Journal of Economic Perspectives—Volume 23, Number 3—Summer 2009—Pages 37–60

The Online Advertising Industry: Economics, Evolution, and Privacy

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Advertising delivered over the Internet—"online advertising"—has become a significant source of revenue for web-based businesses. Fifty-six of the top 100 websites based on page views in February 2008 presented advertising; these 56 accounted for 86 percent of the total page views for these 100 sites. Twenty-six of these 56 sites, accounting for 77 percent of all page views for the top 100 sites, likely earn most of their revenue from selling advertising.[1] Advertising is a significant source of revenue for many smaller websites. Online advertising is also central to the $34 billion—and rising—e-commerce economy (U.S. Department of Commerce, 2008). Web-based sellers use online advertising to drive consumers directly to their sites where they can browse for goods and services and purchase them with a few clicks. Online advertising accounted for 8.8 percent of all advertising in the United States in 2008 (Hallerman, 2008), and that share is expected to grow over time.

Internet-based advertising is a "gale of creative destruction" (in the words of Schumpeter, 1942) sweeping across the advertising and media landscape. Newspapers, particularly, are losing readers and advertisers to web media supported by

[1] The top websites were based on comScore MediaMetrix rankings. A researcher reviewed each website to determine whether it presented advertising on the home page or immediate branches of the home page. We determined whether advertising was the most significant source of revenue based on a consideration of other apparent sources of revenue and the business model followed by the site. An appendix available on the online version of this paper at ⟨http://ssrn.com/abstract=1086473⟩ provides the details. The top 100 websites accounted for 41 percent of all page views on the web according to comScore.

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online advertising. The market capitalizations of the major publicly traded newspaper businesses in the United States declined by 42 percent between January 2004 and August 2008, compared to a 15.6 percent increase for the Dow Jones industrial average over that same time period (Blodget, 2008). More generally, online advertising is disrupting all aspects of the global advertising industry—which had estimated revenues of $625 billion in 2007 (Minton, 2007)—changing how creative work is done, how advertising campaigns are run, and how advertising is bought and sold.

Online advertising is a "two-sided market" (Rochet and Tirole, 2003; Anderson and Gabszewicz, 2005), as is advertising generally. Intermediaries operate platforms that faciliate the connection of advertisers and consumers. Innovative intermediaries operate exchanges and face the critical liquidity issues discussed in the market microstructure literature (O'Hara, 1998; also see Evans and Schmalensee, 2009).

This essay discusses the evolution of the online advertising business. It examines the supply of online advertising "inventory" (the space times the views of that space); the demand for that inventory; and intermediaries that operate between the sell and buy sides. It also explores some of the key developments for matching advertising messages to consumers and suggests that online advertising methods are arguably leading to significant reductions in transactions costs between merchants and consumers. But in doing so, online advertising methods collect and analyze detailed information about how people use their computers—raising difficult issues concerning the expectation of privacy and the regulation of the online advertising industry. In addition, this essay suggests some interesting questions and economic puzzles about the advertising industry—offline and online—that remain to be addressed.

Evolution of Online Advertising

Online advertising started in 1994 when HotWired, a web magazine, sold a banner ad to AT&T and displayed the ad on its webpage (Kaye and Medoff, 2001). The ad was sold based on the number of "impressions"—individuals who saw the ad—which was the model followed by most traditional media for brand advertising. Many web ads were subsequently sold based on "cost per mille," which is advertising terminology for cost per 1,000 viewers of the advertisement and often referred to as "CPM." Paying by number of viewers remained the norm until Procter & Gamble negotiated a deal with Yahoo! in 1996 that compensated the web portal for ads based on the "cost-per-click," commonly known as "CPC." Yahoo! was paid only when a user clicked on the ad; this was the web-version of paying for direct response commonly used by advertisers for things such as mail and telephone solicitations. As of 2008, most "display ads" on websites—the ads that look like those in newspapers and magazines—were still sold based on thousands of views.

The exploding supply of web pages led to the birth, in 1994, of search engines

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that sold advertising to make money. At first, they sold banner ads on a cost-per-mille basis—that is, based on how many people saw the ad. However, that approach led to a conflict for the search engine between helping people find things quickly and keeping eyeballs trained on the site to see more ads. The search engines later moved to the cost-per-click model. GoTo.com—which was bought by Yahoo!—introduced many of the key technological and business model innovations in the next three years (bg Theory, LLC, 2005; Semvironment, 2007). These included adopting the cost-per-click approach to pricing and the use of auctions to allocate the advertising spots on the page showing results of the search.

During this same period, traditional methods of advertising were mimicked on the web. These included web versions of business directories similar to the yellow pages, such as yellowpages.com; web versions of newspaper classified ads, such as Craigslist; and web versions of direct mail and telephone marketing, such as CheetahMail. These web-based vehicles were charged for in ways that were similar to their traditional counterparts with the exception of Craigslist, which enabled individuals to insert "classified ads" for free. The remainder of this essay does not discuss web-based directories or e-mail advertising because they do not raise particularly novel issues.

Online advertising revenue has increased steadily over time, both in absolute terms and as a fraction of all advertising revenue. Consistent figures are available since 2000. They show that U.S. online advertising has increased from $8.1 billion in 2000 to $21.2 billion in 2007 and from 3.2 percent of all advertising to 8.8 percent over that time period. The relative mix of online advertising has also changed. Table 1 shows the evolution of various online advertising formats from 2000 through 2008. In 2008, search ads, which are linked to a search for a keyword, accounted for the largest share of revenue, with 45 percent of the total.[2] They were followed by display ads, which are similar to newspaper and magazine ads and accounted for 33 percent of online ad spending. Eight years earlier display advertising accounted for 78 percent of spending and search only 1 percent.

In 2009, 15 years after its birth, the online advertising industry remains in considerable flux in terms of business relationships and technologies. Nevertheless, certain features of the "online advertising ecosystem" have become clear. On one side of the business are advertisers that want to reach consumers. On the other side are consumers who may or may not be receptive to receiving advertising messages. In between are various intermediaries. Figure 1 shows the relationship between the various agents. Almost all of the participants in intermediation sometimes work with agents for the advertiser and sometimes with agents for the consumer. For example, media-buying firms work for advertisers and advertising agencies on the "buy side" and with publishers on the "sell side." This results in an industry of

[2] The data in the table includes contextual advertisements—ads that are linked to keywords that appear on a web page—in the search category, thereby overstating "search" and understating "display" revenues.

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Table 1
Evolution of Revenues from Online Advertising Formats

	Share of advertising coming from this format								
Advertising format	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Display related	**78%**	**72%**	**60%**	**42%**	**39%**	**34%**	**32%**	**34%**	**33%**
Banners	48%	36%	29%	21%	19%	20%	22%	21%	21%
Sponsorships	28%	26%	18%	10%	8%	5%	3%	3%	2%
Rich media	2%	2%	5%	8%	10%	8%	7%	8%	7%
Slotting fees	0%	8%	8%	3%	2%	1%	0%	0%	0%
Digital video	0%	0%	0%	0%	0%	0%	0%	2%	3%
Search	**1%**	**4%**	**15%**	**35%**	**40%**	**41%**	**40%**	**41%**	**45%**
Classifieds	**7%**	**16%**	**15%**	**17%**	**18%**	**17%**	**18%**	**16%**	**14%**
Lead generation	**4%**	**2%**	**1%**	**1%**	**2%**	**6%**	**8%**	**7%**	**7%**
E-mail	**3%**	**3%**	**4%**	**3%**	**1%**	**2%**	**2%**	**2%**	**2%**
Interstitials	**4%**	**3%**	**5%**	**2%**	**0%**	**0%**	**0%**	**0%**	**0%**
Other	**3%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Total (million $)	8,087	7,134	6,010	7,267	9,626	12,542	16,879	21,206	23,400

Source: Interactive Advertising Bureau annual reports and press releases, 2000–2009.
Note: **Ad Formats Definitions: Display** ads on websites look like those in newspapers and magazines. A **banner** is a space (usually rectangular) on a web page that shows the advertiser's message; this category includes all display ads except for the other specialized categories listed below it. **Sponsorships** represent custom content and/or experiences created for an advertiser that may or may not include ad elements (for example, reskinning a section of a website with the advertiser's branding). "**Rich media**" refers to advertisements that incorporate animation, sound, and/or interactivity in any format. **Slotting fees** are the fee charged for premium ad placement and/or exclusivity. **Digital video** format includes commercials that appear in live, archived, and downloadable streaming content. "**Search**" refers, for the data reported in this table, to paying Internet companies to present an advertisement linked to a specific search word or phrase. It includes paid listings (text links appear at the top or side of search results for specific keywords); contextual search (text links appear in an article based on the context of the content rather than on the basis of a user-submitted keyword); and paid inclusion (guarantees that a marketer's URL is indexed by a search engine). Although this data source includes "contextual advertisements" in the search category, these ads are targeted display ads that are not based on the use of a search engine and are treated as part of display ads in the remainder of this paper. Contextual advertisements accounted for about 8 percent advertising revenue in 2008. "**Classifieds**" refer to the posting of a product or service in an online listing for a fee. "**Lead generation**" indicates referrals to qualified purchase inquiries. **E-mail** ads include banner ads, links, or advertiser sponsorships that appear in commercial e-mail communication. **Interstitials** are ads displayed during a transition from one Web page to the next. Figures are rounded.

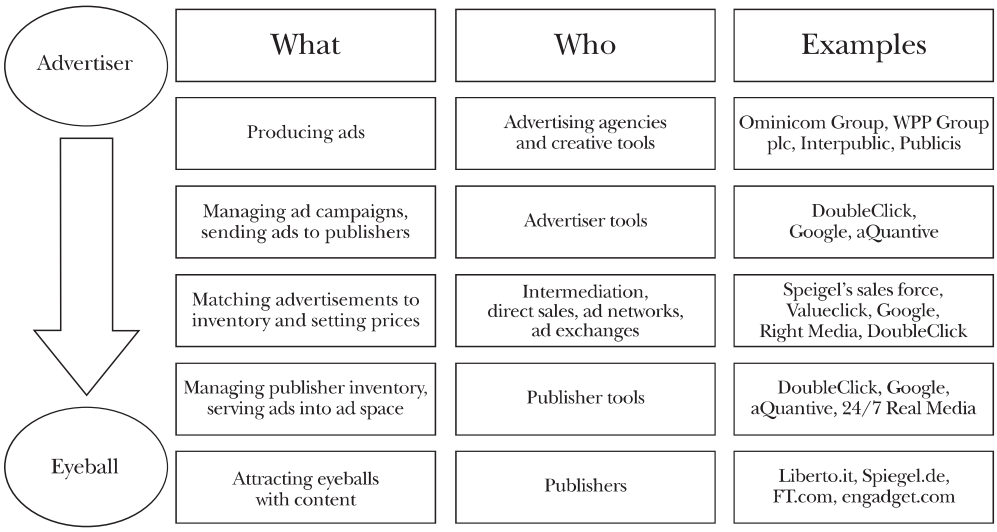
interlocking multisided platforms. Some of these platforms have more "sides" than just buy and sell. Facebook, for example, operates a software platform (Evans, 2009) that encourages developers to write applications that also enlist advertisers and consumers.

Fully integrated intermediaries touch consumers and advertisers directly. The search-based advertising platforms (Evans, 2008) are examples: they bring consumers to their search results pages and sell access to these consumers directly to advertisers; their platforms integrate the necessary technology for doing this. Many intermediaries are partly integrated. Publishers such as reuters.com bring consum-

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Figure 1
Relationship between Various Online Advertising Businesses



ers to their sites and have sales forces that sell advertising inventory directly to advertisers. But these publishers also typically rely on technology providers ("ad servers") that handle the passage of ads from the advertisers to the publishers' advertising spaces, as well as advertising networks that aggregate online advertising inventory and sell it to advertisers. Finally, some publishers are highly specialized and contract out most tasks.

A number of advertising networks have arisen that enter into agreements with publishers to sell available advertising and with advertisers to deliver viewers with specified characteristics in return for a fee. Some of these networks provide behaviorally targeted ads, although many place ads based on crude demographic information. Google has developed a computerized solution that has proved economic for many small websites such as blogs. Google's Content Network supplies advertising inventory from "hundreds of thousands" of websites that have joined its network (Google, 2008). In what is known as "contextual advertising," Google's advertising network auctions keywords that appear on the web page of participating publishers and inserts ads from participating advertisers based on the appearance of those keywords and possibly some other characteristics of the website. The publisher pastes html code into its webpage to receive and display the ad, while the advertiser typically uses an auction and advertising campaign management tool that is bundled into the software package it uses for search campaigns (Sears, 2005). Many larger websites also use Google's contextual advertising for some of their less desirable space.

As with advertising generally, a key feature of online advertising is that consumers are "paid" with content and services to receive advertising messages, while

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advertisers pay to send these messages. A fundamental question, not addressed here, is why this particular pricing and reward structure has held over long periods of time and across many different types of advertising. Among other things, the answer would help to illuminate the extent to which advertising should be viewed as a method for reducing transactions costs between buyers and sellers, or a source of imperfection that distorts decision making (Bagwell, 2007).

Online versus Offline Advertising

Online advertising has some fundamental differences from traditional advertising. The structure of online communications allows publishers and ad networks to learn considerably more about online users than has been possible with traditional media such as print, radio, and television. For example, online media or their ad networks typically know for certain whether an individual is viewing their site at a certain time; in contrast, a radio station has limited ability to determine whether a particular individual is listening or ignoring the ads, and a newspaper or magazine can't tell if or when a reader is looking at pages with advertising. Online media can often learn valuable details about the individual, too. Each user has an IP (Internet protocol) address which typically identifies the location of the individual down to at least the zip code level in the United States. People who browse from home and from smaller companies typically have a unique IP address that remains the same over time. Online media and advertising networks can also use this address to track other sites that users with that IP address have visited and to match up other details about the individual or household. (Some large companies change the IP addresses of individual users frequently so that the address cannot identify the user uniquely nor provide a precise geographic location.)

In addition, individual websites, such as wsj.com and myspace.com, may have detailed information on registered users, which they can also use for advertising. Print, radio, and television media generally do not know this level of information for individual users. Cable systems do have the names and addresses of their subscribers and also have specific information on the viewing habits of subscribers that have set-top boxes (Lafayette, 2008).

The fact that advertisers (and their intermediaries) know with confidence what content a particular consumer is viewing allows advertising to be targeted. The platform can determine the time of day and location of the view and may also be able to determine certain characteristics of the viewer. For example, search engines know the keywords a user requested, and publishers know the content of the page at which the user is looking. Both may know recent search or browsing behavior. Most on-line advertising inventory is selected in "almost" real time—less than the blink of an eye—and customized for the particular viewer in a way that could not happen offline. Advertisers can target their messages to those consumers for whom

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the messages are most relevant and who are most likely to buy as a result of receiving this message.

The essence of the advertising industry is to solve a massive matching problem: a large number of advertisers want to deliver multiple messages to a large number of consumers. Indeed, advertising agencies were formed in the mid nineteenth century to deal with the coordination of supply and demand among businesses wanting to advertise outside their locality and the daily and weekly newspapers (Pope, 1983). Online advertising offers the potential to be a more efficient match-making vehicle for advertisers and viewers than offline advertising.

Consider a business that sells saltwater fishing rods to people who enjoy fly fishing. The traditional approach to matching this buyer and seller involved the creation of a magazine, such as *Fly Fisherman,* with content that attracts the relevant people. In contrast, the online approach relies on a variety of techniques to match an advertising message to a consumer. A search engine indexes web results that are relevant to a consumer who types in the phrase "saltwater fishing rod," and with this information, the search engine can sell ads to sellers of saltwater fishing rods. Contextual advertising on web pages could do the same thing. A consumer who visits a blog for fly fishermen could be presented with an advertisement. Behavioral targeting techniques, which are still being developed, can also identify individuals who are interested in fly fishing and determine whether they are looking around the web for information that would suggest they might be in the market for a saltwater rod.

As a result, online advertising provides two potentially significant economic efficiencies. A first promising conjecture is that online advertising allows the economy to reduce the amount of resources devoted to creating content for aggregating and sorting potential buyers. Society may not need to invest as much in magazines, newspapers, and other media whose main purpose is aggregating the right eyeballs for advertisers. Second, online advertising almost certainly increases the accuracy of the match between the buyer and the seller. The seller has greater ability to target consumers that are likely to buy, and the consumer is more likely to receive useful messages and less likely to receive time-consuming but irrelevant messages.

In both cases, one can argue that certain losses also need to be considered. The news media gathers and reports news through professional journalists who are in some cases scattered through the world. One can argue that the news media provides an important public service in a democratic society and that its value exceeds what individuals or advertisers may pay for it. Moreover, those who strongly prefer the touch and feel of newspapers will lose if not enough people are willing to support the costs of these newspapers. In addition, online advertising may provide more efficient matching and delivery of ads, but that begs the longstanding question of whether advertising is providing people with valuable information that helps them make better buying decisions, or whether it is getting people to buy based on deceptive information or by persuading them to do things that they will

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later regret. These potential costs and benefits pose issues for the evolution of online advertising in the future that will be discussed in more detail after the next two sections provide an overview of the market structure of supply and demand for online advertising.

Supply of Advertising Space and its Market Structure

Any website that attracts viewers is a potential supplier of advertising inventory. Some websites choose to make money mainly in other ways: for example, e-commerce, gaming, adult sites, and a few others are largely free of advertising. But websites that account for a preponderance of page views among the top 100 sites earn most of their revenue from advertising. Table 2 shows the 20 largest advertising-supported sites in terms of page views, as of February 2008, and describes the content they use to attract eyeballs. Notable sites include Google, which primarily uses search results as well as user-uploaded video for its YouTube site; Yahoo!, which owns properties ranging from entertainment to automotive to email on which it presents ads; and Facebook, which operates a social networking site in which users see advertising on their own pages, the pages of their friends, and on other pages specifically designed for advertisers. The table also reports 2008 advertising revenue for sites where this is publicly available.

The supply of advertising inventory is highly skewed. Thousands of websites supply some advertising inventory in addition to the top 100. While comprehensive data on sites that supply advertising is not available, data on the overall distribution of page views provides a good approximation. According to comScore Media Metrix,[3] the top 10 sites as of February 2008 accounted for 36 percent of page views, the top 300 accounted for 54 percent of page views, and the top 10,000 websites attracted 67 percent of the total page views.

There are four large fully integrated suppliers of advertising inventory in the United States: AOL, Google, MSN, and Yahoo! Each of these sites is a "publisher" in the sense that it presents content to attract viewers to its pages. Each also acts as a "distributor" of ad space by directly selling inventory to either advertisers or "brokers" that act as middlemen and match publishers with advertisers. Finally, these four sites supply most of their own technology. To be more specific, they operate the software and communication technology that takes copy from an advertiser and inserts it into space at the appropriate time for a viewer.

Most of the other large suppliers of advertising inventory are partly integrated. They typically have their own sales forces that distribute their inventory to advertisers, but they also rely on outside providers for the technology that receives copy from advertisers and inserts it into inventory, and they also rely on advertising

[3] We have used the actual Media Metrix report for February 2008 purchased from comScore. These Media Metrix reports are not public.

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Table 2
The Top 20 Web Properties with Ads and the Content They Use to Attract Viewers

Rank	*Property*	*Content*	*2008 Internet advertising revenues ($ millions)*
1	Fox Interactive Media, including MySpace	entertainment video, news, social networking, image hosting, games network	900
2	Yahoo! sites	search results and various applications (news, e-mail, weather forecast)	3430
3	Google sites including YouTube	search results, e-mail, maps, user-uploaded videos, blogs	7430
4	Microsoft sites	search results, e-mail, entertainment videos, music, news	1970
5	AOL LLC	news, entertainment, e-mail, search results, greetings	1360
6	Facebook.com	social networking site	130
7	eBay	online auction and shopping site for mostly used goods	
8	Comcast Corporation	TV listings, free TV episodes, cable television services	
9	Viacom Digital	entertainment news, videos, music clips, TV listings, reviews	
10	Time Warner (excludes AOL)	movies, TV schedule, videogames, cable television services,	
11	Amazon sites	online shopping site, daily blog, customer reviews	
12	EA Online	strategy video games	
13	Ask Network	search results, public-generated questions and answers, maps, news	480
14	Photobucket.com LLC	image and video hosting, sharing applications	
15	Bebo.com	social media network, music, videos, applications	
16	Cox Enterprises Inc.	news, entertainment news, motor vehicles marketplace	
17	Disney Online	entertainment videos for kids, games, music library, fairy tale creating applications	270
18	United Online, Inc	floral product, Internet services, social networking	
19	Glam Media	news and content on fashion, health, and life style	
20	ESPN	sports news and videos, TV listings, sports results and rankings	

Source: For advertising revenues, this table uses comScore Media Metrix data for February 2008.
Notes: Rankings are based on page views. Some properties included well-known sites that are not broken out separately; MySpace is included in the Fox properties and accounts for 98 percent of page views. Content information is determined through direct website reviews. Some web pages on any given web property may not include advertising.

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networks to sell some of their ad space. Smaller websites ordinarily rely on an advertising network that may also provide the necessary technology. For example, a publisher can paste html code supplied by the advertising network into the part of the webpage the publisher wants to sell; that code will retrieve and insert an advertisement.

There are at least three main sources of supply of online advertising inventory, each of which results in different methods for selling advertising.

First, search engines generate search-results pages. In the late 1990s, search engines struggled to find the right balance between providing valuable search results to attract eyeballs and selling advertisers access to these eyeballs. Most ended up dividing the search-results page into "organic search results" that are based on the relevance of the web page to the keywords entered by the user, and "paid search results" which are clearly demarcated text advertisements that also look like search results. Although organic search results are valuable to advertisers, search engine providers do not charge for these listings.[4] Instead, advertisers often hire "search engine optimization" companies, such as Performics, to increase their rankings in the search results. Each search results page typically has around ten slots available for a paid search advertisement. Advertisers bid on a cost-per-click basis for these slots and the search provider allocates the slots, roughly speaking, on the basis of expected revenue it will receive—that is, cost-per-click times expected clicks (Evans, 2008; Varian, 2007). Projecting the number of clicks and the effects of different allocation mechanisms is a difficult problem; the relative success of search engine providers in solving this problem creates differences in the revenue they receive for each search conducted (Evans, 2008).

Online media sites provide content that is broadly similar to what consumers get from traditional media. In fact, many traditional media companies have established websites which use some material that is also provided through offline channels, like cnn.com, nytimes.com, mtv.com, and cosmopolitan.com. Other sites such as Yahoo! redeploy content from a variety of sources such as newswire services. Finally, some sites, such as youtube.com and drudgereport.com, provide content only online. With the exception of the video sites, these sites generally sell the ads on a cost-per-mille basis—that is, based on how many eyeballs see their pages—through their own sales team and through advertising networks.

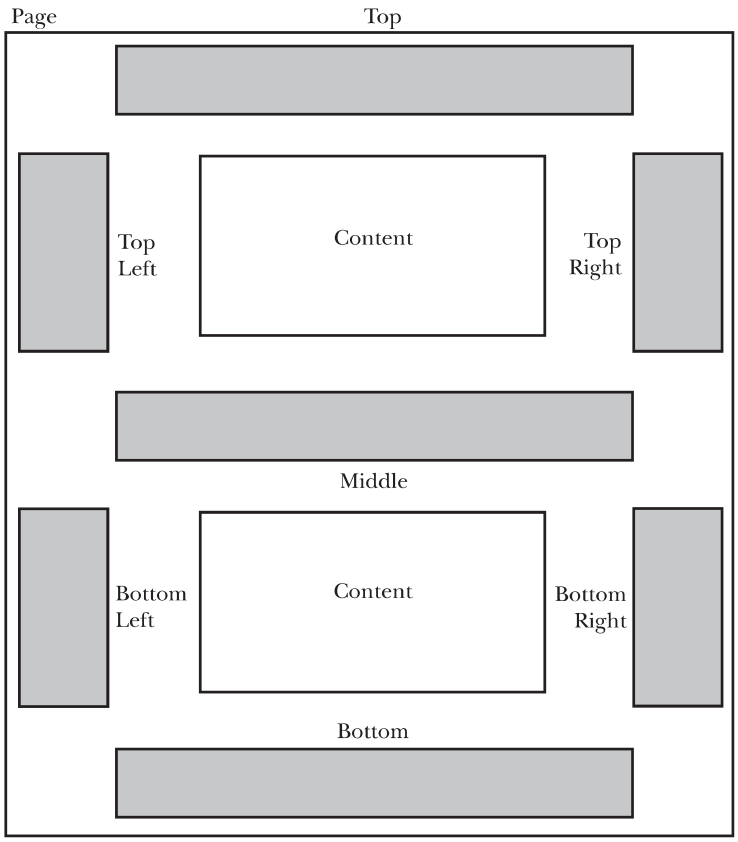
Figure 2 provides a sample layout: as with newspapers ads, different spots are perceived as more valuable because they are likely to receive more attention from consumers. Conversations with knowledgeable industry participants indicate that

[4] Search engines can be viewed as (at least) three-sided platforms based on third-party content obtained from the web, users looking for this content, and advertisers who seek access to these users. In principle, search engines could charge third-party content providers for the indexing and listing services made available but thus far have generally chosen not to. In March 2004, Yahoo! launched a paid inclusion program that guaranteed listings on the Yahoo! search engine for commercial websites in return for payment. This scheme was not popular with website marketers or the public and was discontinued. Microsoft and AskJeeves charged for inclusion for a time but also discontinued this practice.

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Figure 2
Sample Layout of Content and Advertising on Web Page



ads in the top half of the page garner a cost-per-mille of around $12.50 while ads in the bottom half of the page realize about half of that. Banners and skyscraper ads typically go for more than $12.50 cost-per-mille. The more desirable space tends to be sold directly, while the less desirable space tends to be sold through advertising networks. These ad networks pay between 15 and 45 percent of the cost-per-mille for a display ad on the top half of the page depending on the quality of the space.

Social networking sites have also allocated some space for advertising, but this space is sometimes known as the "dead zone" because of the lack of attention that social networking users pay to it. The average cost-per-mille payments to social networking sites are often less than $0.50. Whether social networking sites can achieve cost-per-mille payments for their viewers that are comparable to other types of on-line advertising remains to be seen. The promise of advertising on social networking websites is that word-of-mouth referrals are the primary influence on purchase decisions (BIGresearch, 2008), and perhaps online communities can be used to create a source for such referrals. Google, for example, has developed a

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technology that makes it possible for advertisers to identify and target "influencers" in social networking communities hoping they will distribute messages to their followers (Helft, 2008).

The supply of advertising inventory is highly heterogeneous. It differs in size, the likelihood that consumers will pay attention to it, and the characteristics of the viewers. Not surprisingly, the price that advertisers pay per thousand views varies from a few cents to more than $100 (for attracting many high-income professionals). Even controlling for quality, however, suppliers of advertising engage in extensive "value-based pricing"—which economists call price discrimination.

The search-based advertising platforms, in principle, use second-price auctions to allocate slots and in this way seek to extract higher payments from those willing to pay more (Varian, 2007; see also Edelman, Ostrovsky, and Schwartz, 2007). Indeed, we might expect that any rents earned from the advertiser side would be bid away, at least partly, on the viewer side through competition among platforms (Rochet and Tirole, 2003; Armstrong, 2006), including through explicit subsidies to viewers to join the platform.[5] That has happened to a degree. Microsoft adopted some mechanisms for providing incentives to viewers in 2008; for instance, the Windows Live Search site has a button labeled "Search a lot, Earn a lot," which describes incentives for searching that include a free Xbox, Microsoft software, frequent flier miles, cash back, and more (see ⟨http://www.live.com/?form=MXCA00&kwid=019409a179d80c4ba7fe55c739b4f11c⟩, visited on November 28, 2008). As another example, Yahoo! shares revenue with companies that get people to search with Yahoo! and those companies in turn provide benefits—such as donations to charity—to individuals who download a toolbar that contains the Yahoo! search feature (see ⟨http://affiliates.freecause.com/index.cgi?action=about⟩, visited on May 19, 2008). However, there does not yet appear to be robust price competition to persuade searchers to use alternative engines. Instead, Google, Microsoft and Yahoo! compete to become the default search engine on the browser, on various tool bars that are distributed, and in publisher websites. Although consumers can readily change these default settings, the search engine providers pay for these presumably because enough consumers stick with the default.

[5] In general, multisided platforms can have profit-maximizing equilibrium price structures in which one or more sides have zero or negative prices (Rochet and Tirole, 2006). In the case of search-based advertising platforms, the pricing on the advertiser side is fixed insofar as the platform adopts the standard auctions approach. These platforms compete, however, in a number of dimensions including the amount and quality of the search results provided to the users and the ease of use of the platform for users and advertisers. Such competition is similar to free television, which competes through the attractiveness of the content rather than cash transfers to viewers. The search-based advertising platforms can dissipate the rents from the second-price auctions of advertising space by spending on research and development and other activities that improve quality for users and advertisers. They can also dissipate it through distribution deals such as those discussed in the text.

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Demand for Online Advertising Space

Economists have developed a variety of models concerning the role of advertising, but most of that work focuses on how advertising might affect demand. Little empirical work assesses the extent to which advertising spending provides valuable information (including quality signals) to consumers and helps match buyers and sellers on the one hand or provides disinformation that harms consumers, or alters preferences, on the other. In addition, few studies have examined how advertisers decide how much to spend or how to allocate that spending across different forms of advertising (Silk, Klein, and Berndt, 2002). Existing work together with anecdotal information suggest that advertisers—and their agents—determine an overall advertising budget, allocate that budget among different methods (such as brand advertising on national television) for achieving the objectives of an advertising campaign, and then select advertising outlets for spending their dollars. Traditional methods have included placing ads on different media such as television, radio, newspapers, magazines, billboards, and directories and engaging in sales efforts through mail and telemarketing. An advertising "campaign" seeks objectives that may range from increasing sales of an existing product, to introducing a new one, to affecting the image of the company or brand. Advertisers base decisions about the level and allocation of their budgets on formal or informal analyses of the rate of return on investment (Duboff, 2007). For these ad campaigns, the different advertising methods can be substitutes to the extent they provide alternative ways of delivering messages to an audience, and complements to the extent they can reinforce each other (*Adweek,* 2002). Berndt, Arzaghi, Davis, and Silk (2002) find that 57 percent of the 28 pairs of the cross-elasticities they estimated indicated the advertising methods were, on net, substitutes and the remainder were complements—although typically weak ones.

Different methods of online advertising are potentially substitutes or complements both with each other and with other forms of advertising. For example, if an advertiser wants to reach a large number of individuals to introduce a new product, it can buy a banner ad on the Yahoo! home page, which has 48 million visitors a day (based the comScore Media Metrix report for February 2008), or it can buy a couple of 30-second television spots on Fox TV's *American Idol,* which had more than 20 million viewers for its early 2008 episodes. A typical advertiser will place display ads on multiple websites as well as several television shows to reach a large audience. However, as these methods are all designed to reach large numbers of people, they are probably substitutes at the margin. The advertiser might complement this campaign by buying keywords on one or more of the major search engines so that consumers that see the product can search for it online, learn more about it, and possibly purchase it. Of course, the extent to which different methods of offline and online advertising substitute or complement for each other depends on the nature of the particular campaign, the objectives the advertiser seeks to pursue, the aggregation across advertisers of many possibly varying demand rela-

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tionships, and other factors. In particular, online advertisements in some ways offer a closer connection to buyers. Online, the GM ad viewer can click through to a website; someone from out-of-town can find the pizza restaurant on Yahoo!; and the e-mail solicitation for vacuum cleaners can take a buyer to a website to purchase the vacuum.

Advertisers typically hire firms to design and execute advertising campaigns. Although these firms often have relationships through a conglomerate, such as WPP, they have become more specialized over time (Berndt, Arzaghi, Davis, and Silk, 2008). Increasingly one firm does the creative work and plans the campaign, while another firm engages in buying and placing media. While some firms specialize in online advertising, most creative work and media buying is performed by advertising firms that manage both offline and online work for advertisers. Within the online part of the business, advertisers or their agents also purchase various technologies for distributing online advertisements to suppliers of advertising inventory and for measuring the success of online campaigns.

Issues in Industry Evolution

Online advertising is one of those "gales of creative destruction" that will reshape several industries and radically change traditional ways of delivering advertising messages from sellers to prospective buyers.

Behavioral Targeting and Data Analytics

As noted earlier, it is possible for online entities to gather data on what people have done on line, including their previous searches, what websites they have browsed, and perhaps even what they have purchased online. Those data, together with other information, can be used to target advertisements to people based on their behavior.

For example, an advertising intermediary could help an automobile insurer target individuals who probably have good risk profiles, who may be buying an expensive new car, and who are therefore likely to be in the market for automobile insurance. The intermediary could infer that the individual may have bought a new expensive car from the fact that the individual has been browsing particular websites that people go to when they are going to purchase a luxury automobile. The intermediary might also be able to infer from online behavior that the individual falls into a low-risk insurance category. It could infer from a user's IP address and browsing behavior that the user is probably a woman (from browsing behavior) who lives in a well-off suburb (from the IP address), in a region with low accident and theft rates (from the IP address), and is over the age of 25 (from browsing behavior). The advertising intermediary can implement such decisions almost instantaneously and then insert an ad into advertising space on the page that the target is viewing. The advertiser would typically pay a premium over standard

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online advertising rates for views by these targeted individuals because of the increased likelihood that they will "convert" the view by this "qualified prospect" into a sale.

Although behavioral targeting is an area of intense innovation, as of 2009 only a small portion of the advertising revenue earned by publishers results from selling these sorts of behaviorally targeted advertisements, with most of that stemming from advertising networks.[6] Two factors limit greater deployment of this method of advertising.

First, since behavioral targeting narrows the group of people that see an advertisement, the likelihood that these individuals will ultimately purchase the product has to be high enough to offset the reduction in the number of people that view that advertisement. On average, only about 1 out of 400 viewers click on a given ad (Marketing Sherpa, 2008), and only a fraction of those viewers purchase the product. Unless behavioral targeting is sufficiently precise, advertisers may prefer to reach a larger group of individuals. Reaching 10,000 people of whom 1/1000 (or 10) will ultimately purchase a product is better than reaching 2,000 people of whom 1/500 (4) will ultimately purchase the product. There is a tradeoff between precision and reach. Precision is limited by the amount and quality of data that are available. In addition, behavioral targeting is not relevant for brand advertising, which is generally aimed at a broad audience to influence their views on a company or a product rather than to make a direct sale.

Second, the advertising platform that implements a behavioral targeting campaign must have access to a large enough universe of viewers to make the campaign worthwhile to the advertiser. There are fixed costs of designing and executing advertising campaigns; the advertiser needs to make enough sales to recover these costs and make a return. Suppose that it costs $10,000 to design a campaign and the expected incremental profit from each sale that results from this campaign is $10. Then the campaign would have to generate an expected 1000 conversions to recover the fixed costs. If only one out of 1000 consumers that are exposed to an ad is converted to a sale, the campaign would need to reach at least 1,000,000 individuals for it to break even. Consider a behavioral targeting campaign that converts one out of 500 consumers by targeting the 20 percent of the potential universe of people that are the most likely buyers. To yield 1000 conversions, that campaign would need to access information on 2,500,000 people of whom 500,000 would receive the targeted ad.

Several developments may increase the use of behavioral targeting methods. Improvements in predictive techniques and the availability of data on viewers would allow behavioral targeting to become more precise. If advertising networks that use

[6] Advertisements placed by advertising networks account for a small portion of the advertisements on publisher websites, and only a portion of the advertisements placed by advertising networks rely on behavioral targeting. Based on discussions with industry participants, the fraction of revenue for advertisements placed by advertising networks is small, and behavioral targeting smaller still.

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behavioral targeting methods increase their scale, or if larger advertising platforms increasingly deploy behavioral targeting and data collection methods, they would be more likely to obtain enough viewers to make behavioral campaigns economically efficient. On the other side, privacy concerns discussed below could limit the development of behavioral targeting. Consumers may resist having advertising platforms collect detailed information about their browsing behavior and government regulations may limit the ability of advertising intermediaries to collect these data.

Electronic Exchanges

Online publishers rely on advertising networks to sell inventory that they have not succeeded in selling directly and also as a substitute for direct selling in some cases. Some advertising networks enter into deals with online publications to sell some of their inventory to advertisers. Some networks might sell the advertiser the ability to deliver their ads into a variety of similarly situated advertising inventory (such as financial publications) without guaranteeing which ones; others might sell the advertiser the ability to deliver ads into selected publications; and still others might sell the advertiser the ability to target particular types of users. Some advertising networks focus on broad publications while others concentrate on particular niches.

Several firms have developed or are proposing to develop electronic exchanges (for one example, see the discussion the DoubleClick Advertising Exchange at ⟨http://www.doubleclick.com/products/advertisingexchange/index.aspx⟩, visited on November 29, 2008). These exchanges connect web-based publishers (or their agents) that would make their advertising inventory available and advertisers (or their agents) that would want to purchase this inventory. Advertising networks that have an excess supply or demand of advertising inventory could also participate. The advertising inventory is auctioned off in real time and the exchange handles the delivery of the advertising from the advertiser to the publisher. No data on the size of these exchanges is available, but based on discussions with individuals in the online advertising business, as of the end of 2008, it does not appear that the existing exchanges have yet achieved a critical mass of liquidity that would enable them to sustain themselves. Indeed, few such business-to-business exchanges have achieved critical mass in any area of business—most have died (Evans, 2009). (Harris (2002) discusses the role of liquidity for an exchange, and in Evans and Schmalensee (2009), my coauthor and I discuss the role of critical mass for multisided platforms.)

Creative Destruction and the Migration from Offline to Online Media

A wide range of media entities earn significant portions—sometimes all—of their revenues from the sale of advertising inventory, including newspapers, magazines, free television, free radio, billboards, and yellow pages. In turn, these businesses support a variety of content generation businesses, including television

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production companies and musicians. Diverse other businesses work with advertisers including advertising agencies, media buyers, and audience measurement firms. Every business in this ecosystem felt a breeze as on-line advertising arrived in the mid-1990s, and then felt a stiff wind by the early 2000s as the online advertising industry came together.

Online advertising methods pose a serious threat to traditional methods for several reasons. First, they increase the efficiency of matching buyers and sellers and delivering advertising messages to the buyer, which over time should reduce the economic importance of traditional intermediaries such as advertising agencies, media buyers and sellers, and direct sales forces. Second, online providers increase the supply of advertising inventory significantly. During the 2000s, new content providers have included user-generated video sites such as YouTube, social networking sites such as Facebook, and blogs such as Huffington Post. Americans viewed more than 458 billion web pages in 2007, each of which could have carried advertising and many of which did. The aggregate number of page views increased at an average rate of 21 percent between February 2004 and February 2008 (according to comScore Media Metrix reports for February 2004 and February 2008). This increased supply of advertising inventory puts downward pressure on advertising rates, promises to reduce the returns that traditional media can get from advertising, and therefore potentially reduces the quality-adjusted supply of content by traditional media. (The increase in the quality of advertising could increase or decrease the demand by advertisers, which could therefore have a partly offsetting effect on rates.)

Third, the potential returns from online advertising encourage entities such as Yahoo! and MSN, as well as traditional media, to present various kinds of content online that consumers used to consume mainly offline. In addition, of course, viewers are moving from offline to online media because, as with the move from radio to television, they simply like the content better along certain dimension, which can include the ease, flexibility, and interactive dimensions of access. Thus far, consumers appear to have substituted away from radio and newspaper content, but not television content. Persons above 12 years of age spend 32 percent more time watching cable and satellite television than they did in 2001. The usage of radio and traditional newspapers has declined by 3 and 15 percent, respectively (U.S. Census Bureau, 2009, table 1089).

These trends are likely to accelerate as more content is available either online or through other technologies that enable the sellers of advertising inventory to employ online methods. Some traditional media may make a fairly smooth transition to the online world. The television industry could change its delivery method so that programming is delivered primarily through Internet protocols—what is known as IPTV—and implement online technologies to serve ads. Verizon's FiOS Television, which is based on Internet technologies, had 2.5 million Internet subscribers and 1.9 million television customers in the United States as of December 31, 2008 (Verizon, 2009). The production and programming sides of the

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television business could operate much like they do today although many of the business methods, and assorted institutions, for selling and delivering advertising would change. The same is true for radio, which is already being delivered over the Internet. As cars become equipped with Internet-enabled electronics and wireless coverage becomes more extensive, it will become possible to listen to Internet radio on the morning drive to work.

The forces of creative destruction have hit the newspaper industry the hardest with the self-reinforcing migration of readers and advertisers online. Figure 3 shows the circulation for all U.S. daily newspapers, their advertising revenues, and the market capitalizations of the Standard & Poor's 500 Publishing Index—all indexed to 100 in 2002. There has been a precipitous drop in circulation and advertising revenue, and the stock prices indicate that the market expects dramatic reductions in the future profit stream of the newspaper industry. Daily average newspaper circulation fell from 54.6 million in 2004 to 50.6 million in 2007, according to the Newspaper Association of America. Although many newspapers have developed web versions that attract significant number of viewers, and although page views at newspaper websites increased from a monthly average of 1.5 billion in 2004 to 3.2 billion by 2008, the increased online advertising revenues for newspapers have only partly compensated for their loss of traditional advertising revenues. As radio and television move to Internet-enabled platforms, they may find a decline in advertising revenues with a corresponding depressing effect on the economics of providing traditional content.

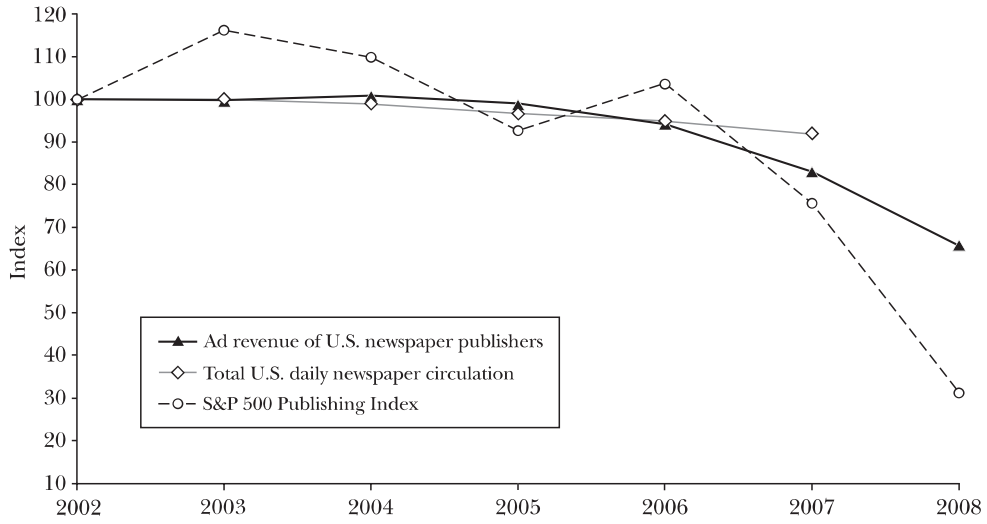
The industrial structure of the online advertising industry could evolve in a variety of ways. One possibility is that the industry will have a highly concentrated set of intermediaries at its center, with many content providers around this core. This result would be akin to the U.S. stock exchange system, in which exchanges controlled by the largest four firms account for 96 percent of transaction volume on exchanges.[7] Another possibility is that the industry will have many intermediaries at its center. Some of the intermediaries will focus on mass advertising, while others will focus on niches. The ultimate structure depends on balance between the strength of indirect network effects and scale economies on one side, and the possible benefits of specialization of knowledge in certain areas.

[7] NYSE Euronext owns NYSE, NYSE Arca, and the American Stock Exchange, which accounted for 21.2, 24.7, and 0.2 percent, respectively, of all trading volume in U.S. equities in April 2009, for a total of 46.1 percent; the proportion of trading volume on the same basis was 31.4 percent on Nasdaq, 15.1 percent on BATS, and 3.7 percent on the International Stock Exchange. The shares reported are expressed as a proportion of trades matched on exchanges that meet the SEC definition. The volume included in these share calculations does not include trades executed off exchanges, which are reported to trade reporting facilities (TRF) and accounted for 33.6 percent of all trading volume in April 2009. The volume reported to TRFs include volume from alternative trading systems such as electronic communications systems, which do not qualify as an exchange. BATS was an electronic communications systems until it became an exchange recently. See NYSE Arca Market Metrics Data for April 2009, available at ⟨https://www.arcavision.com/⟩.

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Figure 3
Newspaper Industry Performance Measures



Source: Advertising Age, Newspaper Association of America, and Washington Post Company annual reports.
Notes: All quantities are indexed to 100 for the 2002 base year. "Ad revenue of U.S. newspaper publishers" and "S&P 500 Publishing Index" are adjusted for inflation. In 2002, ad revenue of all U.S. newspapers equaled $44 billion, and total U.S. daily newspaper circulation was 50.7 million. The S&P 500 Publisher Index is composed of the prices of the common stocks of the following companies: Gannett Co., Inc.; The McGraw-Hill Companies, Inc.; Meredith Corporation; The New York Times Company; and Washington Post Company. It is weighted by market capitalization (market cap). In 2002, the total market cap of these companies was $44.1 billion.

The Privacy Dilemma

Participants in the online advertising industry collect and store a great deal of information about people who use the Internet. Search-engine providers capture every search a user does with their search engines, along with the websites visited. They store these data in a way that enable them to identify the individual IP address that generated the data for several months. Many participants in the online advertising industry also insert "tracking cookies" into the computers of users with whom they have had contact. These cookies enable the provider that inserted them to track the websites that an individual has visited. These providers may also capture these data and store them along with the IP address that identifies the user. "Web beacons" are code on web pages that determine that an individual has opened a page and captures the IP address of that individual. These beacons can track the activity of the individual on a site. Of course, the traditional advertising industry also collects data on people and uses that for targeted mailings and telephone calls, but the online advertising industry collects vastly more data.

In some cases, the providers that collect these data employ them to conduct

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research to improve their products. Google's privacy page, for example, says that it uses these data to conduct research on common spelling mistakes and to assess the effectiveness of the ad rankings. But past browsing behavior is also critical to the implementation of the behavioral targeting strategies described above. These data can be used to infer general characteristics of individuals such as their gender and their buying interests, such as particular sports or whether they are planning a vacation. These detailed data on browsing enable providers of online advertising to provide higher-quality prospects to advertisers and to therefore charge more for the advertising inventory they supply. They also possibly provide more valuable advertisements to users, who in turn will be more likely to visit websites of interest to them. Given that a website is going to display an advertisement, consumers might prefer that the advertisement be more relevant than not.

However, consumer privacy advocates and regulators have criticized the search-engine providers for capturing and storing data (Dye, 2009). In response, these providers have agreed to reduce the length of time for which they store data with individual identifiers. Google, for example, has reduced this period from two years to nine months (BBC News, 2008). The collection of data, as well as behavioral targeting, has attracted lawsuits and legislative inquiries. For example, the two behavioral targeting firms NebuAd and Phorm enlisted Internet service providers into their advertising network and used browsing data from these Internet service providers to target advertisements. They quickly became the subject of legislative inquiries in the United States and the United Kingdom, and many of the Internet service providers stopped taking ads from these firms as a result of the controversy (Paul, 2008).

The use of personal data for targeted advertising raises several public policy issues. If people had ownership over information about themselves, and there was a competitive market for it, they could decide whether to sell this information to an online advertising business. In making this decision, people could take into account the value of receiving possibly more relevant ads as well as any other compensation they might get. They would also take into account any costs from the possible leakage of their private information.

To a certain extent, consumers do have some control over their private information. For example, a user can choose not to use websites that insert "cookies" that collect data on that user's machine (or choose to delete such "cookies" on a regular basis). Web browsers have increasingly provided mechanisms for consumers to control the retention of information on their browsing history and manage their cookies. Reviews of the recently released browsers in the market, Internet Explorer 8.0 and Google Chrome 2.0, emphasize new features such as private browsing and search suggestions.[8] To the extent that the consumers exercise these choices they put competitive pressure on online advertisers to account

[8] For discussion, see ⟨http://www.microsoft.com/windows/internet-explorer/features/overview.aspx?tabid=1&catid=1⟩ and ⟨http://www.google.com/chrome/intl/en/features.html#⟩.

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for the value that consumers place on data about themselves. Consumers can also avoid websites and web services that scan and store personal content. For example, some users may avoid Google Gmail because it scans and records the content of emails while others may value the targeted ads that result from Google's ability to examine the content of the emails.

Nevertheless, three potential problems arise that could warrant the consideration of government intervention into the treatment of privacy by the online advertising industry.

First, there is the usual imperfect information problem that is often used to justify consumer protection efforts (Stiglitz and Walsh, 2002). Consumers may not know that information is being collected and stored. Before this was the subject of news stories, few consumers seemed to know that Google stored each user's search history for two years, including details sufficient to identify the IP address of the user's computer (for example, CNN.com, 2008). Many consumers probably still know little about the extent to which online advertising-related businesses collect information about them.

Second, consumers may agree (either tacitly or explicitly) to provide private information without anticipating that this information will be sold to other vendors that may combine it with other information about them. For example, a consumer may feel differently about providing search data associated with the user's IP address to a search engine provider if the search engine provider is selling that data to another vendor that has figured out a way to associate the user's IP with other personal information including name, address, and telephone number.

Third, competition among advertising platforms may not necessarily result in the optimal provision of privacy. Online advertising intermediaries are multisided platforms that compete simultaneously for advertisers and viewers. Whether this competition results in the optimal provision of privacy, and the extent to which it would do so in a highly concentrated market, would need to be investigated carefully. As an example of how this kind of analysis might be done, Rochet and Tirole (2006) consider similar issues that arise in markets for credit cards.

In principle, of course, consumers could learn about the collection and use of their information. But this incurs costs. Likewise, the online advertising businesses could increase efforts to engage in transparent contracts with consumers. But this incurs costs, too. The critical public policy question is how property rights—including those enforced through regulation—over private data should be assigned.

Public policymakers in the United States and the European Community are grappling with these issues (Federal Trade Commission, 2007a,b; European Commission, 2008). Extremely stringent regulations could harm consumers. After all, the online advertising industry increases the likelihood that consumers will receive relevant ads and decreases the likelihood that they will waste time on irrelevant ads. Moreover, it promises to reduce the costs of advertising to businesses, and some or all of these costs would be passed on to consumers in the form of lower prices. On

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the other side, overly lenient regulations could also harm consumers. Consumers could incur the costs of having private information disclosed and potentially misused, and incur the costs of reducing their use of the web because of concerns over privacy. Regardless of whether their private information is disclosed, consumers may dislike receiving ads that reflect too much knowledge about them—even if the knowledge is contained only on a software program on a remote server.

Resolving the privacy dilemma is important to the future of online advertising. Innovators will benefit from knowing what information they can collect and how they can use it without risking lawsuits, being pilloried in the press, and being hauled in front of Congress. Consumers will benefit from balancing the benefits of receiving relevant ads against the cost of losing valuable privacy.

■ *I would like to thank Howard Chang with whom I have worked closely on this topic; the many people in the online advertising industry who provided deep insights, including Andrew Chen, Jon Kaiser, Jared Kopf, and Scot McLernon; Ben Edelman for suggesting this piece and providing helpful comments; the editor and referees for many comments and suggestions that have improved this piece; and Alina Marinova for excellent research assistance. I have worked as a strategic advisor and on litigation matters for a number of businesses that are in the online advertising business and am an investor in several start-up ventures in this industry; none provided financial support for the preparation of this piece.*

References

Adweek. 2002. "The Medium Is the Messages." July 29.http://www.allbusiness.com/marketing-advertising/4196971-1.html.

Anderson, Simon P., and Jean J. Gabszewicz. 2005. "The Media and Advertising: A Tale of Two-Sided Markets." *CEPR Discussion Paper 5223.*

Arango, Tim. 2008. "Cable Firms Join Forces to Attract Focused Ads." *New York Times,* March 10.

Arcavision. 2009. "Exchange Volume Summary—1/1/2008–12/31/2008." https://www.arcavision.com/, (accessed on April 2; user account is needed.)

Armstrong, Mark. 2006. "Competition in Two-Sided Markets." *RAND Journal of Economics,* 37(3): 668–91.

Bagwell, Kyle. 2007. "The Economic Analysis of Advertising." In *Handbook of Industrial Organization,* vol. 3, ed. Mark Armstrong and Rob Porter, 1701–1844. North-Holland: Amsterdam.

BBC News. 2008. "Google to Dump User Data Earlier." September 9. http://news.bbc.co.uk/2/hi/technology/7605801.stm.

Berndt, Ernst, Mohammad Arzaghi, James C. Davis, and Alvin J. Silk. 2008. "Economic Factors Underlying the Unbundling of Advertising Agency Services." *NBER Working Paper W14345.*

bg Theory, LLC. 2005. "GoTo to Overture to YSM-Timeline." September 21. http://www.bgtheory.com/blog/goto-to-overture-to-ysm-timeline/.

BIGresearch. 2008. Simultaneous Media Usage Study (SIMM12) titled "Media Influence to Purchase & New Media Usage—Voters." June. Available at: http://www.bigresearch.com/BIG-Info.htm.

Blodget, Henry. 2008. "Newspapers' Fab 2007: $11 Billion of Market Value Vaporized." *Silicon Alley Insider,* January 2. http://www.alleyinsider.

Duration v. Rich Media Club
IPR2023-00953, 11,443,329
RMC EX2060

Duration Media Ex-1051

com/2008/1/newspapers_11_billion_of_market_value_vaporized_in_2007.

Chiaravalle, Bill, and Barbara Schenck. 2006. *Branding for Dummies.* John Wiley & Sons.

CNN.com. 2008. "Google's Growth Raises Privacy Concerns." November 4.

comScore. 2008. "U.S. Search Engines Rankings." Press Release, November 26. ⟨http://www.comscore.com/Press_Events/Press_Releases/2008/11/US_Search_Engine_Rankings⟩

Duboff, Robert S. 2007. *ROI for Marketing: Balancing Accountability with Long-Term Needs.* New York: Association of National Advertisers.

Dye, Jessica. 2009. "Consumer Privacy Advocates Seek Search Engine Solution." *EContent,* March issue. http://www.econtentmag.com/Articles/News/News-Feature/Consumer-Privacy-Advocates—Seek-Search-Engine-Solution-52679.htm.

Edelman Benjamin, Michael Ostrovsky, and Michael Schwarz. 2007. "Internet Advertising and the Generalized Second-Price Auction: Selling Billions of Dollars Worth of Keywords." *American Economic Review,* 97(1): 242–59.

Elliott, Stuart. 2006. "At the Four A's, a Focus on Getting Stronger." *New York Times,* April 3. http://www.nytimes.com/2006/04/03/business/03adcol.html?pagewanted=print.

European Commission. 2008. "Opinion on Data Protection Issues Related to Search Engines." April. ⟨http://ec.europa.eu/justice_home/fsj/privacy/docs/wpdocs/2008/wp148_en.pdf⟩.

Evans, David S. 2008. "The Economics of the Online Advertising Industry." *Review of Network Economics,* 7(3): 359–91.

Evans, David S. 2009. "How Catalysts Ignite: The Economics of Platform-Based Start-Ups." In *Platforms, Markets and Innovation,* ed. Annabelle Gawer, chap. 5. Northampton, MA: Edward Elgar. (Also available at SSRN: http://ssrn.com/abstract=1279631.)

Evans, David, and Richard Schmalensee. 2005. *Paying with Plastic: The Digital Revolution in Buying and Borrowing,* 2nd ed. Cambridge: The MIT Press.

Evans, David, and Richard Schmalensee. 2009. "Platform Failure: Critical Mass in Platform Businesses." Available at SSRN: http://ssrn.com/abstract=1353502.

Federal Trade Commission. 2007a. Workshop titled "Behavioral Advertising: Tracking, Targeting, and Technology," held November 1 and 2. http://www.ftc.gov/bcp/workshops/ehavioral/.

Federal Trade Commission. 2007b. "Online Behavioral Advertising: Moving the Discussion Forward to Possible Self-Regulatory Principles." December. http://www.ftc.gov/os/2007/12/P859900stmt.pdf.

Forbes.com. 2008. "Verizon posts in-line 1Q adj eps; wireless biz adds 1.5M customers." April 28. http://www.forbes.com/feeds/afx/2008/04/28/afx4939948.html.

Google. 2008. Webpage labeled "Content Network" https://adwords.google.com/select/afc.html?sourceid=awo&subid=en-us-et-awhp_related&hl=en_US, (visited December 7, 2008).

Hagel, John, and Marc Singer. 1999. *Net Worth.* Cambridge: Harvard Business School Press.

Hallerman, David. 2008. Summary of "US Online Advertising: Resilient in a Rough Economy." March. http://www.emarketer.com/Reports/All/Emarketer_2000488.aspx.

Harris, Larry. 2002. *Trading and Exchanges: Market Microstructure for Practitioners.* Oxford University Press.

Helft, Miguel. 2008. "Google's New Tool Is Meant for Marketers." *New York Times,* August 6. http://www.nytimes.com/2008/08/06/business/media/06adco.html.

Interactive Advertising Bureau. 2000–2009a. Annual reports.

Interactive Advertising Bureau. 2000–2009b. Press releases.

Kaye, Barabara K., and Norman Medoff. 2001. *Just a Click Away: Advertising on the Internet.* Massachusetts: Allyn and Bacon.

Lafayette, Jon. 2008. "Nielsen Gains Access to Data from Charter's Set-Top Boxes." TVWeek.com, March 12. http://www.tvweek.com/news/2008/03/nielsen_gains_access_to_data_f.php.

Marketing Sherpa. 2008. "Banner Ad Size and Click Rate: Bigger a Bit Better, But It is the Click that Counts." September 16. Available at https://www.marketingsherpa.com/barrier.html?ident=30829.

Microsoft Advertising. 2008. "Spending on Behavioral Targeting Predicted to Increase." Industry News, September 8. http://advertising.microsoft.com/news-events/behavioral-targeting.

Minton, Stephen. 2007. *Worldwide Telecom Spending 2007–2011 Forecast: World Telecom Black Book.* IDC.

O'Hara, Maureen. 1998. *Market Microstructure Theory.* Oxford: Blackwell Publishing.

Paul, Ryan. 2008. "EU Calls Phoul over Ad Company Phorm's Invasive Snooping." Ars Technica, August 15. http://arstechnica.com/old/content/2008/08/eu-calls-phoul-over-ad-company-phorms-invasive-snooping.ars.

Duration v. Rich Media Club
IPR2023-00953, 11,443,329
RMC EX2060

Duration Media Ex-1051

Pope, Daniel. 1983. *Making of Modern Advertising.* New York, NY: Basic Books.

Rochet, Jean-Charles, and Jean Tirole. 2003. "Platform Competition in Two-Sided Markets." *Journal of the European Economic Association,* 1(4): 990–1029.

Rochet, Jean-Charles, and Jean. Tirole. 2006. "Externalities and Regulation in Card Payment Systems." *Review of Network Economics* 5(1): 1–14.

Schumpeter, Joseph. 1942. *Capitalism, Socialism and Democracy.* New York: Harper and Brothers.

Sears, Jay. 2005. "The Evolution of Contextual Advertising." *Upgrade Magazine,* April/May. Available at: http://www.contextweb.com/pdf/UpgradeMagazine.pdf.

Semvironment. 2007. "History of Pay per Click Advertising and Yahoo! Sponsored Search," November 1. http://www.semvironment.com/the-history-of-pay-per-click-advertising-and-yahoo-sponsored-search.

Silk, Alvin J., Lisa R. Klein, and Ernst R. Berndt. 2001. "The Emerging Position of the Internet as an Advertising Medium." *Netnomics* 3(2): 129–48.

Silk, Alvin J., Lisa R. Klein, and Ernst R. Berndt. 2002. "Intermedia Substitutability and Market Demand by National Advertisers." *Review of Industrial Organization,* 20(4): 323–48.

Stiglitz, Joseph, and Carl Walsh. 2002. *Principles of Microeconomics.* New York: W. W. Norton.

U.S. Census Bureau. 2009. *Statistical Abstract of the United States.* At http://www.census.gov/compendia/statab/. (Table 1089 at http://www.census.gov/compendia/statab/tables/09s1089.pdf)

U.S. Department of Commerce. 2008. "Quarterly Retail E-Commerce Sales 3rd Quarter 2008." Press Release, November 19. ⟨http://www.census.gov/mrts/www/data/html/08Q3.html⟩.

Varian, Hal R. 2007. "Position Auctions." *International Journal of Industrial Organization,* 25(6): 1163–78.

Verizon. 2009. Webpage: http://newscenter.verizon.com/kit/fios-symmetrical-internet-service/all-about-fios.html, (accessed March 24, 2009).

Yahoo! 2007. "*Yahoo!'s New 'SmartAds' Meld Brand and Direct Response Advertising.*" Press Release, July 2. http://yhoo.client.shareholder.com/PRESS/ReleaseDetail.cfm?ReleaseID=252034.

Duration v. Rich Media Club
IPR2023-00953, 11,443,329
RMC EX2060

Duration Media Ex-1051

This article has been cited by:

1. Sajani Thapa, Francisco Guzmán, Audhesh Paswan. 2024. We are just 10 feet away! How does location-based advertising affect consumer-brand engagement?. *Journal of Business Research* **172**, 114425. [Crossref]
2. Denni Arli. 2023. Consumer perceptions of the ethicality of re-targeting online advertising. *Asia Pacific Journal of Marketing and Logistics* **49**. . [Crossref]
3. Yaming Yang, Hongchang Wu, Ziyu Guan, Jianxin Li, Wei Zhao, Cai Xu, Hao Li, Qingyu Cao, Yuanhai Lv. 2023. Distributed dominance graph-based neural multi-objective evolutionary strategy for sponsored search real-time bidding. *Knowledge-Based Systems* **279**, 110921. [Crossref]
4. Salome Baslandze, Jeremy Greenwood, Ricardo Marto, Sara Moreira. 2023. The expansion of varieties in the new age of advertising. *Review of Economic Dynamics* **50**, 171-210. [Crossref]
5. Qiwei Han, Carolina Lucas, Emila Aguiar, Patrícia Macedo, Zhenze Wu. 2023. Towards privacy-preserving digital marketing: an integrated framework for user modeling using deep learning on a data monetization platform. *Electronic Commerce Research* **23**:3, 1701-1730. [Crossref]
6. Katharine Dommett, Junyan Zhu. 2023. What is an online political advert? An interrogation of conceptual challenges in the formation of digital policy response. *Policy & Internet* **22**. . [Crossref]
7. Ke Fang, Junfeng Wu, Hao Liu, Xinyun Chen, Yang Tan, Chao Li, Qiuqiang Lin, Qingyu Cao. Receding Bid Optimization Method with Real-Time Feedback and Prediction for Sponsored Search Advertising on Taobao 3476-3483. [Crossref]
8. Taekyung Kim, Jaehwan Lee, Jihae Suh. 2023. L-Shape advertising for mobile video streaming services: Less intrusive while still effective. *Displays* **78**, 102436. [Crossref]
9. Imdad Ullah, Roksana Boreli, Salil S. Kanhere. 2023. Privacy in targeted advertising on mobile devices: a survey. *International Journal of Information Security* **22**:3, 647-678. [Crossref]
10. Pradeep Reddy K., Venkateswarlu Chandu, Narendra Ryali, Amala Gangula, Debesh Mishra, Swagatika Mishra. Ethical Business Marketing 259-276. [Crossref]
11. Raul Rios-Rodríguez, Sara Fernández-López, Adrián Dios-Vicente, David Rodeiro-Pazos. 2023. Reconversion in a declining market: the return to profitability of the print newspaper industry. *Journal of Media Business Studies* **20**:2, 204-222. [Crossref]
12. Reem A. Alzahrani, Malak Aljabri. 2023. AI-Based Techniques for Ad Click Fraud Detection and Prevention: Review and Research Directions. *Journal of Sensor and Actuator Networks* **12**:1, 4. [Crossref]
13. Remi Devaux. 2023. Display Advertising: How Context Matters?. *SSRN Electronic Journal* **91**. . [Crossref]
14. Aziza Zhuparova, Lenera Memetova. The Role of Education in the Development of Creative Industries: The Case of Kazakhstan 253-264. [Crossref]
15. Derek John Ireland. 2023. Why Self-Preferencing and Why Preferences for Ex-Ante Regulations. *SSRN Electronic Journal* **43**. . [Crossref]
16. Bertin Martens, Geoffrey Parker, Georgios Petropoulos, Marshall W. Van Alstyne. 2023. Platform Competition and Information Sharing. *SSRN Electronic Journal* **14**. . [Crossref]
17. Nishant Chadha, Viswanath Pingali, D. Daniel Sokol. 2023. Small Firms and Digital Platforms. *SSRN Electronic Journal* **1**. . [Crossref]
18. Georgios Petropoulos, Bertin Martens, Geoffrey Parker, Marshall W. Van Alstyne. 2023. Platform Competition and Information Sharing. *SSRN Electronic Journal* . [Crossref]

19. Olga Obizhaeva. 2023. 'OK Google': ETF's Online Visibility and Fund Flows. *SSRN Electronic Journal* **29**. . [Crossref]
20. Henk Lütjens, Maik Eisenbeiss, Maximilian Fiedler, Tammo Bijmolt. 2022. Determinants of consumers' attitudes towards digital advertising – A meta-analytic comparison across time and touchpoints. *Journal of Business Research* **153**, 445-466. [Crossref]
21. Parneet Pahwa. 2022. On the Role of Ad Networks: To Endogenize or Not to Endogenize the Number of Bidders in Auctions?. *Review of Marketing Science* **20**:1, 1-20. [Crossref]
22. Xue (Jane) Tan, Fujie Jin, Alan R. Dennis. 2022. How Appreciation and Attention Affect Contributions to Electronic Networks of Practice. *Journal of Management Information Systems* **39**:4, 1037-1063. [Crossref]
23. Lee Hair, Ross Bonifacio, Donghee Yvette Wohn. 2022. Multi-platform practices among digital patronage creators. *Convergence: The International Journal of Research into New Media Technologies* **28**:5, 1438-1456. [Crossref]
24. Jorge Padilla, Salvatore Piccolo, Helder Vasconcelos. 2022. Business models, consumer data and privacy in platform markets. *Journal of Industrial and Business Economics* **49**:3, 599-634. [Crossref]
25. Raul Rios-Rodríguez, Sara Fernández-López, Adrián Dios-Vicente, David Rodeiro-Pazos. 2022. Digital Opportunities for Local Journalism: A Panel Data Analysis on the Economic Performance of Online-Only vs. Print Newspapers. *Digital Journalism* **26**, 1-20. [Crossref]
26. Rémi Devaux, Olivier Bomsel. 2022. Externalities across advertising markets. *Journal of Media Economics* **34**:3, 152-175. [Crossref]
27. Jessica A Thomas, Joshua Trigg, Julia Morris, Emma Miller, Paul R Ward. 2022. Exploring the potential of citizen science for public health through an alcohol advertising case study. *Health Promotion International* **37**:2. . [Crossref]
28. Omary Swallehe. The Impact of Social Media Marketing on the Performance of SMEs: The Case of Retailing Business in Tanzania 437-456. [Crossref]
29. Tomas Lego. Privacy and Cost Concerns in Online Advertising—Literature Review and Analysis 529-568. [Crossref]
30. Victoria Akberdina, Anna Barybina. Digital Platform for Regional Industry: Prerequisites and Functionality 109-120. [Crossref]
31. Aalaa Affooni, Allam Hamdan. The Relationship Between Food E-Advertising and Children's Obesity in Bahrain 231-247. [Crossref]
32. Gökhan Akel, Gizem Candan. Adoption of Online Advertising by Small and Medium Enterprises 180-198. [Crossref]
33. Giulia Schneider. Health Data Pools: Case-Studies and Involved Interests 61-135. [Crossref]
34. Chengcheng Li, Zhongliang Guan, Xiang Xie. 2022. Advertisements on Knowledge Payment Platforms: A Game Theoretic Analysis of Pricing Strategies. *IEEE Access* **10**, 118342-118352. [Crossref]
35. Sailaja Bohara, Ashulekha Gupta, Diksha Panwar. 2022. Relationship Between Factors of Online Marketing and Student Enrollment Decisions in Higher Education. *International Journal of Online Marketing* **12**:1, 1-18. [Crossref]
36. Lokesh Gupta, Rakesh Kumar. 2022. Influence of social media advertisements on consumer's buying behaviour: Empirical evidences from India. *SSRN Electronic Journal* **37**. . [Crossref]
37. Olga Obizhaeva. 2022. "OK Google": Online Visibility and ETF Fund Flows. *SSRN Electronic Journal* **29**. . [Crossref]

38. Doruk AYBERKİN, Üstün ÖZEN. 2021. BLOKZİNCİR TEKNOLOJİSİNİN DİJİTAL REKLAM VE PAZARLAMA SEKTÖRÜNDE KULLANIMI: MODELLEME ÇALIŞMASI VE KAVRAMSAL BİR ÇERÇEVE. *Journal of Business in The Digital Age* . [Crossref]
39. Max Wurfel, Qiwei Han, Maximilian Kaiser. Online Advertising Revenue Forecasting: An Interpretable Deep Learning Approach 1980-1989. [Crossref]
40. Oliver Cruz-Milán, Veysel Avsar. 2021. Evaluating the effects of an online marketing program: The case of Mexico's national tourism promotion board. *Journal of Global Scholars of Marketing Science* **31**:4, 645-662. [Crossref]
41. Muhammad Asad, Zahid Halim, Muhammad Waqas, Shanshan Tu. 2021. An In-ad contents-based viewability prediction framework using Artificial Intelligence for Web Ads. *Artificial Intelligence Review* **54**:7, 5095-5125. [Crossref]
42. Nada Farah Amrudhia, Sylvie Nurfebiaraning. 2021. The "9.9 Super Shopping Day" Advertisement Video and Its Impact on Shopee Users on TikTok. *Kanal: Jurnal Ilmu Komunikasi* **10**:1, 22-27. [Crossref]
43. Birger Wernerfelt, Alvin Silk, Shuyi Yu. 2021. Internalization of Advertising Services: Testing a Theory of the Firm. *Marketing Science* **40**:5, 946-963. [Crossref]
44. James G. Phillips, C. Erik Landhuis, Jay Wood. 2021. Appreciation of achievement and a behavioural preference to view failure: Schadenfreude online. *Personality and Individual Differences* **172**, 110597. [Crossref]
45. Panagiotis Adamopoulos, Vilma Todri, Anindya Ghose. 2021. Demand Effects of the Internet-of-Things Sales Channel: Evidence from Automating the Purchase Process. *Information Systems Research* **32**:1, 238-267. [Crossref]
46. Behnam Pourghassemi, Jordan Bonecutter, Zhou Li, Aparna Chandramowlishwaran. 2021. adPerf. *Proceedings of the ACM on Measurement and Analysis of Computing Systems* **5**:1, 1-26. [Crossref]
47. So-Hyun Lee, Sang-Hyeak Yoon, Hee-Woong Kim. 2021. Prediction of Online Video Advertising Inventory Based on TV Programs: A Deep Learning Approach. *IEEE Access* **9**, 22516-22527. [Crossref]
48. Zahra Pooranian, Mauro Conti, Hamed Haddadi, Rahim Tafazolli. 2021. Online Advertising Security: Issues, Taxonomy, and Future Directions. *IEEE Communications Surveys & Tutorials* **23**:4, 2494-2524. [Crossref]
49. Victoria Fast, Daniel Schnurr, Michael Wohlfarth. 2021. Regulation of Data-driven Market Power in the Digital Economy: Business Value Creation and Competitive Advantages from Big Data. *SSRN Electronic Journal* **29**. . [Crossref]
50. Xue Tan, Fujie Jin, Alan R. Dennis. 2021. Not All Feedback is Created Equal: How Appreciation and Attention Affect Knowledge Contribution. *SSRN Electronic Journal* **25**. . [Crossref]
51. Derek John Ireland. 2021. Practical Guide to Applying Behavioral Economics To Competition Policy and Law In Developing Economies. *SSRN Electronic Journal* **18**. . [Crossref]
52. Ulrich Matter, Philine Widmer. 2021. Who Owns the Online Media?. *SSRN Electronic Journal* **75**. . [Crossref]
53. Neil Shah, Sarth Engineer, Nandish Bhagat, Hirwa Chauhan, Manan Shah. 2020. Research Trends on the Usage of Machine Learning and Artificial Intelligence in Advertising. *Augmented Human Research* **5**:1. . [Crossref]
54. Emanuel Bayer, Shuba Srinivasan, Edward J. Riedl, Bernd Skiera. 2020. The impact of online display advertising and paid search advertising relative to offline advertising on firm performance and firm value. *International Journal of Research in Marketing* **37**:4, 789-804. [Crossref]

55. Shrutika Mishra, A. R. Tripathi. 2020. Literature review on business prototypes for digital platform. *Journal of Innovation and Entrepreneurship* **9**:1. . [Crossref]
56. Jian Li, Jin-Song Huang. 2020. Dimensions of artificial intelligence anxiety based on the integrated fear acquisition theory. *Technology in Society* **63**, 101410. [Crossref]
57. Afroditi Nikolaidou, Ifigeneia Mylona. 2020. Promotional Greek screen industries: Branded entertainment in the digital age. *Journal of Greek Media & Culture* **6**:2, 241-259. [Crossref]
58. Meihan He, Jongsu Lee. 2020. Social culture and innovation diffusion: a theoretically founded agent-based model. *Journal of Evolutionary Economics* **30**:4, 1109-1149. [Crossref]
59. Alexander Bleier, Avi Goldfarb, Catherine Tucker. 2020. Consumer privacy and the future of data-based innovation and marketing. *International Journal of Research in Marketing* **37**:3, 466-480. [Crossref]
60. Nicole J. Hess, Corinne M. Kelley, Maura L. Scott, Martin Mende, Jan H. Schumann. 2020. Getting Personal in Public!? How Consumers Respond to Public Personalized Advertising in Retail Stores. *Journal of Retailing* **96**:3, 344-361. [Crossref]
61. Oyedele Ola Olusegun, Oworu Oyefemi Olympus, Adbulganiyu Ibrahim Olakunle. 2020. Online Marketing and the Performance of Small-Scale Enterprises in Nigeria: A Study of Selected SMEs in Ikeja, Lagos State, Nigeria. *Annals of Contemporary Developments in Management & HR* **2**:3, 15-24. [Crossref]
62. Joshua M. Pearce. 2020. Energy Conservation with Open Source Ad Blockers. *Technologies* **8**:2, 18. [Crossref]
63. Hana Choi, Carl F. Mela, Santiago R. Balseiro, Adam Leary. 2020. Online Display Advertising Markets: A Literature Review and Future Directions. *Information Systems Research* **31**:2, 556-575. [Crossref]
64. Andreas Hefti, Shuo Liu. 2020. Targeted information and limited attention. *The RAND Journal of Economics* **51**:2, 402-420. [Crossref]
65. Jannick Kirk Sørensen, Hilde Van den Bulck. 2020. Public service media online, advertising and the third-party user data business: A trade versus trust dilemma?. *Convergence: The International Journal of Research into New Media Technologies* **26**:2, 421-447. [Crossref]
66. Michael R. Baye, David E. M. Sappington. 2020. Revealing transactions data to third parties: Implications of privacy regimes for welfare in online markets. *Journal of Economics & Management Strategy* **29**:2, 260-275. [Crossref]
67. Lester C. Tong, M. Yavuz Acikalin, Alexander Genevsky, Baba Shiv, Brian Knutson. 2020. Brain activity forecasts video engagement in an internet attention market. *Proceedings of the National Academy of Sciences* **117**:12, 6936-6941. [Crossref]
68. Dai Griffiths. The Ethical Issues of Learning Analytics in Their Historical Context 39-55. [Crossref]
69. Jorge Padilla, Salvatore Piccolo, Helder Vasconcelos. 2020. On the Private and Social Value of Consumer Data in Vertically-Integrated Platform Markets. *SSRN Electronic Journal* **62**. . [Crossref]
70. William Lehr, David D. Clark, Steven Bauer. 2020. Changing Markets for Domain Names: Technical, Economic, and Policy Challenges. *SSRN Electronic Journal* . [Crossref]
71. Philine Widmer, Elliott Ash, Sergio Galletta. 2020. Media Slant is Contagious. *SSRN Electronic Journal* **130**. . [Crossref]
72. Michael Wohlfarth. 2019. Data Portability on the Internet. *Business & Information Systems Engineering* **61**:5, 551-574. [Crossref]
73. Bowei Chen, Mohan Kankanhalli. 2019. Pricing Average Price Advertising Options When Underlying Spot Market Prices Are Discontinuous. *IEEE Transactions on Knowledge and Data Engineering* **31**:9, 1765-1778. [Crossref]

74. Paul Milgrom. 2019. Auction Market Design: Recent Innovations. *Annual Review of Economics* **11**:1, 383-405. [Crossref]
75. Vincent Lefrère. 2019. 7. Quel est le coût des applications gratuites ?. *Regards croisés sur l'économie* **n° 23**:2, 94-104. [Crossref]
76. José Estrada-Jiménez, Javier Parra-Arnau, Ana Rodríguez-Hoyos, Jordi Forné. 2019. On the regulation of personal data distribution in online advertising platforms. *Engineering Applications of Artificial Intelligence* **82**, 13-29. [Crossref]
77. Ab Shaqoor Nengroo, K S Kuppusamy. 2019. 'Advertisements or adverse-tisements?'—An accessibility barrier for persons with visual impairments. *The Computer Journal* **62**:6, 855-868. [Crossref]
78. Mehmet Türkay Yoldar, Uğur Özcan. 2019. Collaborative targeting: Biclustering-based online ad recommendation. *Electronic Commerce Research and Applications* **35**, 100857. [Crossref]
79. Alexandre JOUX. 2019. Le spot TV à l'heure des plateformes. Une analyse de la stratégie publicitaire du Groupe TF1. *Tic & société* :Vol. 13, N° 1-2, 295-322. [Crossref]
80. Elizabeth A. Holm. 2019. In defense of the black box. *Science* **364**:6435, 26-27. [Crossref]
81. Avi Goldfarb, Catherine Tucker. 2019. Digital Economics. *Journal of Economic Literature* **57**:1, 3-43. [Abstract] [View PDF article] [PDF with links]
82. Mercy Mpinganjira, Daniel K. Maduku. 2019. Ethics of mobile behavioral advertising: Antecedents and outcomes of perceived ethical value of advertised brands. *Journal of Business Research* **95**, 464-478. [Crossref]
83. Philipp K. Masur, Doris Teutsch, Tobias Dienlin. Privatheit in der Online-Kommunikation 337-365. [Crossref]
84. Maximilian Schreieck, Christoph Pflügler, Janik Halbherr, Manuel Wiesche, Helmut Krcmar. Monetarisierung von Mobilitätsplattformen 53-68. [Crossref]
85. Hana Choi, Carl F. Mela, Santiago Balseiro, Adam Leary. 2019. Online Display Advertising Markets: A Literature Review and Future Directions. *SSRN Electronic Journal* **64**. . [Crossref]
86. Alexander White, Kamal Jain. 2019. The Attention Economy of Online Advertising. *SSRN Electronic Journal* **72**. . [Crossref]
87. . References 169-199. [Crossref]
88. Bodo Herzog. 2018. Valuation of Digital Platforms: Experimental Evidence for Google and Facebook. *International Journal of Financial Studies* **6**:4, 87. [Crossref]
89. Michael Arnold, Eric Darmon, Thierry Penard. 2018. The impact of organic links in position auctions with popular versus niche keywords. *International Journal of Economic Theory* **14**:3, 257-278. [Crossref]
90. Steven Schmeiser. 2018. Online advertising networks and consumer perceptions of privacy. *Applied Economics Letters* **25**:11, 776-780. [Crossref]
91. Zhuli Xie, Yong Liu. 2018. User-level incremental conversion ranking without A/B testing. *Journal of Marketing Analytics* **6**:2, 62-68. [Crossref]
92. Qun Wang. 2018. Dimensional Field Theory. *Digital Journalism* **6**:4, 472-491. [Crossref]
93. Susan Athey, Emilio Calvano, Joshua S. Gans. 2018. The Impact of Consumer Multi-homing on Advertising Markets and Media Competition. *Management Science* **64**:4, 1574-1590. [Crossref]
94. Xi He, Rigoberto Lopez, Yizao Liu. 2018. Are Online and Offline Advertising Substitutes or Complements? Evidence from U.S. Food Industries. *Journal of Agricultural & Food Industrial Organization* **15**:2. . [Crossref]
95. . Bibliography 331-339. [Crossref]

96. Ying Chen Lo, Chin-Yi Fang. 2018. Facebook marketing campaign benchmarking for a franchised hotel. *International Journal of Contemporary Hospitality Management* **30**:3, 1705-1723. [Crossref]
97. Lisa B Hurwitz, Aubry L Alvarez, Alexis R Lauricella, Thomas H Rousse, Heather Montague, Ellen Wartella. 2018. Content analysis across new media platforms: Methodological considerations for capturing media-rich data. *New Media & Society* **20**:2, 532-548. [Crossref]
98. Yongwoog Andrew Jeon. Skip or Not to Skip: Impact of Empathy and Ad Length on Viewers' Ad-Skipping Behaviors on the Internet 261-265. [Crossref]
99. Philipp K. Masur, Doris Teutsch, Tobias Dienlin. Privatheit in der Online-Kommunikation 1-29. [Crossref]
100. Maximilian Schreieck, Fabian Kolbe, Christoph Pflügler, Manuel Wiesche, Helmut Krcmar. Monetarisierungsstrategien für Mobilitätsplattformen 67-91. [Crossref]
101. Ralf Nöcker. Der Werbemarkt heute 1-20. [Crossref]
102. Anca D. Chirita. The Rise of Big Data and the Loss of Privacy 153-189. [Crossref]
103. Luis Miralles-Pechuán, Hiram Ponce, Lourdes Martínez-Villaseñor. 2018. A novel methodology for optimizing display advertising campaigns using genetic algorithms. *Electronic Commerce Research and Applications* **27**, 39-51. [Crossref]
104. Ana L Herrera, Anna V Wilkinson, Elizabeth A Cohn, Cheryl L Perry, Susan P Fisher-Hoch. 2018. Exposure to e-cigarette marketing and product use among Mexican American young adults on the US-Mexico border: A pilot study. *Cogent Medicine* **5**:1, 1534306. [Crossref]
105. Junqi Jin, Chengru Song, Han Li, Kun Gai, Jun Wang, Weinan Zhang. Real-Time Bidding with Multi-Agent Reinforcement Learning in Display Advertising 2193-2201. [Crossref]
106. Adam White. 2018. Google's Antitrust Woes and Google Shopping (Introduction). *SSRN Electronic Journal* . [Crossref]
107. Elad Yom-Tov, Anat Brunstein-Klomek, Or Mandel, Arie Hadas, Silvana Fennig. 2018. Inducing Behavioral Change in Seekers of Pro-Anorexia Content Using Internet Advertisements: Randomized Controlled Trial. *JMIR Mental Health* **5**:1, e6. [Crossref]
108. Lara Lobschat, Ernst C. Osinga, Werner J. Reinartz. 2017. What Happens Online Stays Online? Segment-Specific Online and Offline Effects of Banner Advertisements. *Journal of Marketing Research* **54**:6, 901-913. [Crossref]
109. Shilpa Kumari, Xiaohong Yuan, Joshua Patterson, Huiming Yu. Demystifying ad fraud 1-5. [Crossref]
110. A. Daly, A. Scardamaglia. 2017. Profiling the Australian Google Consumer: Implications of Search Engine Practices for Consumer Law and Policy. *Journal of Consumer Policy* **40**:3, 299-320. [Crossref]
111. Darius Bufnea, Diana Sotropa. Measuring and Visualizing the Scrappiness Level of a Website 304-311. [Crossref]
112. Zhen Sun, Milind Dawande, Ganesh Janakiraman, Vijay Mookerjee. 2017. Not Just a Fad: Optimal Sequencing in Mobile In-App Advertising. *Information Systems Research* **28**:3, 511-528. [Crossref]
113. Henk Kox, Bas Straathof, Gijsbert Zwart. 2017. Targeted advertising, platform competition, and privacy. *Journal of Economics & Management Strategy* **26**:3, 557-570. [Crossref]
114. Alan T. Sorensen. 2017. Bestseller Lists and the Economics of Product Discovery. *Annual Review of Economics* **9**:1, 87-101. [Crossref]
115. J A McBride, C C Carson, R M Coward. 2017. Readability, credibility and quality of patient information for hypogonadism and testosterone replacement therapy on the Internet. *International Journal of Impotence Research* **29**:3, 110-114. [Crossref]

116. José Estrada-Jiménez, Javier Parra-Arnau, Ana Rodríguez-Hoyos, Jordi Forné. 2017. Online advertising: Analysis of privacy threats and protection approaches. *Computer Communications* **100**, 32-51. [Crossref]
117. Radha Mookerjee, Subodha Kumar, Vijay S. Mookerjee. 2017. Optimizing Performance-Based Internet Advertisement Campaigns. *Operations Research* **65**:1, 38-54. [Crossref]
118. A. Constantinescu-Dobra, V. Maier. Generation Z and Online Dentistry. An Exploratory Survey on the Romanian Market 291-296. [Crossref]
119. D. Daniel Sokol, Roisin Comerford. Does Antitrust Have a Role to Play in Regulating Big Data? 293-316. [Crossref]
120. Han Zhu, Junqi Jin, Chang Tan, Fei Pan, Yifan Zeng, Han Li, Kun Gai. Optimized Cost per Click in Taobao Display Advertising 2191-2200. [Crossref]
121. Andreas Hefti, Shuo Liu. 2017. Targeted Information and Limited Attention. *SSRN Electronic Journal* **40**. . [Crossref]
122. David Bounie, Morrisson Vallrie, Martin Quinn. 2017. Do You See What I See? Ad Viewability and the Economics of Online Advertising. *SSRN Electronic Journal* . [Crossref]
123. Jan Kraemer, Daniel Schnurr, Alexandre de Streel. 2017. Internet Platforms and Non-Discrimination. *SSRN Electronic Journal* . [Crossref]
124. Mario Gonzalez-Fuentes. The Organization of the Future and the Marketing Function 126-145. [Crossref]
125. Saliha Akhtar, Cynthia Israel, Michelle Lee D'Abundo. Diversifying Clinical Research Participants 158-183. [Crossref]
126. Michelle Lee D'Abundo, Saliha Akhtar, Cynthia Israel. Increasing the Participation of Women and Minority Populations in Clinical Trials 1018-1028. [Crossref]
127. Lidia Maestro Espínola, José Vicente García Santamaría, María José Pérez Serrano. 2016. La 'prensa' digital generalista, como soporte publicitario y los cambios en su modelo de negocio. *Revista Latina de Comunicación Social* :71, 1048-1068. [Crossref]
128. Hartmut Egger, Josef Falkinger. 2016. Limited Consumer Attention in International Trade. *Review of International Economics* **24**:5, 1096-1128. [Crossref]
129. Muhammad Tahir Jan, Djihane Ammari. 2016. Advertising online by educational institutions and students' reaction: a study of Malaysian Universities. *Journal of Marketing for Higher Education* **26**:2, 168-180. [Crossref]
130. Alessandro Acquisti, Curtis Taylor, Liad Wagman. 2016. The Economics of Privacy. *Journal of Economic Literature* **54**:2, 442-492. [Abstract] [View PDF article] [PDF with links]
131. Eline De Cuypere, Koen De Turck, Sabine Wittevrongel, Dieter Fiems. 2016. Opinion propagation in bounded medium-sized populations. *Performance Evaluation* **99-100**, 1-15. [Crossref]
132. Michal Novák, Tomáš Kincl, Martin Luštický. 2016. Industry analysis of TV commercials: Do companies reflect audience profiles?. *Journal of Direct, Data and Digital Marketing Practice* **17**:3, 187-200. [Crossref]
133. Alexandre de Cornière, Romain de Nijs. 2016. Online advertising and privacy. *The RAND Journal of Economics* **47**:1, 48-72. [Crossref]
134. Tom Evens, Kristin Van Damme. 2016. Consumers' Willingness to Share Personal Data: Implications for Newspapers' Business Models. *International Journal on Media Management* **18**:1, 25-41. [Crossref]
135. Subodha Kumar. Evolution of Web Advertising 1-7. [Crossref]
136. Subodha Kumar. Pricing Models in Web Advertising 9-13. [Crossref]

137. Sahin Cem Geyik, Sergey Faleev, Jianqiang Shen, Sean O'Donnell, Santanu Kolay. Joint Optimization of Multiple Performance Metrics in Online Video Advertising 471-480. [Crossref]
138. Cristiano Codagnone, Bertin Martens. 2016. Scoping the Sharing Economy: Origins, Definitions, Impact and Regulatory Issues. *SSRN Electronic Journal* . [Crossref]
139. Cristiano Codagnone, Fabienne Abadie, Federico Biagi. 2016. The Future of Work in the Sharing Economyy. Market Efficiency and Equitable Opportunities or Unfair Precarisation?. *SSRN Electronic Journal* . [Crossref]
140. Anca D. Chirita. 2016. The Rise of Big Data and the Loss of Privacy. *SSRN Electronic Journal* . [Crossref]
141. Andreas M. Hefti, Shuo Liu. 2016. Targeted Information and Limited Attention. *SSRN Electronic Journal* **40**. . [Crossref]
142. Diane Coyle. 2016. Making the Most of Platforms: A Policy Research Agenda. *SSRN Electronic Journal* . [Crossref]
143. Henk LM Kox, Bas Straathof, Gijsbert Zwart. 2016. Targeted Advertising, Platform Competition and Privacy. *SSRN Electronic Journal* . [Crossref]
144. Saliha Akhtar, Cynthia Israel, Michelle Lee D'Abundo. Diversifying Clinical Research Participants 234-258. [Crossref]
145. Jenny V. Bittner, Robin Zondervan. 2015. Motivating and achievement-eliciting pop-ups in online environments: A user experience perspective. *Computers in Human Behavior* **50**, 449-455. [Crossref]
146. Nadia van Huyssteen, Johan Wilhelm Strydom, Sharon Rudansky-Kloppers. 2015. Online marketing communication tools used by guest houses in Pretoria, South Africa. *African Journal of Science, Technology, Innovation and Development* **7**:4, 313-322. [Crossref]
147. Frago Kourandi, Jan Krämer, Tommaso Valletti. 2015. Net Neutrality, Exclusivity Contracts, and Internet Fragmentation. *Information Systems Research* **26**:2, 320-338. [Crossref]
148. Vaibhav Garg, L. Jean Camp. Spare the rod, spoil the network security? Economic analysis of sanctions online 1-10. [Crossref]
149. James Campbell, Avi Goldfarb, Catherine Tucker. 2015. Privacy Regulation and Market Structure. *Journal of Economics & Management Strategy* **24**:1, 47-73. [Crossref]
150. Andrey Pepelyshev, Yuri Staroselskiy, Anatoly Zhigljavsky. Adaptive Targeting for Online Advertisement 240-251. [Crossref]
151. David E.M. Sappington. Regulation, Economic Theory of 166-171. [Crossref]
152. Martin Peitz, Markus Reisinger. The Economics of Internet Media 445-530. [Crossref]
153. Catherine E. Tucker. Privacy and the Internet 541-562. [Crossref]
154. Suman Nath. MAdScope 59-73. [Crossref]
155. Cheng Li, Yue Lu, Qiaozhu Mei, Dong Wang, Sandeep Pandey. Click-through Prediction for Advertising in Twitter Timeline 1959-1968. [Crossref]
156. ## #. 2015. Pop-Up Ads Is Not as Bad as You Think. *Journalism and Communications* **03**:02, 45-56. [Crossref]
157. Jialin Hardwick, Lauriane Delarue, Barry Ardley, Nick Taylor. Mobile Phone Purchases and the Consumer Decision-Making Process 303-333. [Crossref]
158. Alessandro Acquisti, Curtis R. Taylor, Liad Wagman. 2015. The Economics of Privacy. *SSRN Electronic Journal* **347**. . [Crossref]
159. Benedikt Berger, Thomas Hess. Die Konvergenz von Medien und Handel im Internet 449-458. [Crossref]