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Direct-to-Consumer Advertising and Online Search

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Direct-to-Consumer Advertising and Online Search*

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Abstract

Beginning in 1997, the Food and Drug Administration (FDA) allowed television advertisements to make major statements about a prescription drug, while referring to detailed drug information on the internet (FDA 1997; 2015). The hope was that consumers would seek additional information online to fully understand the risks and benefits of taking the medication. To better understand the effects of the policy, we analyze direct-to-consumer advertising (DTCA) and search engine click-through data on a set of drugs over a three-year period.

Regression analysis shows that advertising on a prescription drug serves to increase the frequency of online search and subsequent clicks for that drug, as well as search for other drugs in the same class. We find the relationship between DTCA and search is stronger for younger drugs, for those drugs that treat acute conditions, those drugs that are less likely to be covered by insurance, and those whose searcher population tends to be older. These findings suggest that DTCA motivates consumers to search online for drug information, but the magnitude of the effect is heterogeneous and potentially associated with clicks on websites that are more promotional in nature.

JEL: D83, I18, K32, L81

Keywords: Direct-to-consumer Advertising, Prescription Drugs, Internet Search

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1 Introduction

Advertising regulations have extended from traditional medias to the internet. Take prescription drugs for example: in 1997, the Food and Drug Administration (FDA) allowed a television advertisement to focus on the essential efficacy and side effect information of a prescription drug as long as the manufacturer provided detailed drug information on the internet and in other publications (FDA 1997; 2015).[1] The key assumptions are that (1) a television-watching consumer will seek more information on the internet, and (2) this process will result in a balanced understanding of the drug.

Our paper contributes to the recent literature assessing both assumptions. On the first, Kim (2015) analyzed warning letters issued to pharmaceutical companies regarding problems with their online search ads and found that most violations were for a lack of adequate risk information on branded drug websites and in online paid advertisements. After receiving these letters, many of the advertisements were removed. Choiu and Tucker (2010) looked at how search patterns changed as a result and found that consumers were more likely to click on websites that featured user-generated content and online pharmacies.

Beyond drug advertising, a number of papers have looked at the relationship between television advertising and online search. Joo et al. (2015) look at how advertisements for financial services companies affected search for both individual brands and more general product categories. They find a positive effect on brand searches, but no effect on category searches.[2] Lewis and Reiley (2013) show similar positive effects focusing on a range of consumer products advertised during the Super Bowl. Dinner et al. (2014) find cross-channel effects on sales: offline (online) advertising affects online (offline) sales. The interaction of offline and online advertising is studied in Goldfarb and Tucker (2011) where they show that online ads can be a substitute for offline ads in affecting sales of alcoholic beverages.[3]

An intensive debate also targets the second assumption that consumers receive a balanced understanding of the risks and benefits of taking a particular drug. One side of the debate argues that it is misleading to provide drug information to consumers as they cannot directly choose their prescription. To make things worse, pharmaceutical manufacturers may not have the incentive to provide "balanced" information: researchers show that television advertisements tend to emphasize drug benefits over risk information (Kopp and Bang 2000; Day 2006) and although most prescription drug websites provide both risk and benefit information, the risk information is presented in a less prominent and accessible way (Huh and Cude 2004).

[1] The FDA's guidelines state that the adequate provision for detailed drug information could be met with both reference to a website on the internet and a means for "many persons with limited access to technologically sophisticated outlets" to obtain the information. This could be in the form a toll-free number, reference to other available print ads, or the "availability of sufficient numbers of brochures containing package labeling in a variety of publicly accessible sites (e.g., pharmacies, doctors' offices, grocery stores, public libraries)."

[2] If this result holds for drug searches, it would mean that advertisements for the cholesterol drug, Lipitor, lead to more searches for the brand, but has no significant effect for searches on cholesterol or heart disease.

[3] Other studies that find positive effects of online advertising on online search and clicks include Papadimitriou et al. (2011), Van der Lans et al. (2014), Ghose and Todri (2015), and Chiou and Tucker (2012). Lewis and Nguyen (2015) use an experiment run on Yahoo!'s search engine to show that display advertising for a particular brand increases searches for that brand by 30-45% and has positive spillovers to competing brands.

The other side of the debate stresses the educational value of drug advertising: it informs consumers of a drug's existence, which may prompt consumers to research the drug, associate it with self-observed symptoms and eventually seek treatment. Some evidence lent support to these arguments (Iizuka and Jin 2005; Avery et al. 2007) while other evidence confirms the concern that consumer pressure for advertised drugs may compromise doctors' prescription choices (Kravitz et al. 2005) or lead to adverse drug-related events (David, et al. 2010).[4]

Do consumers search for online information upon exposure to direct-to-consumer advertising (DTCA)? If they do, the information communicated via the internet could play an important role on both sides of the debate. To the extent that manufacturer websites are biased towards drug benefits, will DTCA motivate consumers to search for information on other websites? If there is an educational value in drug advertisements, will DTCA encourage consumers to go beyond the advertised drug and research competing drugs? In this paper, we employ consumer click-through data to answer these questions.

Our analysis focuses on the click behavior of consumers using comScore's click-through data from the five largest search engines. According to Pew internet and the American Life Project (2008)[5], search engines like Google and Yahoo! are an important gateway to the internet. Use of the internet in the U.S. increased from 52% of all American adults in 2000 to 84% in 2015 (Perrin 2015).[6] When consumers go online, using a search engine is a very popular online activity: 91% of internet users visited a search engine in 2012 (Purcell 2012). While consumers formerly relied on their doctor as the primary source of medical information, now they increasingly turn to the internet. A study by Pew Research found that 72% of internet users searched for health-related information on the internet in the past 12-months and 77% of users began at a search engine (Fox 2013).[7]

Interestingly, while most DTCA for prescription drugs are conveyed via traditional medias such as television, radio, magazines, newspapers, and billboards, a small but growing portion is devoted to display (banner) advertisements and sponsored search on the internet. For example, pharmaceutical manufacturers spent $270 million on online display ads in 2010, 6.4% of overall DTCA spending.[8] Overall, total DTCA spending on prescription drugs increased from $662 million in 1996 (the year before the FDA's new guidance) to $4.2 billion in 2010, a 542% increase. According to Nielsen, in 2014, pharmaceuticals were the third largest category of ad spending.[9]

Our analysis shows that advertising on a prescription drug serves to increase the frequency of online search for that drug as well as search for other drugs in the same class.[10] The number

[4]There is also a large literature analyzing the effects of DTCA on initial drug take-up and adherence. See, for example, Avery et al. (2012), Dave and Saffer (2012), and Woskinska (2005).

[5]See http://www.pewinternet.org/~/media/Files/Reports/2008/PIP_Search_Aug08.pdf.

[6]Figure A1 in the appendix shows the overall growth of U.S. internet users and the simultaneous increase in prescription drug expenditure.

[7]Another survey finds that "approximately 40% of respondents with internet access reported using the internet to look for advice or information about health or health care in 2001." (JAMA 2003).

[8]Source: Kantar Media. Note the data do not include paid search advertising.

[9]Source: http://www.nielsen.com/us/en/insights/news/2015/tops-of-2014-advertising.html.

[10]Some of our results show that class-level DTCA has a larger effect than own-drug DTCA, which is consistent

of clicks following drug queries is positively associated with DTCA and the effect is significantly larger for paid clicks compared to organic clicks. Clicks (both organic and paid) on promotional websites are more strongly associated with DTCA compared to clicks on informational websites. The magnitude of the effect of DTCA varies significantly by media type with broadcast and internet advertising having the strongest positive effects.

We also find the relationship between DTCA and search is stronger for younger drugs and for those drugs that treat acute conditions. This group of drugs may be particularly important from the FDA's point of view because consumers may be first-time users and lack experience taking a drug. As expected, drugs that are less likely to be covered by insurance plans also show a stronger positive relationship between DTCA and search activity, particularly clicks on promotional websites.

Ippolito and Mathios (1991) show that older and potentially more informationally-disadvantaged populations are more responsive to advertising.[11] If the advertising is associated with more clicks on promotional websites, it may expose these populations to relatively more biased and less balanced information. However, if the advertising is associated with clicks on informative websites, they also may benefit more than other populations if they lack awareness of alternatives. Our results show more evidence of the first hypotheses, primarily for older searchers. Promotional clicks are more strongly associated with DTCA for older searchers. In contrast, the relationship between DTCA and promotional clicks is reduced for less wealthy searchers. Neither age nor income level appears to affect the relationship between DTCA and clicks on informational websites.

The remainder of this paper is organized as follows. In section 2, we provide a description of the data, which includes click-through data from comScore, drug information from the FDA, and advertising data from Kantar Media. Section 3 presents summary statistics on drug-related searches and advertising. Regression results are presented in section 4 that show how DTCA is associated with the frequency of search and clicks following drug queries. We also consider spillovers of drug DTCA to other drugs in the same class and how searcher demographics affect the relationship between advertising and search. Section 5 concludes.

2 Data

We combine three different data sources to estimate the effects of DTCA on online search. Search and click-through data are obtained from comScore, monthly advertising data are obtained from Kantar Media, and drug information is obtained from both the FDA's Orange Book and the Medical Expenditure Panel Survey (MEPS).

with studies by Donohue and Berndt (2004) and Shapiro (2015) that show that DTCA (unlike detailing to a physician) has more of an effect on market expansion than on specific drug choice.

[11] Also, see Johnson and Cobb-Walgren (1994).

2.1 Search Data

Search and click-through data are based on a 37-month sample (September 2008-September 2011) from comScore for 373 prescription drugs.[12] ComScore's Search Planner product provides the frequency of searches and clicks for a given query (drug) on the five largest internet search engines (Google, Yahoo!, Bing, AOL, and Ask) for all U.S. internet users.[13] Reports are generated for both "exact" queries (i.e., the metrics reported are for searches on the precise query entered into the search engine) and "match-all-form" queries (i.e., the metrics reported are for searches on the precise query and alternative forms of the query such as additional words, plural forms, and common misspellings).[14] Most of our analysis will rely on the match-all-forms reports though results using the exact reports are provided in the appendix.

To request the search data from comScore, we needed to provide a list of queries on which to generate the reports. To create the database of queries, we use the FDA's Orange Book, which includes all drugs that have been approved by the FDA.[15] We focus on drug names only (as opposed to medical conditions and drug classes) because drug names are mentioned prominently (and repeatedly) in advertisements and one study found that over 80% of drug advertisements promoted specific products rather than medical conditions.[16] Because many of these drugs are unpopular or have more obscure names, we first ran the full list of drug names through comScore to download the search activity during the first and last six months of our sample period. Drugs with no search activity in either window were dropped, leaving us with a sample of 2,158 drugs. After merging with the advertising database and restricting to drugs that have positive ads in at least one month during our time period, we are left with 373 drugs on which we perform our analysis.[17] ComScore also provides demographic information, including age and household income, for the average searcher of a given query.

[12] Because 51 drugs are newly approved during our sample period, we only include the period after approval for those drugs.

[13] Throughout this paper, we use the term "query" to designate the search term a consumer enters in a search engine. In our case, queries are drug names. See https://www.comscore.com/Products/Audience-Analytics/Search-Planner.

[14] The match-all-forms report for the query "lipitor" would include metrics for "buy lipitor", "lipetor", "lipitor side effects," etc.

[15] At the time of download, the Orange Book included 26,590 drugs.

[16] See http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2690298/ for more on the evolution of drug advertising in the U.S. Prior to the FDA's 1997 guidelines, broadcast ads generally featured either the drug name or the condition treated, but not both.

[17] ComScore censors the search and click reports if the sample size is too small to reliably extrapolate to the population. This is less of an issue for our sample of drugs that are all actively advertised. Approximately 15% of drug-months show zero searches and clicks, which could be due to censoring.

Table 1: Descriptive Statistics - Search Data

Variable	Min	Mean	Median	Max	Std.Dev.
Searches	0	39,394	10,437	3,619,427	93,021
Searchers	0	22,380	7,346	738,124	41,783
Searches Per Searcher	0.0	1.4	1.3	23.1	1.1
All Clicks					
Total	0	27,754	6,667	916,841	58,864
Organic	0	25,214	5,945	914,106	54,189
Paid	0	2,541	0	172,231	8,191
Promotional Clicks					
Total	0	4,288	0	181,842	11,477
Organic	0	3,205	0	148,249	8,335
Paid	0	1,083	0	133,625	4,980
Informational Clicks					
Total	0	9,056	885	407,544	22,780
Organic	0	8,657	833	404,809	21,895
Paid	0	399	0	50,350	2,265
Other Clicks					
Total	0	14,411	2,889	509,297	31,716
Organic	0	13,352	2,565	509,297	29,918
Paid	0	1,059	0	82,153	3,799
Searcher Demographics					
Searcher Age	21.0	48.5	48.4	71.6	8.6
Searcher Income	13,749	81,385	77,102	155,693	32,832
Unique Queries	373				
Observations	13,358				

Notes: The unit of observation is a drug-month based on data from September 2008 - September 2011. Promotional, informational, and other may not sum to "all clicks" due to censoring at the website level. Searcher age and income as of first month in sample. Source: comScore Inc.

Descriptive statistics on the comScore click-through data are shown in Table 1. Drugs in our sample received an average of about 40,000 searches each month and those searches generated approximately 28,000 clicks. While most clicks are on "organic" links, about 10% of clicks are on "paid" or "sponsored" links. Organic links are those displayed based only on the search engine's algorithm, while paid links appear based both on their relevance to the search query and a payment made to the search engine by the link's owner.

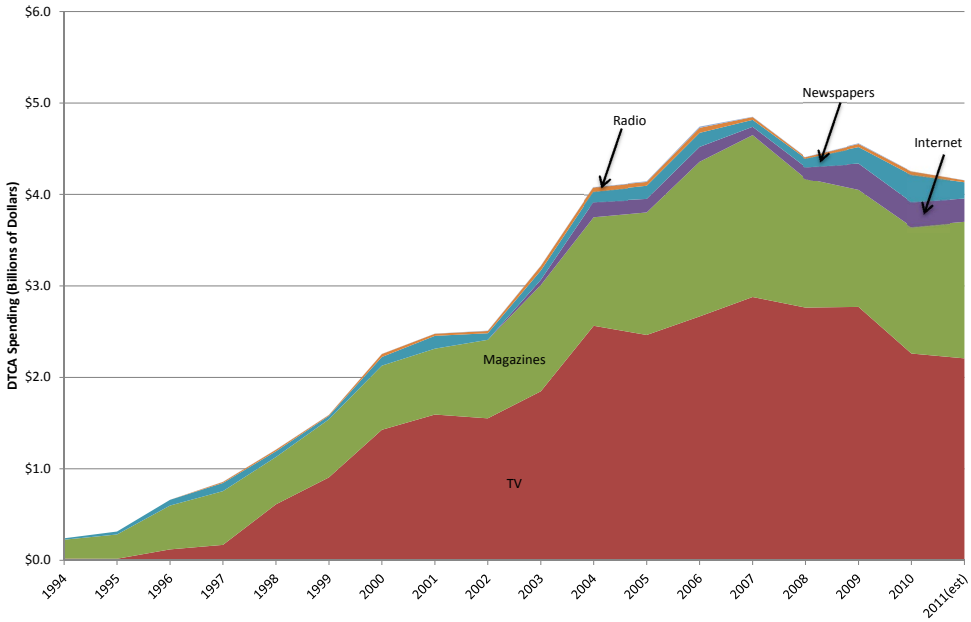
While many websites often contain both informational and promotional content, we further classify clicks on websites as being primarily promotional or informational. Promotional clicks are those on online pharmacies (e.g., drugstore.com), brand websites (e.g., lipitor.com), and producer websites (e.g., pfizer.com). Informational clicks are those on websites ending in dot-gov (e.g., fda.gov), those ending in dot-edu (medicine.yale.edu), and other health information websites (e.g.,

webmd.com).[18] It is important to note that we are not viewing promotional websites as *bad* and informational websites as *good*, but simply classifying the websites based on their likely primary content. All other clicks are classified as "other" and they include clicks on non-health related websites and generally popular websites, such as yahoo.com. Promotional clicks are much more likely to be paid compared to informational clicks. The average searcher in our sample is 49 years old with a household income of over $81,000.

2.2 Advertising Data

We also gather data on DTCA for each drug in the sample. We have monthly data from January 1994 through September 2011 from Kantar Media. The data include 1,684 unique brand name drugs, of which 832 had positive DTCA between September 2008 and September 2011, the date range of the comScore data. Advertising expenditure is broken down by media type and the full time series of DTCA spending is shown in Figure 1.

Figure 1: Total DTCA Spending on All Prescription Drugs, 1994-2011



The growth of total DTCA is clearly evident with the largest increases in television and magazine advertising, and more recently, spending on the internet. In 2011, total DTCA was divided between television (53.1%), magazines (35.9%), internet (6.1%), newspapers (4.3%), radio (0.5%), and outdoor ads (0.02%). The growth in television advertising is particularly apparent following the

[18] We created our list of online pharmacies by merging the pharmacies listed on pharmacy certifying websites, LegitScript.com, PharmacyChecker.com, NABP.net, CIPA.com, and websites classified by comScore as drug retailers. More details can also be found in Chesnes, Dai, and Jin, "Banning Foreign Pharmacies from Sponsored Search: The Online Consumer Response," which is under review.

FDA's new guidance on DTCA issued in 1997. Kantar only reports internet ad spending on display ads which appear, for example, across the top of many websites though generally not search engines. It does not include spending on sponsored/paid search results which is reported to be about the same size as display ad spending in the pharmaceutical industry.[19] Figure A2 in the appendix shows the 25 drugs with the largest DTCA spending in 2011.

Descriptive statistics of the advertising data over the time period for which we observe search data are shown in Table 2. The average drug in our data has close to one million dollars per month of DTCA, though the average is highly skewed as 66 drugs (18%) had monthly DTCA above the mean and 307 (82%) were below. Although the median DTCA expenditure across all drugs-months is zero, the total DTCA for the smoking-cessation drug, Chantix, was over $72 million in December 2009. Television, magazine, and, increasingly, internet-based advertising have the largest average monthly expenditure among the media channels.

Table 2: Descriptive Statistics - Advertising Data

Variable	Min	Mean	Median	Max	Std.Dev.
DTCA (thousands)					
Total	$0.0	$911.1	$0.0	$72,799.3	$3,207.0
TV	$0.0	$529.6	$0.0	$30,684.5	$2,157.9
News	$0.0	$40.1	$0.0	$30,774.1	$556.7
Magazines	$0.0	$280.2	$0.0	$23,525.9	$1,093.0
Radio	$0.0	$5.9	$0.0	$3,308.2	$88.1
Internet	$0.0	$55.2	$0.0	$33,617.8	$413.5
Outdoor	$0.0	$0.1	$0.0	$190.5	$3.1

Notes: The unit of observation is a drug-month based on data from September 2008 - September 2011 for the 373 drugs included in Table 1. Source: Kantar Media.

2.3 Drug Data

Finally, we gather characteristics of each drug in our sample from the FDA Orange Book as well as the MEPS from 2008-2011. Descriptive statistics on the variables used in the remainder of the paper are shown in Table 3.

[19] See "Health & Pharma Marketers Split Digital Spend Between Search, Display," *eMarketer*, http://www.emarketer.com/Articles/Print.aspx?R=1014123, June 23, 2016.

Table 3: Descriptive Statistics - Drug Attributes

Variable	Min	Mean	Median	Max	Std.Dev.
Drug Attributes					
Age (years)	0.00	7.25	5.80	26.68	6.12
Brand	0.00	0.93	1.00	1.00	0.25
Chronic	0.00	0.35	0.00	1.00	0.48
Insurance Coverage	0.00	0.76	0.81	1.00	0.19
Rx Per Year	1.00	4.02	4.06	12.38	1.96

Notes: The unit of observation is a drug-month based on data from September 2008 - September 2011 for the 373 drugs included in Table 1. Source: FDA Orange Book and MEPS. Statistics for age of drug based on the drug's age in the first month it appears in our sample. Insurance coverage measures the amount of the total payment paid for by third parties. Rx per year is the average number of prescriptions written for a patient in a given year.

The average drug in our sample was approved by the FDA around the year 2001 and almost all drugs in our sample are brand name drugs.[20] For each drug, the MEPS reports the amount the customer pays for each prescription and the amount paid by third parties, such as private insurance and Medicare. The *insurance coverage* variable in the table is the ratio between what the customer pays and the total payment. Drugs in our sample have approximately 76% coverage though some have zero coverage and others are fully covered by insurance.

We also use the MEPS to calculate the average prescription rate per year for each drug. Drugs with an average of five or more prescriptions per patient per year are classified as chronic. Others are classified as treating acute conditions.[21] In our sample, the average drug is prescribed four times per year to a particular customer and 35% of drugs are classified as treating chronic conditions.[22] Finally, from the FDA's National Drug Code Directory, we obtain the therapeutic class to which each drug belongs (e.g., cardiovascular agents, respiratory agents, etc.).[23]

3 Descriptive Analysis

In this section we present general descriptive statistics on the advertising and search activity of drugs in our sample. Descriptive statistics on the 10 most advertised drugs are shown in Table 4.[24]

[20] For 7% of drugs in the sample, the drug is listed under its generic name.

[21] We chose a cut-off of five prescriptions because the distribution of prescription rates in the MEPS (among our sample of drugs) is bi-modal with modes at about one and five prescriptions per year. Our results are robust to changing the cut-off to four and six prescriptions per year.

[22] For example, Tamiflu is an acute drug with 1.04 prescriptions per year and Zonegran (an anti-seizure medicine) is a chronic drug with 8.11 prescriptions per year.

[23] A full list of drug classes is shown in Table A3. See http://www.fda.gov/Drugs/InformationOnDrugs/ucm142438.htm.

[24] A similar table for the 10 most searched drugs is shown in the appendix table A1.

Table 4: Descriptive Statistics - Top 10 Drugs by DTCA

	Drug	DTCA ('000s $)	Searches	All Clicks	Drug Age	Searcher Age	Searcher Income	Rx Per Year	Insurance Coverage	Keywords	Class
1	lipitor	$21,171	137,237	101,567	11	51	64,506	5.3	81%	cholesterol	metabolic agents
2	cymbalta	$18,035	315,586	202,744	4	40	$93,794	6.0	82%	mental health	psychotherapeutic agents
3	cialis	$16,008	283,256	196,260	4	49	$69,981	3.2	35%	sexual, contraceptive, menopause	miscellaneous agents
4	advair	$15,518	105,986	80,440	8	57	$57,477	4.8	87%	asthma	respiratory agents
5	abilify	$14,728	150,869	113,104	5	54	$104,505	5.8	89%	mental health	psychotherapeutic agents
6	symbicort	$11,609	22,763	18,634	2	57	$61,166	4.0	68%	asthma, copd	respiratory agents
7	lyrica pregabalin	$10,826	1,146	971	3	30	$87,500	6.1	83%	anti-epileptic, fibromyalgia	central nervous system agents
8	plavix	$10,151	95,039	68,760	10	52	$101,310	6.2	77%	heart, blood pressure, cholesterol	coagulation modifiers
9	viagra	$9,586	674,040	397,917	10	48	$79,958	2.5	20%	sexual, contraceptive, menopause	miscellaneous agents
10	pristiq	$8,952	81,445	81,522	0	52	$98,964	6.1	80%	mental health, antidepression	psychotherapeutic agents

Notes: DTCA, searches and clicks are month averages from 9/2008-9/2011. Age of drug, Searcher age, and Searcher income as of the first month a drug appears in the sample. Keywords from Kantar database of drug DTCA. Insurance coverage is the ratio of the total payment made by third parties (private insurance, Medicare, etc.) to the total payment (including payments by the patient).

The list reveals that although most highly advertised drugs are also searched often, there is a wide range of drug ages, prescription rates, insurance coverage rates, and searcher demographics among these drugs. The cholesterol drug, Lipitor, has average DTCA of over $21 million a month and receives almost 140,000 searches. Averages of the key search and advertising variables for all drugs are shown in Table 5.

Table 5: Drug Averages

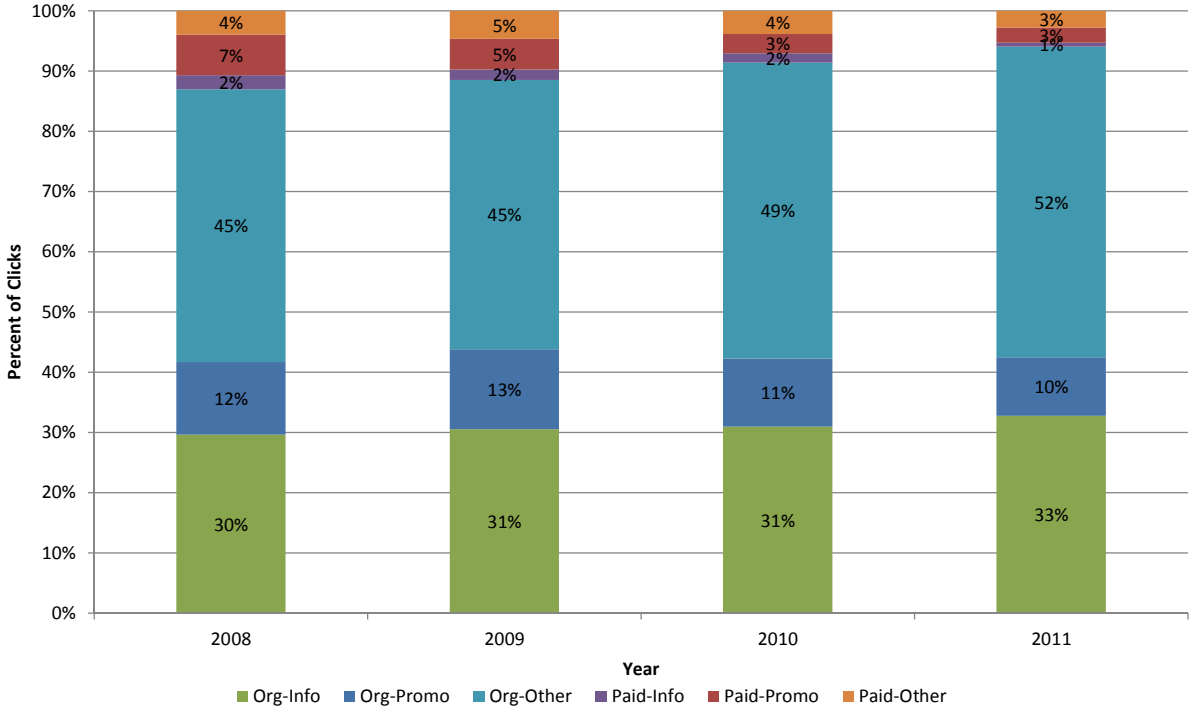
Number of Drugs	373	Searches	39,394
Observations	13,358	All Clicks	27,754
		Organic Clicks	25,214
DTCA ('000)	$911	% Organic	90.8%
% TV	58.1%	Paid Clicks	2,541
% Newspapers	4.4%	% Paid	9.2%
% Magazines	30.8%	Promo Clicks	4,288
% Radio	0.6%	% Promo	15.4%
% Internet	6.1%	Info Clicks	9,056
% Outdoor	0.0%	% Info	32.6%

Notes: DTCA, searches and clicks are month averages per drug from 9/2008-9/2011. Promo clicks are clicks on pharmacies, brand, and producer websites. Info clicks are clicks on dot-edu, dot-gov, and other general health information websites.

The average drug in our sample has total DTCA of $911,000 each month. Television DTCA

represents about 58% of the total consumer-directed advertising budget for a drug. Over 90% of clicks are organic, and as shown in Figure 2, this percentage has grown about eight percentage points from 2008 to 2011.[25] As a percentage of total clicks received, over twice as many (33% versus 15%) are clicks on informational websites compared to promotional websites. Figure 2 also shows that clicks on informational websites have slightly increased between 2008 and 2011, while clicks on promotional websites have been falling (as a percentage of total clicks).[26]

Figure 2: Clicks by Type, 2008-2011



[25]The growth in organic clicks relative to paid clicks is partially due to Google's ban on unapproved online pharmacies from advertising via paid links in February 2010. Other search engines followed suit in subsequent months. All of our regression specifications include month fixed effects to control for any effects of the ban. For more, see: Chesnes, Dai, and Jin, "Banning Foreign Pharmacies from Sponsored Search: The Online Consumer Response," (under review).

[26]Informational (promotional) clicks represented 32% (19%) of clicks in 2008 and 34% (13%) of clicks in 2011. Note that percentages in Table 5 are across all years.

Figure 3: Destination Websites, by Click Type

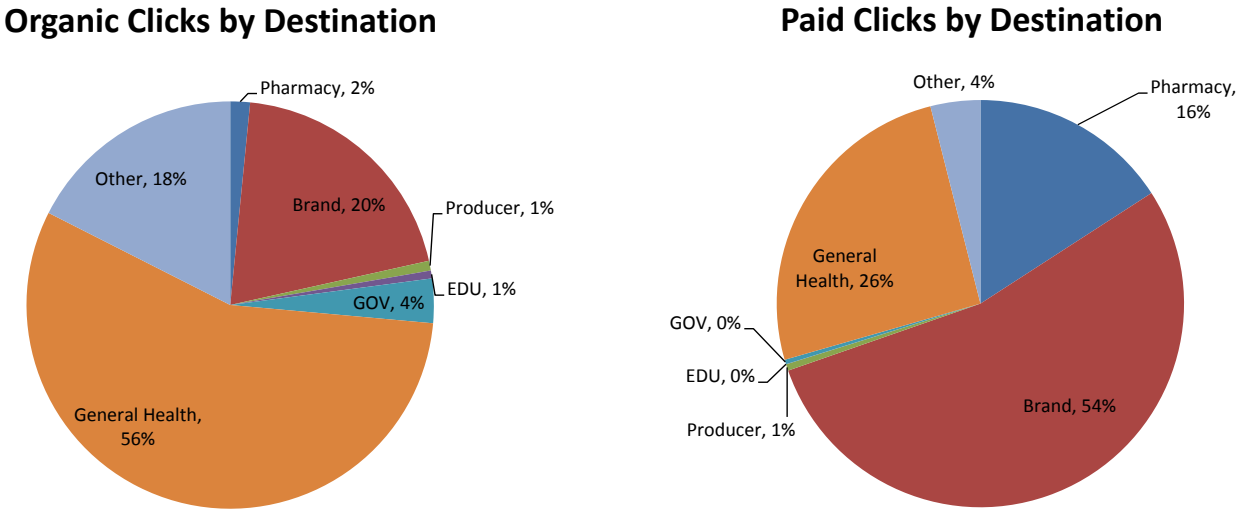


Figure 3 shows the distribution of destination websites for organic and paid clicks. Among organic clicks, over half of clicks following drug queries are on general health information websites, followed by clicks on the the brand website and other sites like major search engines. The distribution of paid clicks is quite different with over half going to brand websites, followed by general health websites and a significant fraction, 16%, to online pharmacies.[27] Figure A3 in the appendix shows the organic/paid split for each entity type ranging from online pharmacies with the highest percentage of paid clicks (52.2%) to dot-edu websites with the highest percentage of organic clicks (99.8%).

[27] Note the general health websites with the largest number of paid clicks include webmd.com, righthealth.com, and healthline.com.

Table 6: Descriptive Statistics - By Drug Characteristics and Searcher Demographics

	Number of Drugs	Rx Per Year	Insurance Coverage	Drug Age	Searcher Age	Searcher Income	Searches	All Clicks	% Paid	% Promo	% Info	DTCA
Condition												
Acute	195	2.9	74%	7.7	47.8	$78,510	47,121	32,833	9%	16%	33%	$940,023
Chronic	102	6.0	83%	7.5	49.1	$82,802	42,258	31,438	9%	16%	33%	$1,447,154
Unknown	76			5.3	50.6	$91,096	15,707	9,724	8%	15%	30%	$104,767
Insurance												
High Coverage	174	4.4	87%	7.5	48.6	$81,802	34,568	25,075	9%	15%	34%	$1,143,919
Low Coverage	123	3.5	62%	7.9	47.8	$77,659	60,590	42,501	9%	16%	32%	$1,078,366
Unknown	76			5.3	50.6	$91,096	15,707	9,724	8%	15%	30%	$104,767
Searcher Age												
under30	6	3.1	65%	2.7	28.5	$61,567	7,119	5,474	9%	21%	9%	$2,126,339
30to35	6	3.7	73%	8.8	32.6	$56,637	22,203	17,491	5%	23%	28%	$621,705
35to40	30	4.1	75%	7.9	38.0	$85,142	50,824	32,078	9%	15%	29%	$914,079
40to45	45	3.9	75%	9.4	42.8	$81,640	64,231	45,715	9%	13%	37%	$960,624
45to50	78	4.2	76%	8.7	47.7	$81,125	76,368	53,298	9%	14%	34%	$1,180,561
50to55	43	4.2	81%	7.4	52.1	$83,698	46,829	35,253	9%	17%	33%	$1,853,429
55to60	30	4.0	75%	7.3	57.3	$75,028	33,493	24,611	10%	22%	31%	$1,745,596
60to65	12	4.4	79%	5.8	62.0	$96,463	23,780	17,303	11%	24%	25%	$952,933
over65	13	4.3	74%	6.1	69.4	$85,520	10,445	6,267	13%	19%	18%	$48,803
Unknown	110	3.7	78%	5.4			5,599	3,883	6%	19%	19%	$143,376
Searcher Income												
under25k	8	5.4	88%	7.2	51.3	$14,518	10,849	7,385	18%	9%	33%	$318,028
25kto50k	29	3.8	77%	9.3	49.3	$38,240	14,750	10,650	9%	18%	30%	$370,488
50kto75k	86	4.0	74%	8.5	48.6	$63,088	46,595	33,688	11%	20%	30%	$1,445,894
75kto100k	71	4.2	77%	8.4	45.6	$84,917	98,879	68,510	8%	11%	36%	$1,364,351
100kto125k	36	4.1	79%	6.8	50.7	$108,692	47,847	33,551	12%	18%	34%	$1,723,101
125kto150k	23	4.1	76%	7.4	50.2	$138,126	27,305	19,796	10%	22%	27%	$989,207
over150k	10	3.9	78%	4.2	53.1	$155,157	9,769	7,049	11%	30%	16%	$348,207
Unknown	110	3.7	78%	5.4			5,599	3,883	6%	19%	19%	$143,376

Notes: DTCA, searches and clicks are month averages per drug from 9/2008-9/2011. Age of drug, Searcher age, and Searcher income as of the first month a drug appears in the sample. Chronic drugs are defined as those with an average of 5 or more prescriptions per patient per year. Low coverage drugs are drugs where the percent of the total payment that is paid by third parties is less than 80% (the median coverage).

Table 6 shows the monthly averages of key variables both by drug characteristics and searcher demographics. Acute drugs are searched slightly more often (and receive more clicks following those searches) than drugs that treat chronic conditions. This may be due to the fact that first-time users of these drugs may be unfamiliar with side effects, interactions, etc. and are seeking additional information. Users of chronic drugs may be seeking an inexpensive source of supply, though the percent of clicks on paid and promotional websites is the same as acute drugs. DTCA spending is 54% higher for drugs that treat chronic conditions compared to those that treat acute conditions.

Drugs that are less likely to be covered by third-party payers are searched much more often than drugs with high coverage, but again the percent of clicks on paid and promotional websites is similar for both high and low coverage drugs. If consumers are more likely to seek affordable supply options for drugs with low coverage, we might expect those drugs to receive a higher percentage of promotional clicks. However, if lower third-party coverage is correlated with lower per-prescription prices (and lower out-of-pocket expenditure), we would expect the opposite result. We explore this

further in the regression analysis below.

The number of searches and subsequent clicks varies somewhat with searcher age and income - searchers in their late 40s and those with between $75,000 and $100,000 in income tend to search more than other groups, but the percent of clicks on paid and promotional links do not vary systematically. Tables showing these same variables by drug age (A2) and drug class (A3) are included in the appendix.

4 Regression Results

Our regression analysis is at the drug-month level. The breakdown of advertising by media is important both because of different FDA regulations over what must be conveyed in advertisements on each media and DTCA via different channels may have different effects on consumer search patterns. Because almost 90% of DTCA is either on television or in magazines, we aggregate DTCA into "broadcast" and "print" based ads. Television and radio DTCA are aggregated into the broadcast DTCA variable, while magazine, newspaper, and outdoor-based DTCA are aggregated into the print DTCA variable. We leave internet DTCA separate both because it is the fastest growing segment of DTCA and due to its close proximity to the variables we are measuring, search and clicks.

Broadcast media, especially since the FDA's guidance in 1997 lessening the requirements on what needs to be conveyed during the ad, tends to only highlight the main benefits and potential side effects of a drug (the "major statement"). Magazine ads usually include two pages: one with the highlights of the drug in full color and dramatic fonts, and the other with the details in fine print (the "brief summary"). DTCA in newspapers is likely presenting similar information to magazine ads. The internet ads captured in the data are *display ads* and would likely have a similar effect to broadcast DTCA with only the highlights presented. Therefore broadcast and internet ads, given their lack of detailed information, may have a stronger positive effect on search compared to print ads.

4.1 Baseline: Effects of DTCA on Consumer Search and Clicks

Our baseline regression is shown in equation 1.

$$\begin{aligned} log(search)_{dm} &= \alpha + \beta \cdot log(DTCA_{d,m-1}) + \delta \cdot log(DTCA_{c,m-1}) \\ &\quad + \mu_m + \mu_d + \epsilon_{dm}. \end{aligned} \tag{1}$$

Search for drug d in month m is regressed on advertising for the drug and advertising for other drugs in the same class in the previous month.[28] We control for time effects with year-month

[28] All regressions in this section are in logs. For months where a drug had either no recorded searches or zero advertising, we code the log of those variables as zero. Removing those observations from our model results in almost identical results. Our baseline model in levels is shown in the appendix.

fixed effects in all specifications. Due to the skewed distribution of search popularity for drugs in our sample, we also include drug fixed effects in all specifications.[29] Our dependent variable is alternatively the number of searches, clicks, organic clicks, or paid clicks.

The specifications in the table below each contain either overall DTCA for a drug or a breakdown of DTCA by the broadcast, print, and internet channels. We attempt to limit the endogeneity that may exist between DTCA and search activity by including only DTCA spending in the month prior to the period we observe the search and click activity.[30] We believe this minimizes the endogeneity of last-month advertising as manufacturers plan their DTCA spending in advance and are unlikely to determine offline advertising in expectation of its impact on online search. This does not imply that we assume no effect from concurrent advertising or a complete depreciation of DTCA after one month (more on depreciation below). Rather, what is captured is the correlation between drug search and last month's advertising. To the extent that advertising is serially correlated from month to month, the regression will partially capture the effect of concurrent advertising as well. We have done robustness checks by including the previous three, six, and 12 months aggregate advertising and the results are qualitatively similar to those presented here.[31]

Most of the DTCA in our data is offline with only 6% of total DTCA in the form of online display ads. Online spending on paid-search advertising is not included in the data. Particularly for specifications with paid clicks as the dependent variable, we are not accounting for a potentially important omitted variable, paid search advertising. To the extent that drug companies run simultaneous ad campaigns across channels, the reported coefficients will partially reflect the effect of the paid search ads. However, the bias should be limited because the correlation between internet (display) advertising and both broadcast and print ads is only 0.20, while it is 0.53 between broadcast and print ads.

[29] See the regression results in appendix table A4, which shows how the coefficients on DTCA change with different drug and time fixed effects.

[30] Including DTCA from the same month would incorrectly involve search activity during the first half of the month regressed on DTCA spending in the second half of the same month.

[31] We have also run our regressions using only the contemporaneous advertising variables and obtained similar results that are generally slightly larger in magnitude. These results are available from the authors upon request.

Table 7: Regression Results: Searches and Clicks

VARIABLES	(1) Log Searches	(2) Log Searches	(3) Log All Clicks	(4) Log All Clicks	(5) Log Organic Clicks	(6) Log Organic Clicks	(7) Log Paid Clicks	(8) Log Paid Clicks
Log DTCA	0.027***		0.026***		0.021***		0.085***	
	(5.036)		(5.011)		(3.880)		(14.491)	
Log DTCA-Class	0.016		0.052**		0.053**		0.044*	
	(0.705)		(2.363)		(2.412)		(1.791)	
Log Broadcast		0.020**		0.028***		0.025***		0.071***
		(2.366)		(3.390)		(2.979)		(7.786)
Log Print		0.014**		0.010		0.008		0.027***
		(2.160)		(1.501)		(1.187)		(3.894)
Log Internet		0.017***		0.021***		0.015**		0.085***
		(2.580)		(3.367)		(2.393)		(12.239)
Log Broadcast-Class		0.001		0.001		0.006		0.005
		(0.152)		(0.143)		(0.854)		(0.586)
Log Print-Class		-0.005		-0.002		-0.009		0.008
		(-0.446)		(-0.228)		(-0.791)		(0.691)
Log Internet-Class		0.001		0.046**		0.037**		0.044**
		(0.062)		(2.467)		(1.963)		(2.128)
Constant	10.950***	10.983***	9.759***	9.617***	9.643***	9.724***	6.516***	5.262***
	(19.074)	(20.095)	(17.550)	(18.173)	(17.138)	(18.158)	(10.532)	(8.967)
Observations	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985
R-squared	0.636	0.636	0.650	0.651	0.644	0.644	0.601	0.604
Year/Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Query FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month. Broadcast ads are television and radio ads. Print ads are those in magazines, newpapers and on outdoor displays.

Results of the baseline regression are presented in Table 7. A drug's own and class DTCA are strongly associated with more search and clicks. The largest effect for own DTCA is on paid clicks. A 10% increase in own DTCA is associated with a 0.21%-0.27% increase in searches, all clicks, and organic clicks; and a 0.85% increase in paid clicks, statistically significantly higher than the effect on organic clicks. Note that while the coefficient (elasticity) is larger for paid clicks compared to organic clicks, because most clicks are organic, the change in the absolute number of clicks is over twice as large for organic clicks. [32] We also find positive spillovers from one drug to another within the same class: class DTCA has larger effects than a drug's own DTCA for all clicks and organic clicks and a smaller effect for paid clicks.

Focusing on the breakdown by media category reveals that broadcast and internet advertising have positive and significant effects in all specifications, with the largest effect for paid clicks. This is consistent with the notion that these ads provide relatively less detailed information and may leave a consumer wanting to seek out additional sources. Print ads are positive and significant for searches and paid clicks, though the coefficients are smaller in magnitude compared to broadcast and internet ads. Class-level DTCA via internet ads is positive and significant for both organic and paid clicks. Class-level print-based DTCA is negative (though insignificant) for searches and all clicks, consistent with consumers searching for the drug name appearing in those ads and clicking relatively less on drugs that may be in the same class. Overall, the spillovers from class-level DTCA to clicks are largest for online ads.

[32] From Table, 1, the average drug receives 25,214 organic clicks and 2,541 paid clicks each month. Multiplying these totals by the elasticities yields a change of 5,295 organic clicks and 2,160 paid clicks for a 10% increase in DTCA.

Table 8: Regression Results: By Click Type

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Log All Promo. Clicks	Log Org. Promo. Clicks	Log Paid Promo. Clicks	Log All Info. Clicks	Log Org. Info. Clicks	Log Paid Info. Clicks
Log DTCA	0.058***	0.045***	0.079***	0.025***	0.022***	0.034***
	(9.457)	(7.609)	(15.528)	(4.352)	(3.846)	(8.212)
Log DTCA-Class	0.050*	0.034	0.034	0.033	0.034	0.036**
	(1.950)	(1.370)	(1.625)	(1.388)	(1.429)	(2.094)
Constant	7.702***	7.617***	5.010***	8.828***	8.820***	0.704
	(11.871)	(12.078)	(9.331)	(14.506)	(14.509)	(1.626)
Observations	12,985	12,985	12,985	12,985	12,985	12,985
R-squared	0.636	0.633	0.545	0.705	0.703	0.477
Year/Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Query FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month. Promotional clicks are those on pharmacy, brand and producer websites. Informational clicks are those on dot-edu, dot-gov, and other general health information websites.

In Table 8, we dig deeper into the effects of DTCA on clicks by separating promotional and informational clicks. As explained above, promotional websites include brand and producer websites as well as online pharmacies, while informational websites include dot-gov and dot-edu websites. Only a government agency can register for a website that ends in the dot-gov extension, only schools can use dot-edu, while anyone can register for a dot-com site (see Chesnes (2009)). These three-letter extensions are called top-level domains. We believe that, particularly for complicated drug and health related information, a user processing the results of a search query will base their choice partially on the top-level domain and may prefer more exclusive domains (like dot-gov and dot-edu) if they are seeking unbiased information. Others may be seeking a place to buy a drug they have seen on television, so may be more likely to visit the drug company's website or an online pharmacy (both likely dot-com websites).[33]

We find that DTCA is more strongly associated with promotional clicks than informational clicks, though the latter is still positive and significant. A 10% increase in DTCA is associated with a 0.58% increase in promotional clicks and a 0.25% increase in informational clicks, and these two effects are statistically significantly different from each other. DTCA also has a significantly larger effect on paid promotional and paid informational clicks compared to organic promotional and organic informational clicks, respectively. As before, we can translate these elasticities into absolute magnitudes: the coefficients on DTCA translate into an additional 2,487 promotional clicks and 2,264 informational clicks for each 10% increase in DTCA.[34] Class DTCA shows similar effects as own DTCA for promotional clicks, but generally stronger effects for informational clicks as would be expected if ads for other drugs induce consumers to search for information about an underlying

[33]There are dot-com sites, such as webmd.com, that do provide more informational content.

[34]From Table, 1, the average drug receives 4,288 promotional clicks and 9,056 informational clicks each month.

health condition or for alternative treatments.[35]

The appendix includes various robustness checks on our baseline model. Table A5 shows that using logarithms of both the search and advertising variables provides a significantly better fit to the data (in terms of root MSE) than using levels. Table A6 shows that comScore's "exact" reports produce almost identical results to the specifications based on the "match-all-forms" reports. Alternative dependent variables are presented in Table A7. While the results for searchers is very similar to the models based on searches, we also show that own DTCA has a positive, though only marginally significant, effect on the number of searches per searcher, implying a more in-depth search experience. Regressions using clicks on individual website types as the dependent variable are shown in Table A8. The largest positive effects are for clicks on the brand, general health, and giant websites, while there are smaller positive effects for pharmacy and non-health related websites. Finally, in Table A9, we focus on the rate of depreciation of DTCA.[36] Our baseline model (specification 1) is similar to the results based on the aggregate depreciated DTCA in the prior six months (specification 3).[37]

4.2 Heterogeneous Effects: Drug Attributes

We next analyze how the effects of DTCA on search may be different for various types of drugs. Our model for these regression specifications is shown in equation 2.

$$\begin{aligned} log(search)_{dm} &= \alpha + \beta \cdot log(DTCA_{d,m-1}) + \delta \cdot log(DTCA_{c,m-1}) \\ &\quad + \gamma \cdot X_d \cdot log(DTCA_{d,m-1}) + \mu_m + \mu_d + \ _{dm}. \end{aligned} \tag{2}$$

We include own-drug and class-level DTCA as independent variables as well as the interaction of drug attributes (X_d) with own-drug DTCA. Results are shown in Table 10.

[35] Note that while Table 8 presents results for promotional and informational clicks, the omitted category is "other clicks." A regression using "other clicks" as the dependent variable results in estimates similar to specification 4 for informational clicks (the coefficients on DTCA and class-DTCA are 0.021 and 0.039 respectively). Full results are available from the authors upon request.

[36] Several researchers have attempted to estimate the depreciation rate of DTCA for prescription drugs. Berndt et al. (1995) find that about 15% of DTCA depreciated in a month (using data before the 1997 FDA clarification). Jin and Iizuka (2005) find that the effect of a drug's DTCA on the propensity of consumers to visit their doctor regarding the related drug class, depreciates by only about 4% per month. However, in Jin and Iizuka (2007), they find that the effect of DTCA on the likelihood that a doctor prescribes a drug is small and depreciates almost immediately.

[37] We use a monthly discount rate of 0.9672 for the "6m Dep" variables in specification 3, which is the monthly depreciation rate of DTCA found in Jin and Iizuka (2005).

Table 9: Regression Results: By Drug Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Log All Clicks	Log Org. Clicks	Log Paid Clicks	Log All Promo. Clicks	Log Org. Promo. Clicks	Log Paid Promo. Clicks	Log All Info. Clicks	Log Org. Info. Clicks	Log Paid Info. Clicks
Log DTCA	0.029***	0.023***	0.107***	0.071***	0.062***	0.089***	0.030***	0.027***	0.036***
	(3.400)	(2.754)	(10.191)	(6.606)	(5.949)	(9.521)	(2.938)	(2.637)	(4.695)
Log DTCA-Class	0.006	0.006	0.015	0.028	0.016	0.018	0.017	0.023	0.032
	(0.259)	(0.243)	(0.515)	(0.910)	(0.535)	(0.672)	(0.590)	(0.783)	(1.465)
Drug Age*Log DTCA	-0.019***	-0.018***	-0.013**	-0.036***	-0.033***	-0.016***	-0.026***	-0.026***	0.009*
	(-3.557)	(-3.355)	(-1.992)	(-5.385)	(-5.098)	(-2.797)	(-4.202)	(-4.204)	(1.826)
Chronic*Log DTCA	-0.035***	-0.033***	-0.059***	-0.027*	-0.024*	-0.024*	-0.017	-0.016	-0.018*
	(-3.192)	(-2.934)	(-4.282)	(-1.942)	(-1.749)	(-1.939)	(-1.274)	(-1.201)	(-1.746)
Low Insur.*Log DTCA	0.022**	0.022**	0.022	0.033**	0.015	0.028**	0.011	0.011	0.019*
	(2.039)	(2.024)	(1.633)	(2.350)	(1.144)	(2.339)	(0.847)	(0.849)	(1.929)
Constant	11.020***	10.892***	7.625***	8.311***	8.000***	5.522***	9.045***	8.946***	1.039**
	(19.117)	(18.682)	(10.595)	(11.246)	(11.112)	(8.561)	(13.104)	(12.960)	(1.973)
Observations	9,989	9,989	9,989	9,989	9,989	9,989	9,989	9,989	9,989
R-squared	0.656	0.651	0.597	0.649	0.646	0.546	0.686	0.685	0.449
Year/Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Query FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month. Drug age is standardized based on the age of the drug as of the first month it appears in the sample. Chronic and low insurance indicators constant across all months for each drug. Promotional clicks are those on pharmacy, brand and producer websites. Informational clicks are those on dot-edu, dot-gov, and other general health information websites.

The specifications correspond to all websites, promotional websites, and informational websites, separately for all, organic, and paid clicks. Drug attributes included are the drug's age since FDA approval, the type of condition the drug treats (chronic/acute), and an indicator for drugs with low insurance coverage.[38] The relationship between DTCA and clicks is reduced the older is the drug, particularly for promotional clicks. This may be because consumers are already aware of older drugs and are less influenced by their advertisements.[39] DTCA is generally less effective at driving clicks for drugs treating chronic conditions, again because consumers may be familiar with drugs they take frequently.[40]

DTCA is effective at driving more clicks for low coverage drugs, particularly paid clicks on promotional websites. This is consistent with the explanation that consumers are seeking an affordable supply source. The coefficient of DTCA on (all) informational clicks is positive (though insignificant) for drugs with low insurance coverage so a point of purchase may not be the only motivation for these consumers. Consumers may be clicking on informational websites to obtain information on drug alternatives/equivalents that may offer better insurance coverage.

If low insurance coverage and low per-prescription out-of-pocket drug prices were positively correlated, then consumers may have a reduced incentive to seek affordable sources of supply for drugs with low coverage. However, in our data the correlation between out-of-pocket per-prescription drug costs and the proportion of the drug's total payment made by a third party is -0.23. Appendix Table A11 confirms this result: we add the interaction of DTCA and out-of-pocket drug costs as an

[38] See appendix Table A10 for regression results showing how the effect of DTCA on search varies with a drug's class. Note these results are based on a smaller sample of drugs for which we observe drug characteristics.

[39] Note that the drug age variable is standardized so other coefficients measure the effects for an average-aged drug (approximately seven years after FDA approval).

[40] Although not shown here, regressions that include individual drug attributes (and without query fixed effects) show that chronic drugs are generally positively associated with clicks, particularly on promotional websites. Consumers that purchase a drug often and may be searching for inexpensive sources of supply.

explanatory variable, but it is generally insignificant across specifications.

4.3 Heterogeneous Effects: Searcher Demographics

Finally, we turn to how searcher demographics affect the relationship between DTCA and search. Regressions in this section are similar to equation 2, but we replace drug attributes with searcher age and income from the comScore term profile reports.[41] Results are presented in Table 10.

Table 10: Regression Results: By Searcher Demographics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Log All Clicks	Log Org. Clicks	Log Paid Clicks	Log All Promo. Clicks	Log Org. Promo. Clicks	Log Paid Promo. Clicks	Log All Info. Clicks	Log Org. Info. Clicks	Log Paid Info. Clicks
Log DTCA	0.017***	0.012**	0.092***	0.061***	0.046***	0.090***	0.021***	0.018***	0.042***
	(3.621)	(2.488)	(12.948)	(8.335)	(6.498)	(13.617)	(3.302)	(2.721)	(7.736)
Log DTCA-Class	0.039*	0.045*	0.033	0.061*	0.044	0.031	0.046	0.054*	0.050*
	(1.648)	(1.871)	(0.955)	(1.690)	(1.250)	(0.955)	(1.447)	(1.702)	(1.884)
Age*Log DTCA	0.001	-0.002	0.020***	0.024***	0.021***	0.014**	-0.012*	-0.012*	-0.001
	(0.273)	(-0.326)	(2.743)	(3.250)	(2.956)	(2.034)	(-1.790)	(-1.871)	(-0.257)
Income*Log DTCA	0.002	-0.001	0.014**	0.020***	0.019***	0.016**	-0.011*	-0.010*	-0.005
	(0.524)	(-0.201)	(1.986)	(2.872)	(2.756)	(2.473)	(-1.740)	(-1.684)	(-1.008)
Constant	10.271***	10.169***	6.242***	7.017***	6.995***	4.639***	9.041***	8.906***	0.411
	(19.320)	(18.750)	(7.913)	(8.635)	(8.854)	(6.383)	(12.694)	(12.485)	(0.684)
Observations	9,178	9,178	9,178	9,178	9,178	9,178	9,178	9,178	9,178
R-squared	0.639	0.635	0.568	0.621	0.622	0.532	0.675	0.673	0.470
Year/Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Query FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month. Promotional clicks are those on pharmacy, brand and producer websites. Informational clicks are those on dot-edu, dot-gov, and other general health information websites. Searcher age and income are standardized based on their values in the first month a drug appears in the

DTCA may have a larger effect on older and potentially more informationally-disadvantaged searchers, populations that may be more responsive to advertising if they have limited information and are not internet savvy enough to use online search. They may also benefit more from drug advertisements if they are relatively less aware of a drug's existence, the condition it treats, and its alternatives. We find that DTCA tends to have a stronger effect on promotional clicks for older searchers and those with higher incomes. A smaller effect is found on organic informational clicks for these same populations. Overall, while the effect of DTCA on promotional clicks is larger for older searchers, lower income searchers do not appear more responsive to DTCA and are, in fact, less likely to click on promotional websites.

5 Conclusion

Our analysis shows that consumers seek diverse information about prescription drugs online and their behavior is influenced by the online and offline advertising to which they are exposed. Overall, we show that advertising on a prescription drug serves to increase the frequency of online search and

[41] The data on searcher age and income are reported as the percent "reach" in different age groups (e.g, 15% for ages 18-25 and 10% for incomes between $25,000 and $50,000). We create a continuous variable for each drug based on midpoints of each range, weighted by the reach, and aggregated. For the 65 and older bin, we take the average U.S. life expectancy as the maximum (78) so the midpoint in the top range is 72. Data from the census is used to calculate the average income for the two bins "less than $25,000" and "more than $100,000."

subsequent clicks for that drug as well as search for other drugs in the same class. While broadcast and internet advertising having the strongest positive effects on search, the magnitude of the effect of DTCA varies significantly by media type.

Following drug searches, the effect of DTCA on clicks varies both by the type of link (organic versus paid) and the type of destination website (informational versus promotional). The effect of DTCA is significantly larger for paid clicks and promotional websites compared to organic clicks and informational websites respectively. The relationship between DTCA and clicks is stronger for younger drugs and for those drugs that treat acute conditions. Because these drugs are more likely to be prescribed to first-time users who may lack information about side effects, interactions, etc., the FDA may be reassured that consumers are seeking additional information. It is also encouraging that for less wealthy searchers, DTCA is associated with fewer clicks on promotional drug websites.

However, DTCA is also associated with clicks on promotional websites, and the effect is larger for drugs with low insurance coverage as consumers may be seeking an affordable supply source. For older searchers, a population that may be more responsive to advertising, clicks on promotional websites are more strongly associated with DTCA. Finally, while DTCA may be associated with more clicks on promotional websites, most of those clicks are on brand websites, which the FDA monitors in order to ensure balanced and unbiased information.

Overall, because the total number of clicks on organic links is about 10 times larger than clicks on paid links, the effect of DTCA on the absolute number of clicks is larger for organic links compared to paid links and roughly evenly split between informational and promotional websites. Without more information on drug prices and utilization, it is difficult to make conclusions regarding the welfare effects of DTCA. However, our research shows that at least for some drugs and demographic groups, DTCA is associated with consumers seeking additional information, which supports the FDA's intention when it adopted the 1997 guidelines.

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Appendix

Figure A1: Growth of the Internet and Expenditure on Rx Drugs in the U.S.

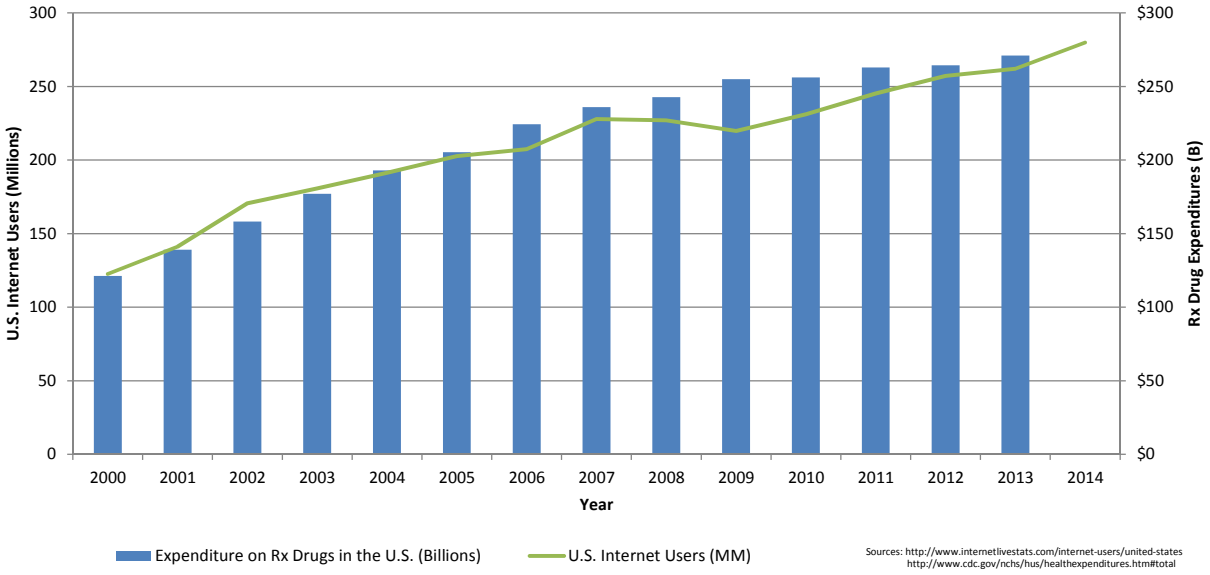
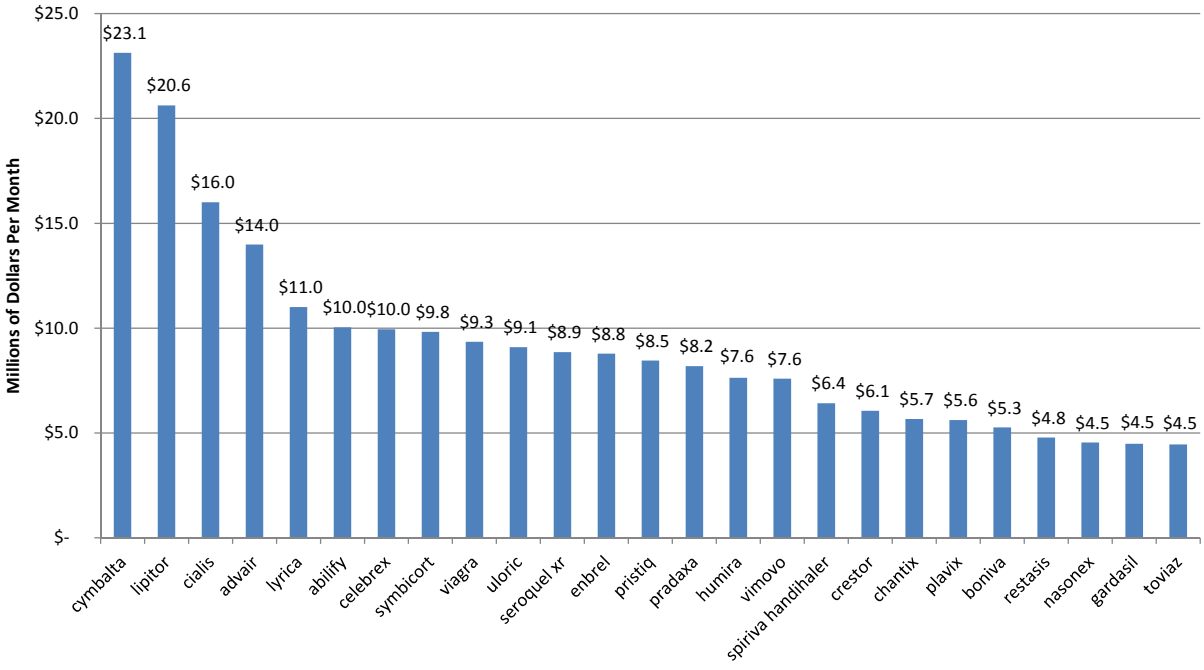


Figure A2: Top 25 Drugs by Total DTCA Spending, 2011



(Drugs shown represent 66% of all Rx drug ad spending)

Figure A3: Click Type, by Destination Website

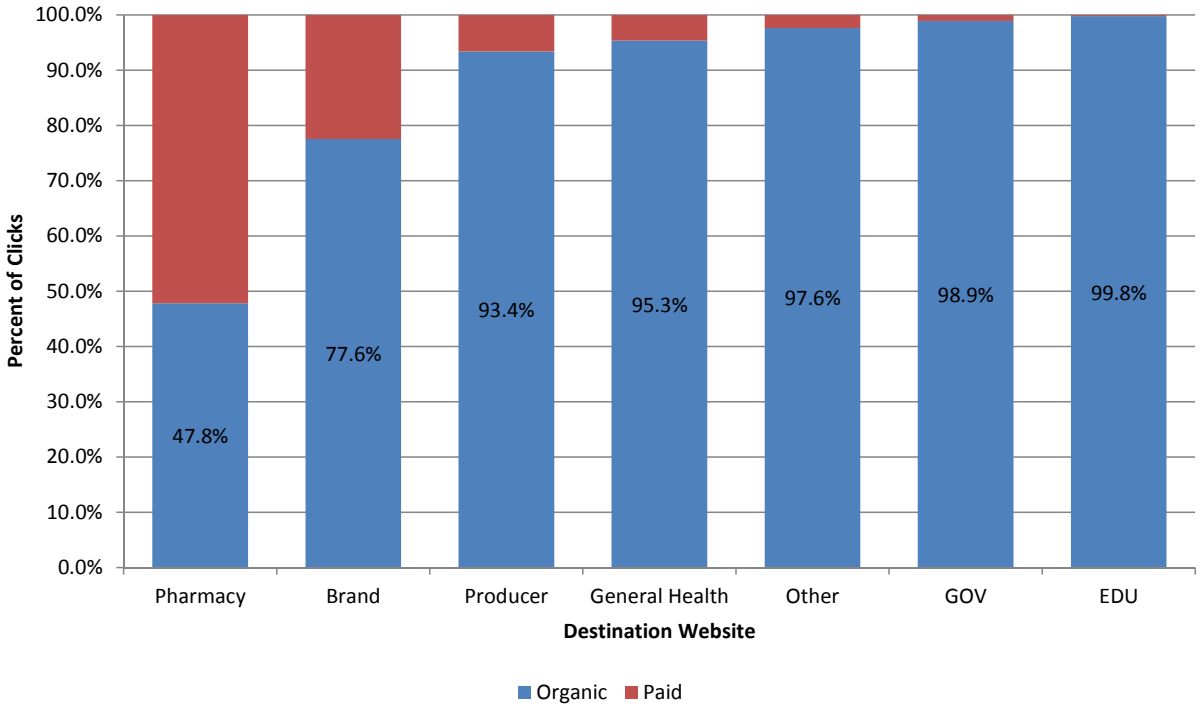


Table A1: Descriptive Statistics - Top 10 Drugs by Search Activity

	Drug	DTCA ('000s $)	Searches	All Clicks	Drug Age	Searcher Age	Searcher Income	Rx Per Year	Insurance Coverage	Keywords	Class
1	viagra	$9,586	674,040	397,917	10	48	$79,958	2.5	20%	sexual, contraceptive, menopause	miscellaneous agents
2	xanax	$0	661,631	411,149	22	46	$78,069	4.0	37%	anxiety	central nervous system agents
3	insulin	$0	486,358	327,555		42	$79,136	3.1	57%	insulin	metabolic agents
4	oxycodone	$2	481,151	370,817	0	44	$75,726	3.7	69%	pain	central nervous system agents
5	botox	$2,039	398,475	189,852	18	37	$94,474			underarm sweating control, wrinkle	central nervous system agents
6	lexapro	$585	332,735	295,789	6	46	$74,527	5.7	71%	mental health	psychotherapeutic agents
7	cymbalta	$18,035	315,586	202,744	4	40	$93,794	6.0	82%	mental health	psychotherapeutic agents
8	oxycontin	$4	307,365	205,621	12	46	$79,007	4.7	85%	analgesic	central nervous system agents
9	cialis	$16,008	283,256	196,260	4	49	$69,981	3.2	35%	sexual, contraceptive, menopause	miscellaneous agents
10	suboxone	$80	263,851	203,393	5	48	$75,816			opioid dependence	central nervous system agents

Notes: DTCA, searches and clicks are month averages from 9/2008-9/2011. Age of drug, Searcher age, and Searcher income as of the first month a drug appears in the sample. Keywords from Kantar database of drug DTCA. Insurance coverage is the ratio of the total payment made by third parties (private insurance, Medicare, etc.) to the total payment (including payments by the patient).

Table A2: Descriptive Statistics - By Drug Age

Drug Age (Years)	Number of Drugs	Rx Per Year	Insurance Coverage	Searcher Age	Searcher Income	Searches	All Clicks	% Paid	% Promo	% Info	DTCA
< 1	62	3.5	76%	45.9	$82,872	22,850	16,132	7%	13%	34%	$638,413
1	24	3.6	76%	52.9	$83,333	19,106	14,334	11%	24%	32%	$721,382
2	30	4.1	81%	50.8	$95,911	27,101	19,255	8%	15%	33%	$936,706
3	18	3.9	82%	47.4	$80,542	15,042	11,071	13%	24%	30%	$1,234,360
4	21	4.3	78%	52.7	$78,895	43,345	29,987	14%	23%	27%	$2,085,644
5	28	4.3	79%	49.1	$84,288	39,024	28,103	11%	21%	30%	$1,669,865
6	17	5.0	73%	45.6	$84,583	42,880	34,611	5%	18%	30%	$363,192
7	11	4.6	84%	52.9	$69,213	35,077	25,319	13%	8%	46%	$400,114
8	17	4.6	75%	49.3	$79,010	40,155	31,042	8%	17%	34%	$1,316,946
9	13	4.1	78%	46.3	$71,284	33,736	20,355	10%	20%	26%	$654,771
10	21	4.5	71%	47.2	$89,930	83,975	53,777	13%	17%	29%	$1,968,690
11	21	4.1	79%	48.9	$76,351	44,287	34,502	12%	23%	29%	$1,503,268
12	17	4.5	80%	51.1	$67,541	44,392	29,317	5%	10%	34%	$112,824
13	6	3.2	75%	46.3	$81,433	53,291	42,700	5%	20%	31%	$127,063
14	6	4.9	87%	50.1	$79,952	10,177	8,367	10%	24%	21%	$17,244
15	4	3.5	74%	47.3	$80,908	117,464	92,325	7%	2%	38%	$1,346,181
16	3	4.8	68%	46.0	$78,726	96,502	79,690	3%	12%	37%	$151,627
18	3	3.2	90%	40.9	$103,355	200,742	111,741	10%	2%	44%	$697,650
19	4	2.8	88%	43.4	$87,950	11,505	10,118	10%	12%	33%	$621
20	5	2.3	72%	48.9	$75,394	31,779	25,253	2%	7%	34%	$48,815
21	1	0.0	0%	0.0	$0	1,516	987	0%	0%	0%	$1,051
22	3	4.6	69%	42.6	$84,662	229,261	145,643	3%	5%	35%	$1,198
23	3	2.1	88%	46.8	$85,050	42,273	32,906	5%	10%	31%	$10,027
24	1	5.0	54%	39.1	$67,874	59,142	41,469	8%	15%	25%	$2,122,919
25	1	3.7	89%	0.0	$0	2,938	1,402	2%	0%	13%	$1,571
26	4	3.5	72%	48.6	$48,100	20,598	12,751	4%	4%	42%	$11,760
Unknown	29	2.6	59%	46.8	$79,086	32,480	21,268	9%	12%	36%	$388,468

Notes: DTCA, searches and clicks are month averages per drug from 9/2008-9/2011. Age of drug, Searcher age, and Searcher income as of the first month a drug appears in the sample. Insurance coverage measures the percent of the total payment that is paid by third parties.

Table A3: Descriptive Statistics - By Drug Class

Drug Class	Popular Drug	Number of Drugs	Rx Per Year	Insurance Coverage	Drug Age	Searcher Age	Searcher Income	Searches	All Clicks	% Paid	% Promo	% Info	DTCA
anti-infectives	tobi	40	3.9	85%	8.6	45.6	$74,329	17,937	10,370	6%	20%	28%	$58,278
antineoplastics	avastin	27	4.8	90%	7.9	48.3	$87,314	12,615	10,997	5%	18%	20%	$6,494
biologicals	procrit	2	6.3	97%	12.4	49.4	$79,665	13,674	11,253	10%	17%	24%	$138,532
cardiovascular agents	metoprolol	23	4.8	71%	7.2	48.6	$80,471	30,822	20,550	7%	14%	33%	$418,718
central nervous system agents	xanax	58	4.4	81%	9.5	46.5	$79,057	71,063	49,803	6%	8%	39%	$759,484
coagulation modifiers	plavix	7	3.8	84%	8.9	46.7	$79,754	31,706	22,642	9%	21%	20%	$1,674,865
gastrointestinal agents	prilosec	24	3.7	77%	7.2	47.7	$78,130	32,665	21,410	13%	11%	35%	$368,099
hormones	yaz	33	3.7	66%	9.5	46.3	$81,018	35,163	25,969	9%	14%	35%	$1,041,937
immunological agents	gardasil	18	4.3	80%	6.5	45.7	$83,741	14,777	11,828	6%	26%	20%	$720,727
metabolic agents	insulin	22	5.1	79%	6.8	48.4	$79,943	60,109	38,393	12%	16%	34%	$2,351,608
miscellaneous agents	viagra	12	4.2	68%	8.7	46.8	$76,768	98,938	63,514	21%	28%	25%	$3,304,938
nutritional products	niaspan	2	4.8	81%	13.0	50.4	$82,739	19,311	15,438	13%	11%	36%	$1,186,722
psychotherapeutic agents	lexapro	21	5.3	80%	10.3	45.8	$79,022	96,344	77,230	7%	15%	35%	$2,758,194
radiologic agents	lexiscan	1	0.0	0%	1.9	46.1	$87,392	8,145	5,300	2%	2%	17%	$31
respiratory agents	allegra	19	3.5	72%	9.4	46.4	$80,487	45,127	33,109	11%	24%	26%	$1,476,950
topical agents	nasonex	41	2.3	74%	9.1	46.8	$81,687	12,850	9,414	11%	22%	25%	$429,594
Unknown	juvederm	22	2.8	69%	11.3	46.7	$82,748	15,578	9,293	12%	23%	27%	$754,135

Notes: DTCA, searches and clicks are month averages per drug from 9/2008-9/2011. Age of drug, Searcher age, and Searcher income as of the first month a drug appears in the sample. Insurance coverage measures the percent of the total payment that is paid by third parties. Popular drug is the most searched drug in each drug class over the sample time period.

Table A4: Regression Results: Fixed Effects

VARIABLES	(1) Log Searches	(2) Log Searches	(3) Log Searches	(4) Log Searches	(5) Log Searches	(6) Log Searches
Log DTCA	0.155***	0.156***	0.130***	0.029***	0.131***	0.027***
	(29.454)	(29.537)	(24.165)	(5.335)	(24.164)	(5.036)
Log DTCA-Class	0.177***	0.179***	-0.062**	0.016	-0.067**	0.016
	(14.469)	(14.560)	(-2.177)	(0.726)	(-2.286)	(0.705)
Constant	4.537***	4.275***	6.895***	11.143***	6.889***	10.950***
	(23.072)	(15.297)	(16.721)	(20.431)	(14.474)	(19.074)
Observations	12,985	12,985	12,193	12,985	12,193	12,985
R-squared	0.082	0.085	0.130	0.632	0.134	0.636
Adj. R-squared	0.0814	0.0828	0.129	0.621	0.130	0.624
Year/Month FE	No	Yes	No	No	Yes	Yes
Class FE	No	No	Yes	No	Yes	No
Query FE	No	No	No	Yes	No	Yes
Root MSE	3.582	3.579	3.448	2.300	3.446	2.292

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month.

Table A5: Regression Results: Levels versus Logs

VARIABLES	(1) Searches	(2) Log Searches	(3) All Clicks	(4) Log All Clicks	(5) Organic Clicks	(6) Log Organic Clicks	(7) Paid Clicks	(8) Log Paid Clicks
DTCA	0.002***		0.001***		0.001***		0.000***	
	(6.282)		(6.517)		(5.142)		(8.307)	
DTCA-Class	-0.000		0.000		0.000		-0.000	
	(-0.092)		(0.489)		(0.561)		(-0.213)	
Log DTCA		0.027***		0.026***		0.021***		0.085***
		(5.036)		(5.011)		(3.880)		(14.491)
Log DTCA-Class		0.016		0.052**		0.053**		0.044*
		(0.705)		(2.363)		(2.412)		(1.791)
Constant	125,776***	10.950***	99,722***	9.759***	90,656***	9.643***	9,065***	6.516***
	(12.580)	(19.074)	(19.530)	(17.550)	(18.733)	(17.138)	(8.974)	(10.532)
Observations	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985
R-squared	0.709	0.636	0.809	0.650	0.798	0.644	0.612	0.601
Year/Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Query FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Root MSE	51,359	2.292	26,229	2.221	24,860	2.247	5,189	2.471

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month.

Table A6: Regression Results: Match-All-Forms versus Exact

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Log Searches (MAF)	Log Searches (exact)	Log All Clicks (MAF)	Log All Clicks (exact)	Log Org. Clicks (MAF)	Log Org. Clicks (exact)	Log Paid Clicks (MAF)	Log Paid Clicks (exact)
Log DTCA	0.027***	0.028***	0.026***	0.030***	0.021***	0.023***	0.085***	0.076***
	(5.036)	(4.436)	(5.011)	(5.094)	(3.880)	(3.872)	(14.491)	(13.740)
Log DTCA-Class	0.016	0.012	0.052**	0.071***	0.053**	0.081***	0.044*	0.015
	(0.705)	(0.463)	(2.363)	(2.898)	(2.412)	(3.278)	(1.791)	(0.640)
Constant	10.950***	10.391***	9.759***	8.344***	9.643***	8.009***	6.516***	6.160***
	(19.074)	(15.715)	(17.550)	(13.419)	(17.138)	(12.783)	(10.532)	(10.497)
Observations	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985
R-squared	0.636	0.570	0.650	0.608	0.644	0.600	0.601	0.509
Year/Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Query FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms (MAF) and exact comScore data. Advertising variables lagged one month.

Table A7: Regression Results: Searches, Searchers, Searches Per Searcher

	(1)	(2)	(3)
VARIABLES	Log Searches	Log Searchers	Log Searches per Searcher
Log DTCA	0.027***	0.027***	0.001*
	(5.036)	(5.119)	(1.867)
Log DTCA-Class	0.016	0.016	0.000
	(0.705)	(0.729)	(0.060)
Constant	10.950***	10.509***	0.916***
	(19.074)	(19.075)	(10.985)
Observations	12,985	12,985	12,985
R-squared	0.636	0.633	0.360
Year/Month FE	Yes	Yes	Yes
Query FE	Yes	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month.

Table A8: Regression Results: Specific Entity Analysis

	Promotional			Informational			Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Log Pharm. Clicks	Log Brand Clicks	Log Producer Clicks	Log Dot-EDU clicks	Log Dot-GOV Clicks	Log Gen. Health Clicks	Log Giant Clicks	Log Non-Health Clicks
Log DTCA	0.015***	0.058***	-0.003	0.002	0.002	0.023***	0.019***	0.007**
	(3.807)	(10.074)	(-1.203)	(0.882)	(0.430)	(4.045)	(3.707)	(2.536)
Log DTCA-Class	0.005	0.036	0.007	0.003	-0.070***	0.050**	-0.009	0.010
	(0.305)	(1.487)	(0.592)	(0.426)	(-3.689)	(2.082)	(-0.413)	(0.808)
Constant	3.488***	7.961***	0.008	0.176	5.148***	8.490***	9.247***	2.428***
	(8.232)	(12.946)	(0.029)	(0.925)	(10.693)	(13.992)	(17.216)	(7.898)
Observations	12,985	12,985	12,985	12,985	12,985	12,985	12,985	12,985
R-squared	0.460	0.663	0.356	0.554	0.435	0.704	0.684	0.476
Year/Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Query FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month.

Table A9: Regression Results: Depreciation Analysis

VARIABLES	(1) Log Searches	(2) Log Searches	(3) Log Searches
Log DTCA (m-1)	0.027***	0.017**	
	(5.036)	(2.100)	
Log DTCA (m-2)		0.003	
		(0.369)	
Log DTCA (m-3)		0.006	
		(0.676)	
Log DTCA (m-4)		-0.013	
		(-1.420)	
Log DTCA (m-5)		-0.001	
		(-0.141)	
Log DTCA (m-6)		0.002	
		(0.250)	
Log DTCA-Class (m-1)	0.016	0.049	
	(0.705)	(1.402)	
Log DTCA-Class (m-2)		-0.039	
		(-0.909)	
Log DTCA-Class (m-3)		0.001	
		(0.013)	
Log DTCA-Class (m-4)		0.037	
		(0.878)	
Log DTCA-Class (m-5)		-0.066	
		(-1.618)	
Log DTCA-Class (m-6)		0.062*	
		(1.951)	
Log DTCA (6m Dep)			0.018***
			(3.138)
Log DTCA-Class (6m Dep)			0.026
			(0.676)
Constant	10.950***	10.970***	11.112***
	(19.074)	(14.371)	(13.020)
Observations	12,985	11,121	11,121
R-squared	0.636	0.638	0.638
Year/Month FE	Yes	Yes	Yes
Query FE	Yes	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data.

Table A10: Regression Results: DTCA x Class Interactions

VARIABLES	(1) Log Searches	(2) Log All Clicks
Log DTCA	0.031*	0.006
	(1.814)	(0.333)
Log DTCA-Class	0.016	0.049**
	(0.679)	(2.184)
antineoplastics* Log DTCA	-0.014	0.012
	(-0.513)	(0.461)
biologicals* Log DTCA	-0.168	0.005
	(-1.331)	(0.042)
cardiovascular* Log DTCA	-0.022	0.021
	(-0.854)	(0.863)
central nervous sys.* Log DTCA	0.003	0.040*
	(0.119)	(1.895)
coagulation modifiers* Log DTCA	-0.016	-0.033
	(-0.304)	(-0.630)
gastrointestinal* Log DTCA	0.017	0.050*
	(0.578)	(1.734)
genitourinary tract agents* Log DTCA	0.076	0.208
	(0.577)	(1.637)
hormones* Log DTCA	-0.004	0.012
	(-0.191)	(0.540)
immunological* Log DTCA	0.023	0.039
	(0.864)	(1.532)
metabolic* Log DTCA	-0.010	0.021
	(-0.358)	(0.749)
miscellaneous* Log DTCA	-0.013	-0.034
	(-0.328)	(-0.897)
nutritional* Log DTCA	-0.031	0.005
	(-0.644)	(0.113)
psychotherapeutic* Log DTCA	-0.026	-0.015
	(-0.939)	(-0.547)
radiologic* Log DTCA	-0.647***	-0.127
	(-2.919)	(-0.593)
respiratory* Log DTCA	-0.028	0.037
	(-0.987)	(1.338)
topical* Log DTCA	0.000	0.029
	(0.003)	(1.236)
Constant	11.339***	10.372***
	(16.667)	(15.778)
Observations	12,193	12,193
R-squared	0.629	0.648
Year/Month FE	Yes	Yes
Query FE	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month. Omitted drug class is anti-infectives.

Table A11: Regression Results: Out-of-Pocket Drug Costs

VARIABLES	(1) Log All Clicks	(2) Log Org. Clicks	(3) Log Paid Clicks	(4) Log All Promo. Clicks	(5) Log Org. Promo. Clicks	(6) Log Paid Promo. Clicks	(7) Log All Info. Clicks	(8) Log Org. Info. Clicks	(9) Log Paid Info. Clicks
Log DTCA	0.024***	0.019**	0.126***	0.072***	0.060***	0.105***	0.025**	0.021*	0.046***
	(2.816)	(2.132)	(11.042)	(6.255)	(5.309)	(10.133)	(2.287)	(1.932)	(5.429)
Log DTCA-Class	-0.004	0.003	0.034	0.057*	0.040	0.034	0.020	0.027	0.045*
	(-0.137)	(0.100)	(0.979)	(1.650)	(1.197)	(1.100)	(0.622)	(0.823)	(1.773)
Drug Age*Log DTCA	-0.015***	-0.014**	-0.010	-0.036***	-0.033***	-0.014**	-0.024***	-0.024***	0.011**
	(-2.733)	(-2.540)	(-1.386)	(-5.058)	(-4.710)	(-2.160)	(-3.621)	(-3.588)	(2.056)
Chronic*Log DTCA	-0.037***	-0.035***	-0.074***	-0.024	-0.022	-0.030**	-0.016	-0.013	-0.032***
	(-3.274)	(-3.073)	(-5.006)	(-1.604)	(-1.502)	(-2.210)	(-1.124)	(-0.938)	(-2.895)
Low Insur.*Log DTCA	0.020*	0.020*	0.005	0.027*	0.013	0.013	0.007	0.007	0.016
	(1.815)	(1.855)	(0.350)	(1.889)	(0.928)	(1.027)	(0.541)	(0.550)	(1.518)
Out of Pocket*Log DTCA	0.007	0.007	0.015**	0.002	0.001	0.009	0.005	0.003	0.008
	(1.321)	(1.366)	(2.156)	(0.262)	(0.208)	(1.480)	(0.753)	(0.505)	(1.588)
Constant	11.345***	11.130***	6.989***	7.752***	7.604***	4.980***	9.076***	8.973***	0.759
	(19.013)	(18.425)	(8.897)	(9.782)	(9.820)	(6.987)	(12.290)	(12.139)	(1.312)
Observations	9,099	9,099	9,099	9,099	9,099	9,099	9,099	9,099	9,099
R-squared	0.657	0.652	0.590	0.658	0.654	0.548	0.682	0.680	0.443
Year/Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Query FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Match-all-forms comScore data. Advertising variables lagged one month. Drug age is standardized based on the age of the drug in the first month the drug appears in the data. Chronic and low insurance indicators constant across all months for each drug. Promotional clicks are those on pharmacy, brand and producer websites. Informational clicks are those on dot-edu, dot-gov, and other general health information websites. Out-of-pocket drugs costs are standardized.