailer is included in the advertisement ID |
| Natural Click-Through Rate (natural_ctr) | Number of clicks divided by impressions for each advertisement ID per fiscalweek that has come from natural search |
| Previous Natural Click-Through Rate (Pnaturalctr) | Number of clicks divided by impressions for each advertisement ID for the lag fiscalweek that has come from natural search |
| Paid Click-Through Rate (Paid_ctr) | Number of clicks divided by impressions for each advertisement ID per fiscalweek that has come from a sponsored advertisement |
| Previous Paid Click-Through Rate (prpaidctr) | Number of clicks divided by impressions for each advertisement ID for the lag fiscalweek that has come from paid search |
| Natural Conversion Rate (Natural_Conversion) | Number of purchases divided by click-throughs for each advertisement ID per fiscalweek that has come from natural search |
| Paid Conversion Rate (Paid_Conversion) | Number of purchases divided by click-throughs for each advertisement ID per fiscalweek that has come from a sponsored advertisement |
| Paid_rank | The position of the sponsored advertisement listing on Google (1 is considered the highest or best position) |
| Natural_rank | The position of the natural search listing on Google (1 is considered the highest or best position) |
| CPC | The average cost of the sponsored link for the particular keyword through Google's bidding system is calculated per fiscalweek |
| Natural Landing Page | An average of 3 separate rating variables (relevancy, navigability, |

| | |
|--------------------------------------|---|
| Quality (natural_landingpagequality) | transparency) on a scale of 1-10 (10 is the highest) for each sponsored link landing page. Manually collected using Google's rating descriptions. |
| Seasonality (m2, m3) | The month of the year the keyword appears. M2 represents fiscalweeks 5-8 and M3 represents fiscalweeks 9-13. |

Table 7a: Antecedents for Paid Click-Through Rates

| Hypothesis | Expected Effect | Rationale |
|---|-----------------|--|
| Antecedents | | |
| <i>Current Natural Click-through Rate -> Current Paid Click-through Rate</i> | + | When a customer searches for a product and a highly relevant natural search listing appears (likely to have a high click-through rate), the same link as a paid search result may be perceived as more credible. Thus, a customer may be more likely to click on the paid link listed first. |
| <i>Current Natural Rank → Current Paid Click-through Rate</i> | - | Customers who see the same or similar website show up naturally in a high rank position may trust the quality of a similar paid search link that appears and thus be more likely to click-through the ad. |
| <i>Current Paid Rank -> Current Paid Click-through Rate</i> | - | Google judges sponsored links and assigns an appropriate ranking within a range of ranks the company has bid on. We suspect that a lower average rank will result in higher click-through as consumers may favor the particular website as determined by Google. |
| <i>Current Brand name -> Current Paid Click-through Rate</i> | + | We expect consumers who include the brand names of products in their search are more likely to click-through a retailer's website which claims to carry that product than consumers who search generically. A customer's intention can be reflected on the specificity of their search. |
| <i>Current Retailer -> Current Paid Click-through Rate</i> | + | When the company's name is included in the search, we expect that a consumer has a high likelihood to click-through that particular retailers' website when it appears as a sponsored advertisement. |
| <i>Current Month → Current Paid Click-through Rate</i> | -/+ | We control for seasonality effects to see if click-through behavior is affected by the time of year. We suspect that months surrounding the holiday and the back-to-school season may have higher conversion rates. |
| <i>Current Natural Landing Page Quality -> Current Paid Click-through Rate</i> | - | We control for the landing page quality of organic search results. Unlike sponsored ads, retailers cannot always control the page that will show up on a consumer's search. Some links have broken links or are not relevant. Therefore we control on 3 metrics: relevancy, navigability, and transparency. We expect poor natural landing pages to increase the likelihood of a sponsored ad click-through because the consumer would have no other option otherwise. |

Table 7b: Variable Descriptions for Paid Click-through Rate Model

| Variable | Operationalization |
|--|---|
| Paid Click-Through Rate (Paid_ctr) | Number of clicks divided by impressions for each advertisement ID per fiscalweek that has come from a sponsored advertisement |
| Natural Click-Through Rate (natural_ctr) | Number of clicks divided by impressions for each advertisement ID per fiscalweek that has come from natural search |
| Natural_rank | The position of the natural search listing on Google (1 is considered the highest or best position) |
| Paid_rank | The position of the sponsored advertisement listing on Google (1 is considered the highest or best position) |

| | |
|---|---|
| Brandname | Whether (1) or not (0) the retailer is included in the advertisement ID |
| Retailer | Whether (1) or (0) the brand is included in the advertisement ID |
| Seasonality (m2, m3) | The month of the year the keyword appears. M2 represents fiscalweeks 5-8 and M3 represents fiscalweeks 9-13. |
| Natural Landing Page Quality (natural_landingpagequality) | An average of 3 separate rating variables (relevancy, navigability, transparency) on a scale of 1-10 (10 is the highest) for each sponsored link landing page. Manually collected using Google's rating descriptions. |

Model 8a: Antecedents for Paid Conversion Rates

| Hypothesis | Expected Effect | Rationale |
|--|-----------------|--|
| Antecedents | | |
| <i>Current Natural Click-through Rate -> Current Paid Conversion Rate</i> | + | When a customer searches for a product and a highly relevant natural search listing appears (likely to have a high click-through rate), the same link as a paid search result may be perceived as more credible. Thus, a customer may be more likely to purchase from the paid link listed first. |
| <i>Current Paid Click-through Rate -> Current Paid Conversion Rate</i> | + | Sponsored ads which have a high click-through rate may also have a high rate of conversion as consumers may favor the particular website and thus place more orders. |
| <i>Current Brand name -> Current Paid Conversion Rate</i> | + | We expect consumers who include the brand names of products in their search are more likely to purchase from a company which claims to carry that product than consumers who search generically. A customer's intention can be reflected on the specificity of their search. |
| <i>Current Retailer -> Current Paid Conversion Rate</i> | + | When the company's name is included in the search, we expect that a consumer has a high likelihood to buy from that particular retailer when its website appears through a sponsored advertisement. |
| <i>Current Month -> Current Paid Conversion Rate</i> | -/+ | We control for seasonality effects to see if purchase behavior is affected by the time of year. We suspect that months surrounding the holiday and the back-to-school season may have higher conversion rates. |
| <i>Current Natural Rank -> Current Paid Conversion Rate</i> | - | Customers who see the same or similar website show up naturally in a high rank position may trust the quality of a similar paid search link that appears and thus be more likely to purchase from the website. |
| <i>Current Paid Rank -> Current Paid Conversion Rate</i> | - | Google judges sponsored links and assigns an appropriate ranking within a range of ranks the company has bid on. We suspect that a lower average rank will result in higher conversions as consumers may favor the particular website as determined by Google. |
| <i>Current Natural Landing Page Quality -> Current Paid Conversion Rate</i> | + | We control for the landing page quality of organic search results. Unlike sponsored ads, retailers cannot always control the page that will show up on a consumer's search. Some links have broken links or are not relevant. Therefore we control on 3 metrics: relevancy, navigability, and transparency. We anticipate higher conversion rates to be associated with higher quality websites. |

Table 8b: Variable Descriptions for Paid Conversion Rate Model

| Variable | Operationalization |
|---|---|
| Paid Conversion Rate (Paid_Conversion) | Number of purchases divided by click-throughs for each advertisement ID per fiscalweek that has come from a sponsored advertisement |
| Natural Click-Through Rate (natural_ctr) | Number of clicks divided by impressions for each advertisement ID per fiscalweek that has come from natural search |
| Paid Click-Through Rate (Paid_ctr) | Number of clicks divided by impressions for each advertisement ID per fiscalweek that has come from a sponsored advertisement |
| Retailer | Whether (1) or (0) the brand is included in the advertisement ID |
| Brandname | Whether (1) or not (0) the retailer is included in the advertisement ID |
| Seasonality (m2, m3) | The month of the year the keyword appears. M2 represents fiscalweeks 5-8 and M3 represents fiscalweeks 9-13. |
| Natural_rank | The position of the natural search listing on Google (1 is considered the highest or best position) |
| Paid_rank | The position of the sponsored advertisement listing on Google (1 is considered the highest or best position) |
| Natural Landing Page Quality (natural_landingpagequality) | An average of 3 separate rating variables (relevancy, navigability, transparency) on a scale of 1-10 (10 is the highest) for each sponsored link landing page. Manually collected using Google's rating descriptions. |

Table 9a: Antecedents for Natural Click-through Rates

| Hypothesis | Expected Effect | Rationale |
|---|-----------------|---|
| Antecedents | | |
| <i>Current Natural Rank</i> → <i>Current Natural Click-through Rate</i> | - | As consumers scan webpages from top to bottom, we expect that a lower natural rank increase a consumer's likelihood to click on the organic link. They would encounter fewer distractions to other websites. |
| <i>Current Brand name</i> → <i>Current Natural Click-through Rate</i> | + | We expect consumers who include the brand names of products in their search are more likely to click on a company's naturally appearing website which carries that product than customers who search generically. A customer's intention can be reflected on the specificity of their search. |
| <i>Current Retailer</i> → <i>Current Natural Click-through Rate</i> | + | When the company's name is included in the search, we expect that a consumer has a high likelihood to click on that company's link when it appears through a naturally through Google. |
| <i>Current Month</i> → <i>Current Natural Click-through Rate</i> | -/+ | We control for seasonality effects to see if click-through behavior is affected by the time of year. We suspect that months surrounding the holiday and the back-to-school season may have higher click-through rates. |
| <i>Current Natural Landing Page Quality</i> → <i>Current Natural Click-through Rate</i> | + | We control for the landing page quality of organic search results. Unlike sponsored ads, retailers cannot always control the page that will show up on a consumer's search. Some links have broken links or are not relevant. Therefore we control on 3 metrics: relevancy, navigability, and transparency. We anticipate higher click-through rates to be associated with higher quality websites. |
| <i>Current Paid Click-through Rate</i> → <i>Current Natural Click-through Rate</i> | + | By including paid click-through as a variable, we attempt to control for the product or keyword heterogeneity. We anticipate that for a given keyword, the rates of click-through for both paid and natural links should have a direct association when also controlled for landing page quality. |

Table 9b: Variable Descriptions for Natural Click-through Rate Model

| Variable | Operationalization |
|---|---|
| Natural Click-Through Rate (natural_ctr) | Number of clicks divided by impressions for each advertisement ID per fiscalweek that has come from natural search |
| Natural_rank | The position of the natural search listing on Google (1 is considered the highest or best position) |
| Brandname | Whether (1) or not (0) the retailer is included in the advertisement ID |
| Retailer | Whether (1) or (0) the brand is included in the advertisement ID |
| Seasonality (m2, m3) | The month of the year the keyword appears. M2 represents fiscalweeks 5-8 and M3 represents fiscalweeks 9-13. |
| Natural Landing Page Quality (natural_landingpagequality) | An average of 3 separate rating variables (relevancy, navigability, transparency) on a scale of 1-10 (10 is the highest) for each sponsored link landing page. Manually collected using Google's rating descriptions. |
| Paid Click-Through Rate (Paid_ctr) | Number of clicks divided by impressions for each advertisement ID per fiscalweek that has come from a sponsored advertisement |

Table 10a: Antecedents for Natural Conversion Rates

| Hypothesis | Expected Effect | Rationale |
|--|-----------------|--|
| Antecedents | | |
| <i>Current Natural Rank</i> → <i>Current Natural Conversion Rate</i> | - | As consumers scan websites from top to bottom, we expect that a lower natural rank increase a consumer's likelihood to purchase from the organic link. They would encounter fewer distractions to other websites. |
| <i>Current Natural Click-Through Rate</i> → <i>Current Natural Conversion Rate</i> | + | Keywords which had a high click-through rate may also have a high rate of conversion as consumers may favor the particular naturally appearing website and thus place more orders. |
| <i>Current Brand name</i> → <i>Current Natural Conversion Rate</i> | + | We expect consumers who include the brand names of products in their search are more likely to purchase from a company's naturally appearing website which carries that product than customers who search generically. A customer's intention can be reflected on the specificity of their search. |
| <i>Current Retailer</i> → <i>Current Natural Conversion Rate</i> | + | When the company's name is included in the search, we expect that a consumer has a high likelihood to purchase from that company's link when it appears through a naturally through Google. |
| <i>Current Month</i> → <i>Current Natural Conversion Rate</i> | -/+ | We control for seasonality effects to see if purchase behavior is affected by the time of year. We suspect that months surrounding the holiday and the back-to-school season may have higher click-through rates. |
| <i>Current Natural Landing Page Quality</i> - <i>Current Natural Conversion Rate</i> | + | We control for the landing page quality of organic search results. Unlike sponsored ads, retailers cannot always control the page that will show up on a consumer's search. Some links have broken links or are not relevant. Therefore we control on 3 metrics: relevancy, navigability, and transparency. We anticipate higher conversion rates to be associated with higher quality websites. |
| <i>Current Paid Conversion Rate</i> → <i>Current Natural Conversion Rate</i> | + | By including paid click-through as a variable, we attempt to control for the product or keyword heterogeneity. We anticipate that for a given keyword, the rates of conversion for both paid and natural links should have a direct association when also controlled for landing page quality. |

Table 10b: Variable Descriptions for Natural Click-through Rate Model

| Variable | Operationalization |
|---|---|
| Natural Conversion Rate (Natural_Conversion) | Number of purchases divided by click-throughs for each advertisement ID per fiscalweek that has come from natural search |
| Natural_rank | The position of the natural search listing on Google (1 is considered the highest or best position) |
| Natural Click-Through Rate (natural_ctr) | Number of clicks divided by impressions for each advertisement ID per fiscalweek that has come from natural search |
| Brandname | Whether (1) or not (0) the retailer is included in the advertisement ID |
| Retailer | Whether (1) or (0) the brand is included in the advertisement ID |
| Seasonality (m2, m3) | The month of the year the keyword appears. M2 represents fiscalweeks 5-8 and M3 represents fiscalweeks 9-13. |
| Natural Landing Page Quality (natural_landingpagequality) | An average of 3 separate rating variables (relevancy, navigability, transparency) on a scale of 1-10 (10 is the highest) for each sponsored link landing page. Manually collected using Google's rating descriptions. |
| Paid Conversion Rate (Paid_Conversion) | Number of purchases divided by click-throughs for each advertisement ID per fiscalweek that has come from a sponsored advertisement |

Table 11a: Antecedents for Cost Per Click (CPC)

| Hypothesis | Expected Effect | Rationale |
|---|------------------------|---|
| Antecedents | | |
| <i>Previous Natural Click-through Rate -> Current Cost Per Click</i> | - | If a company has previously observed a high rate of natural click-throughs, it may not be willing to bid a high price for a sponsored ad, as it appears to garner a customer's attention without it. |
| <i>Previous Paid Click-through Rate -> Current Cost Per Click</i> | + | If a company has previously observed a high rate of paid click-throughs, it may be willing to bid a high price for a sponsored ad, as it appears to garner a customer's attention with it. |
| <i>Current Brand name -> Current Cost Per Click</i> | + | As consumers increase the specificity of their search by including brand names of products, companies who do not carry that brand will be less likely to bid on such keyword. Therefore, for this company who carries the brand searched, the bid price should expectedly be lower. |
| <i>Current Retailer -> Current Cost Per Click</i> | + | Keywords which contain the retailer's name are likely to have very low bid prices. Other companies will find it unappealing to bid against a competitor whose consumer has a high interest in that retailer, thus driving down the bid price. |
| <i>Current Month -> Current Cost Per Click</i> | -/+ | We control for seasonality effects to see if bid prices are affected by the time of year. We suspect that months surrounding the holiday and the back-to-school season may have higher average costs per click. |
| <i>Current Natural Rank -> Current Cost Per Click</i> | - | As consumers scan websites from top to bottom, we expect that a lower natural rank increase a consumer's likelihood to click on the organic link. Therefore, a sponsored ad would be considered less effective by the company resulting in a lower bid price. |
| <i>Current Paid Rank -> Current Cost Per Click</i> | - | Google's tiered pricing system prices lower ranks incrementally higher than each subsequently ranked sponsored link. |

Table 11b: Variable Descriptions for Cost Per Click Model

| Variable | Operationalization |
|---|--|
| CPC | The average cost of the sponsored link for the particular keyword through Google's bidding system is calculated per fiscalweek |
| Previous Natural Click-Through Rate (Pnaturalctr) | Number of clicks divided by impressions for each advertisement ID for the lag fiscalweek that has come from natural search |
| Previous Paid Click-Through Rate (prpaidctr) | Number of clicks divided by impressions for each advertisement ID for the lag fiscalweek that has come from paid search |
| Brandname | Whether (1) or not (0) the retailer is included in the advertisement ID |
| Retailer | Whether (1) or (0) the brand is included in the advertisement ID |
| Seasonality (m2, m3) | The month of the year the keyword appears. M2 represents fiscalweeks 5-8 and M3 represents fiscalweeks 9-13. |
| Natural_rank | The position of the natural search listing on Google (1 is considered the highest or best position) |
| Paid_rank | The position of the sponsored advertisement listing on Google (1 is considered the highest or best position) |

Model 12a: Antecedents for Natural Rank

| Hypothesis | Expected Effect | Rationale |
|---|------------------------|---|
| Antecedents | | |
| <i>Current Brand name -> Current Cost Per Click</i> | - | We expect that searches with greater specificity help retailers' websites appear naturally in lower rank positions if they carry the brand stated in the keyword. |
| <i>Current Retailer -> Current Cost Per Click</i> | - | We expect that searches with greater specificity help retailers' websites appear naturally in lower rank positions since they are the retailer stated in the keyword. |
| <i>Current Month -> Current Cost Per Click</i> | -/+ | We control for seasonality effects to see if natural ranks are affected by the time of year. |
| <i>Previous Natural Click-through Rate -> Current Cost Per Click</i> | - | We expect Google to award websites with a lower rank if the website had a previously high click-through rate. |

Table 12b: Variable Descriptions for Natural Rank Model

| Variable | Operationalization |
|---|--|
| Natural_rank | The position of the natural search listing on Google (1 is considered the highest or best position) |
| Brandname | Whether (1) or not (0) the retailer is included in the advertisement ID |
| Retailer | Whether (1) or (0) the brand is included in the advertisement ID |
| Seasonality (m2, m3) | The month of the year the keyword appears. M2 represents fiscalweeks 5-8 and M3 represents fiscalweeks 9-13. |
| Previous Natural Click-Through Rate (Pnaturalctr) | Number of clicks divided by impressions for each advertisement ID for the lag fiscalweek that has come from natural search |

Model Outputs

Model 1A. Paid Click-Through Rate

| | (1) | (2) | (3) | (4) | (5) | (6) |
|-----------------------------------|------------------------|------------------------|---------------------|------------------------|------------------------|-----------------------|
| natural_ctr | 2.54 *** 0.089 | 2.51 *** 0.091 | 2.45 *** 0.091 | 2.54 *** 0.089 | 2.51 *** 0.091 | 2.45 *** 0.091 |
| natural_rank | 0.00025 0.000303 | 0.00068 0.00077 | 0.0027 ** 0.0012 | 0.00025 0.000303 | 0.00068 0.00077 | 0.0027 ** 0.0012 |
| paid_rank | -0.0018 *** 0.00071 | -0.0052 *** 0.0016 | -0.004 ** 0.0016 | -0.0018 *** 0.00071 | -0.0052 *** 0.0016 | -0.004 ** 0.0016 |
| brand | -0.00623 0.0095 | -0.0095 0.0096 | -0.0124 0.0096 | -0.00623 0.0095 | -0.0095 0.0096 | -0.0124 0.0096 |
| retailer | 0.027 ** 0.011 | 0.026 ** 0.011 | 0.039 *** 0.015 | 0.027 ** 0.011 | 0.026 ** 0.011 | 0.039 *** 0.015 |
| natural_landingpagequality | 0.0014 0.002 | 0.0018 0.002 | 0.0056 ** 0.0025 | 0.0014 0.002 | 0.0018 0.002 | 0.0056 ** 0.0025 |
| sqpaidrank | | 0.00009 ** 0.000038 | 6.2E-05 0.000039 | | 0.00009 ** 0.000038 | 0.000062 0.000039 |
| sqnaturalrank | | -6.7E-06 0.0000112 | -3E-06 1.12E-05 | | -6.7E-06 0.0000112 | -2.8E-06 0.0000112 |
| m2 | | | 0.039 *** 0.011 | | | 0.039 *** 0.011 |
| m3 | | | 0.022 ** 0.01 | | | 0.022 ** 0.01 |
| natural_rank*quality | | | 0.00 *** 0.00012 | | | 0.00 *** 0.00012 |
| paid_rank*retailer | | | -0.01 ** 0.0037 | | | -0.01 ** 0.0037 |
| const | 0.0165 0.0192 | 0.023 0.02 | -0.02 0.024 | 0.0165 0.0192 | 0.023 0.02 | -0.02 0.024 |
| Number of Observations | 900 | 900 | 900 | 900 | 900 | 900 |
| F-Statistic | 151.55 *** | 114.89 *** | 80.34 *** | | | |
| Wald Chi-Squared | | | | 909.31 *** | 919.09 *** | 964.02 *** |
| R-squared | 0.505 | 0.5078 | 0.5208 | 0.5045 | 0.5078 | 0.5208 |

Note: 1-3 OLS
4-6 Random Effects GLS

Model 2A. Paid Click-Through Rate w/o Natural

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---------------------------|------------------------|-------------------------|-----------------------|------------------------|-------------------------|------------------------|
| paid_rank | -0.0017 *** 0.00069 | -0.0049 *** 0.0015 | -0.004 ** 0.0018 | -0.0017 *** 0.00069 | -0.0049 *** 0.0015 | -0.004 ** 0.0018 |
| brand | -0.004 0.0092 | -0.012 0.009 | -0.012 0.012 | -0.004 0.0092 | -0.012 0.009 | -0.012 0.012 |
| retailer | 0.026 *** 0.0104 | 0.023 ** 0.0108 | 0.044 *** 0.014 | 0.026 *** 0.0104 | 0.023 ** 0.0108 | 0.044 *** 0.014 |
| natural_ctr | 2.52 *** 0.087 | 2.44 *** 0.088 | 2.44 *** 0.088 | 2.52 *** 0.087 | 2.44 *** 0.088 | 2.44 *** 0.088 |
| sqpaidrank | | 0.000084 ** 0.000037 | 6.8E-05 * 0.000041 | | 0.000084 ** 0.000037 | 0.000068 * 0.000041 |
| m2 | | 0.038 *** 0.0106 | 0.039 *** 0.011 | | 0.038 *** 0.0106 | 0.039 *** 0.011 |
| m3 | | 0.025 *** 0.0097 | 0.022 ** 0.0098 | | 0.025 *** 0.0097 | 0.022 ** 0.0098 |
| paid_rank*brand | | | 0.00032 0.0018 | | | 0.00032 0.0018 |
| paid_rank*retailer | | | -0.0078 ** 0.00369 | | | -0.0078 ** 0.00369 |
| const | 0.029 *** 0.009 | 0.028 *** 0.011 | 0.025 ** 0.012 | 0.029 *** 0.009 | 0.028 *** 0.011 | 0.025 ** 0.012 |
| Number of Observations | 924 | 924 | 924 | 924 | 924 | 924 |
| F-Statistic | 231.81 *** | 138.06 *** | 108.19 *** | | | |
| Wald Chi-Squared | | | | 927.2 *** | 966.43 *** | 973.7 *** |
| R-squared | 0.5022 | 0.5134 | 0.5158 | 0.5022 | 0.5134 | 0.5158 |

Note: 1-3 OLS
4-6 Random Effects GLS

Model 3A. Paid Conversion Rate

| | (1) | (2) | (3) | (4) | (5) | (6) |
|----------------------------|-------------------------------|---------------------------------|-------------------------------|-------------------------------|---------------------------------|--------------------------------|
| natural_ctr | 0.0304 <i>0.18</i> | 0.084 <i>0.178</i> | 0.0011 <i>0.155</i> | 0.00023 <i>0.187</i> | 0.058 <i>0.19</i> | 0.019 <i>0.16</i> |
| paid_ctr | -0.12 *** <i>0.049</i> | -0.09 * <i>0.048</i> | -0.041 * <i>0.0422</i> | -0.13 *** <i>0.049</i> | -0.09 ** <i>0.048</i> | -0.05 <i>0.042</i> |
| brand | 0.024 * <i>0.014</i> | 0.04 *** <i>0.014</i> | 0.029 *** <i>0.012</i> | 0.023 <i>0.015</i> | 0.039 *** <i>0.015</i> | 0.027 ** <i>0.014</i> |
| retailer | 0.107 *** <i>0.016</i> | 0.12 *** <i>0.017</i> | -0.081 *** <i>0.019</i> | 0.108 *** <i>0.018</i> | 0.121 *** <i>0.019</i> | -0.082 *** <i>0.02</i> |
| paid_rank | 0.0032 *** <i>0.00104</i> | 0.014 *** <i>0.0023</i> | 0.0033 *** <i>0.002</i> | 0.0035 *** <i>0.0011</i> | 0.014 *** <i>0.0023</i> | 0.0036 * <i>0.0021</i> |
| natural_rank | -0.00093 ** <i>0.00044</i> | -0.0031 *** <i>0.0011</i> | -0.001 *** <i>0.00097</i> | -0.00095 ** <i>0.00047</i> | -0.0034 *** <i>0.0012</i> | -0.0012 <i>0.0011</i> |
| natural_landingpagequality | 0.00043 <i>0.0029</i> | -0.00057 <i>0.0029</i> | 0.0011 <i>0.0024</i> | 0.00015 <i>0.0032</i> | -0.001 <i>0.0032</i> | 0.00086 <i>0.0029</i> |
| sqpaidrank | | -0.00027 *** <i>0.000055</i> | -8E-05 *** <i>0.000049</i> | | -0.00028 *** <i>0.000055</i> | -0.000084 * <i>0.000049</i> |
| sqnaturalrank | | 0.000034 ** <i>0.000016</i> | 9.2E-06 ** <i>0.000014</i> | | 0.000038 ** <i>0.000017</i> | 0.000011 <i>0.000015</i> |
| m2 | | -0.018 <i>0.016</i> | -0.029 <i>0.014</i> | | -0.02 <i>0.016</i> | -0.027 ** <i>0.014</i> |
| m3 | | -0.052 *** <i>0.014</i> | -0.015 *** <i>0.013</i> | | -0.057 *** <i>0.014</i> | -0.019 <i>0.013</i> |
| paid_rank*retailer | 0.013 <i>0.028</i> | 0.009 <i>0.029</i> | 0.078 <i>0.0046</i> | | | 0.081 *** <i>0.0046</i> |
| const | 0.013 <i>0.028</i> | 0.009 <i>0.029</i> | 0.011 <i>0.026</i> | 0.016 <i>0.031</i> | 0.014 <i>0.032</i> | 0.015 <i>0.029</i> |
| Number of Observations | 900 | 900 | 900 | 900 | 900 | 900 |
| F-Statistic | 11.64 *** | 11.58 *** | 37.54 *** | | | |
| Wald Chi-Squared | | | | 73.95 *** | 122.74 *** | 465.7 *** |
| R-squared | 0.0837 | 0.1255 | 0.3368 | 0.0834 | 0.1252 | 0.3365 |

Note: 1-3 OLS
4-6 Random Effects GLS

Model 4A. Paid Conversion Rate w/o Natural

| | (1) | (2) | (3) | (4) | (5) | (6) |
|-------------------------------|-----------------------------|-----------------------------|--------------------------------|----------------------------|--------------------------------|--------------------------------|
| paid_rank | 0.0034 *** <i>0.0012</i> | 0.018 <i>0.0027</i> | 0.0101 *** <i>0.003</i> | 0.005 *** <i>0.0013</i> | 0.019 *** <i>0.0026</i> | 0.0074 *** <i>0.0027</i> |
| paid_ctr | -0.147 *** <i>0.043</i> | -0.065 <i>0.043</i> | -0.041 <i>0.04</i> | -0.196 *** <i>0.043</i> | -0.132 *** <i>0.042</i> | -0.079 ** <i>0.037</i> |
| brand | 0.0089 <i>0.017</i> | 0.032 *** <i>0.016</i> | 0.032 * <i>0.02</i> | 0.0046 <i>0.029</i> | 0.029 <i>0.028</i> | 0.013 <i>0.03</i> |
| retailer | 0.094 *** <i>0.019</i> | 0.12 <i>0.019</i> | -0.078 *** <i>0.024</i> | 0.074 ** <i>0.035</i> | 0.119 *** <i>0.034</i> | -0.111 *** <i>0.037</i> |
| natural_conversionrate | 0.041 <i>0.045</i> | 0.044 <i>0.044</i> | 0.052 <i>0.041</i> | 0.083 ** <i>0.04</i> | 0.079 ** <i>0.039</i> | 0.066 ** <i>0.033</i> |
| sqpaidrank | | -0.00039 <i>0.000065</i> | -0.0002 *** <i>0.000066</i> | | -0.00037 *** <i>0.00006</i> | -0.0002 *** <i>0.000056</i> |
| m2 | | -0.054 <i>0.019</i> | -0.066 *** <i>0.018</i> | | -0.041 ** <i>0.017</i> | -0.036 *** <i>0.015</i> |
| m3 | | -0.08 <i>0.017</i> | -0.048 *** <i>0.016</i> | | -0.083 *** <i>0.016</i> | -0.04 *** <i>0.014</i> |
| paid_rank*brand | | | -0.0022 <i>0.0029</i> | | | 0.00013 <i>0.0027</i> |
| paid_rank*retailer | | | 0.074 *** <i>0.006</i> | | | 0.087 *** <i>0.0055</i> |
| const | 0.039 *** <i>0.016</i> | 0.013 <i>0.019</i> | 0.03 <i>0.019</i> | 0.058 *** <i>0.023</i> | 0.017 <i>0.024</i> | 0.06 *** <i>0.024</i> |
| Number of Observations | 924 | 924 | 924 | 924 | 924 | 924 |
| F-Statistic | 9.37 *** | 14.03 *** | 28.71 *** | | | |
| Wald Chi-Squared | | | | 49.75 *** | 118.62 *** | 414.94 *** |
| R-squared | 0.0486 | 0.1093 | 0.2392 | 0.0433 | 0.1026 | 0.2319 |

Note: 1-3 OLS

4-6 Random Effects GLS

Model 5A. Natural Click-Through Rate

| | (1) | (2) | (3) | (4) | (5) | (6) |
|----------------------------|------------------------|--------------------------|-------------------------|------------------------|---------------------------|--------------------------|
| natural_rank | -0.0003 *** 0.00008 | -0.00093 *** 0.00019 | -0.001 *** 0.00031 | -0.0003 *** 0.00009 | -0.001 *** 0.0002 | -0.0011 *** 0.00035 |
| brand | 0.0044 * 0.0025 | 0.0041 0.0025 | 0.0037 0.0031 | 0.0044 0.0028 | 0.0042 0.0028 | 0.0036 0.0034 |
| retailer | -0.0084 *** 0.003 | -0.012 *** 0.0032 | -0.012 *** 0.0034 | -0.0074 ** 0.0034 | -0.012 *** 0.0036 | -0.012 *** 0.0038 |
| paid_ctr | 0.19 *** 0.065 | 0.185 *** 0.00663 | 0.186 *** 0.0067 | 0.17 *** 0.065 | 0.163 *** 0.0066 | 0.163 *** 0.0066 |
| natural_landingpagequality | 0.00031 0.00054 | 0.00013 0.00054 | 0.00005 0.00068 | -0.000062 0.00063 | -0.00022 0.00062 | -0.0003 0.00078 |
| sqnaturalrank | | 9.8E-06 *** 0.0000029 | 9.8E-06 *** 0.000003 | | 0.000011 *** 0.0000031 | 1.1E-05 *** 0.0000031 |
| m2 | | -0.00072 0.003 | -0.0007 0.003 | | -0.0012 0.0028 | -0.0012 0.0028 |
| m3 | | 0.0047 * 0.0027 | 0.0047 * 0.0027 | | 0.0048 * 0.0026 | 0.0048 * 0.0026 |
| natural_rank*brand | | | 0.00003 0.00016 | | | 4.8E-05 0.00018 |
| natural_rank*retailer | | | -3E-06 0.00032 | | | 3.1E-05 0.00034 |
| natural_rank*quality | | | 0.00 0.000034 | | | -5E-06 0.000036 |
| const | 0.01 ** 0.005 | 0.014 *** 0.0054 | -0.02 ** 0.024 | 0.016 *** 0.0058 | 0.021 *** 0.006 | -0.02 ** 0.0072 |
| Number of Observations | 900 | 900 | 900 | 900 | 900 | 900 |
| F-Statistic | 185.88 *** | 120.03 *** | 87.01 *** | | | |
| Wald Chi-Squared | | | | 698.9 *** | 737.8 *** | 733.8 *** |
| R-squared | 0.5097 | 0.5187 | 0.5187 | 0.5091 | 0.5174 | 0.5174 |

Note: 1-3 OLS
4-6 Random Effects GLS

Model 6A. Natural Conversion Rate

| | (1) | (2) | (3) | (4) | (5) | (6) |
|-----------------------------------|---------------------------|------------------------------|-----------------------------|---------------------------|------------------------------|-----------------------------|
| natural_rank | 0.00029 <i>0.00038</i> | 0.00029 <i>0.00096</i> | 0.0011 <i>0.0015</i> | 0.00028 <i>0.00038</i> | 0.00029 <i>0.00096</i> | 0.0011 <i>0.0015</i> |
| natural_ctr | -0.16 <i>0.11</i> | -0.17 <i>0.12</i> | -0.17 <i>0.12</i> | -0.16 <i>0.11</i> | -0.17 <i>0.12</i> | -0.17 <i>0.12</i> |
| brand | 0.03 *** <i>0.012</i> | 0.03 *** <i>0.012</i> | 0.017 <i>0.015</i> | 0.03 *** <i>0.011</i> | 0.03 *** <i>0.012</i> | 0.017 <i>0.015</i> |
| retailer | 0.023 <i>0.015</i> | 0.021 <i>0.015</i> | 0.027 * <i>0.017</i> | 0.023 <i>0.015</i> | 0.021 <i>0.015</i> | 0.027 * <i>0.017</i> |
| paid_conversionrate | 0.038 <i>0.029</i> | 0.04 <i>0.03</i> | 0.038 <i>0.03</i> | 0.038 <i>0.029</i> | 0.04 <i>0.03</i> | 0.038 <i>0.03</i> |
| natural_landingpagequality | 0.00062 <i>0.0026</i> | 0.00058 <i>0.0026</i> | 0.0029 <i>0.0032</i> | 0.00062 <i>0.0026</i> | 0.00058 <i>0.0026</i> | 0.0029 <i>0.0032</i> |
| sqnaturalrank | | -2.8E-08 <i>0.0000141</i> | 2.5E-06 <i>0.0000141</i> | | -2.8E-08 <i>0.0000141</i> | 2.5E-06 <i>0.0000141</i> |
| m2 | | 0.0022 <i>0.0142</i> | 0.0024 <i>0.0142</i> | | 0.0022 <i>0.0142</i> | 0.0024 <i>0.0142</i> |
| m3 | | 0.0059 <i>0.013</i> | 0.0063 <i>0.013</i> | | 0.0059 <i>0.013</i> | 0.0063 <i>0.013</i> |
| natural_rank*brand | | | 0.0013 * <i>0.00077</i> | | | 0.0013 * <i>0.00077</i> |
| natural_rank*retailer | | | -0.002 <i>0.0015</i> | | | -0.002 <i>0.0015</i> |
| natural_rank*quality | | | 0.00 <i>0.00016</i> | | | 0.00 <i>0.00016</i> |
| const | 0.0012 <i>0.024</i> | -0.000034 <i>0.026</i> | -0.01 <i>0.03</i> | 0.0012 <i>0.024</i> | -0.000034 <i>0.026</i> | -0.01 <i>0.03</i> |
| Number of Observations | 900 | 900 | 900 | 900 | 900 | 900 |
| F-Statistic | 2.87 *** | 1.93 ** | 1.87 ** | | | |
| Wald Chi-Squared | | | | 17.3 *** | 17.4 ** | 22.4 ** |
| R-squared | 0.0189 | 0.0192 | 0.0349 | 0.0189 | 0.0192 | 0.0246 |

Note: 1-3 OLS
4-6 Random Effects GLS

Model 7A. Average Cost Per Click

| | (1) | (2) | (3) | (4) | (5) | (6) |
|------------------------------|------------------------|---------------------------|-------------------------|------------------------|---------------------------|-------------------------|
| prnaturalctr | -0.78 ** 0.33 | -0.72 ** 0.33 | -0.71 ** 0.33 | -0.63 * 0.3 | -0.58 ** 0.29 | -0.57 ** 0.29 |
| prpaidctr | 0.254 ** 0.106 | 0.2 ** 0.104 | 0.2 ** 0.104 | 0.23 *** 0.09 | 0.19 ** 0.087 | 0.19 ** 0.087 |
| brand | -0.062 *** 0.011 | -0.071 *** 0.011 | -0.071 *** 0.011 | -0.057 *** 0.017 | -0.067 *** 0.016 | -0.067 *** 0.016 |
| retailer | -0.14 *** 0.013 | -0.13 *** 0.014 | -0.12 *** 0.014 | -0.13 *** 0.021 | -0.13 *** 0.021 | -0.12 *** 0.022 |
| paid_rank | -0.0069 *** 0.00085 | -0.016 *** 0.0018 | -0.016 *** 0.0018 | -0.0084 *** 0.00079 | -0.0084 *** 0.00079 | -0.019 *** 0.0015 |
| natural_rank | 0.00089 *** 0.00035 | 0.0029 *** 0.00086 | 0.0032 *** 0.00088 | 0.0008 * 0.00046 | 0.0008 *** 0.00046 | 0.003 *** 0.0012 |
| sqpaidrank | | 0.00024 *** 0.000044 | 0.00024 *** 0.000044 | | 0.00024 *** 0.000044 | 0.00028 *** 0.000037 |
| sqnaturalrank | | -0.000031 *** 0.000012 | -3E-05 *** 0.000012 | | -0.000031 *** 0.000012 | -3E-05 * 0.000016 |
| m2 | | 0.014 0.013 | 0.014 0.013 | | 0.014 0.013 | 0.0073 0.011 |
| m3 | | -0.016 0.012 | -0.015 0.012 | | -0.016 0.012 | -0.037 0.01 |
| natural_rank*retailer | | | -0.002 * 0.0014 | | | -0.0029 0.002 |
| const | 0.299 *** 0.011 | 0.32 *** 0.014 | 0.32 0.014 | 0.299 *** 0.015 | 0.32 *** 0.014 | 0.32 *** 0.017 |
| Number of Observations | 924 | 924 | 924 | 924 | 924 | 924 |
| F-Statistic | 39.41 *** | 28.43 *** | 26.19 *** | | | |
| Wald Chi-Squared | | | | 175.3 *** | 243.3 *** | 250.5 *** |
| R-squared | 0.205 | 0.2375 | 0.2401 | 0.1992 | 0.2312 | 0.2325 |

Note: 1-3 OLS
4-6 Random Effects GLS

Model 8A. Natural Rank

| | (1) | (2) |
|------------------------|--------------------|--------------------|
| brand | -2.8 *** 1.04 | -2.7 *** 1.05 |
| retailer | -8.05 *** 1.22 | -7.83 *** 1.27 |
| prnaturalctr | -47.83 *** 19.7 | -50.8 *** 20.13 |
| m2 | | -0.46 1.27 |
| m3 | | -0.91 1.14 |
| const | 13.4 *** 0.85 | 13.8 *** 0.98 |
| Number of Observations | 924 | 924 |
| F-Statistic | 23.26 *** | 14.1 *** |
| R-squared | 0.0705 | 0.0711 |

Note: 1,2 OLS