American Economic Review: Papers & Proceedings 2014, 104(5): 481–488
http://dx.doi.org/10.1257/aer.104.5.481

Trading Dollars for Dollars: The Price of Attention Online and Offline[†]

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Recent years have witnessed a crisis in journalism. Newspaper staffs have been cut by a third since 2000 (Pew Research Center 2013). Stock prices of major newspaper companies have fallen by more than half over the same period. The costly work of gathering, interpreting, and disseminating news—activities widely believed to have large positive political and social externalities (Downs 1957; Becker 1958)—seems not to pay the way it once did.

The root cause, according to many accounts, is that the Internet has reduced the return news outlets can earn by selling the attention of their consumers to advertisers. This is held to be true both because the price of a given unit of attention is lower online than offline,[1] and because the price of attention in traditional media has fallen as the Internet has made advertising markets increasingly competitive.[2] The result is news outlets "trading analog dollars for digital pennies" (Zucker 2008).

In this paper, I present simple theory and descriptive evidence relevant to these claims. I first introduce a model of advertising pricing before and after the introduction of the Internet, and ask how the price varies both over time and between online and offline media at a point in time. The model is essentially a simplified version of Bergemann and Bonatti (2011). It highlights the dependence of both the point-in-time and the over-time comparisons on the interaction of two effects: (i) the Internet allows more efficient targeting of ads, which tends to raise prices, and (ii) the Internet gives advertisers more ways to reach a given consumer, which can decrease prices.

Next, I draw from a variety of sources to construct a time series of media time use and advertising revenue from 1920–2012, and to compute average revenue per hour of attention for each medium in each year. Discussions of advertising prices have often been muddied by different units of measurement. Print advertising revenue per daily circulation in newspapers, for example, is often compared to digital revenue per unique monthly visitor, despite the fact that the average print subscriber spends an order of magnitude more time reading than the average monthly visitor online. My measure allows for consistent comparisons across media and across time.

The first result is that the price of attention for similar consumers is actually higher online than offline. In 2008, newspapers earned \$2.78 per hour of attention in print, and \$3.79 per hour of attention online. By 2012, the price of attention in print had fallen to \$1.57, while the price for online papers had increased to \$4.24. Offline revenue per hour for magazines was similar to newspapers, and offline revenue per hour for television was substantially lower.

The second result is that changes in the price of attention have been very different across different media. While the price of attention in

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† Go to http://dx.doi.org/10.1257/aer.104.5.481 to visit the article page for additional materials and author disclosure statement(s).

[1] For example, Rice (2010) asserts that "online ads sell at rates that are a fraction of those for print, for simple reasons of competition." Wall Street analyst, Craig Moffett, writes in a frequently quoted 2008 report, "The notion that the enormous cost of real news-gathering might be supported by the ad load of display advertising down the side of the page, or by the revenue share from having a Google search box in the corner of the page, or even by a 15-second teaser from Geico prior to a news clip, is idiotic on its face" (quoted in, e.g., Pew 2009; Carr 2009; Swensen and Schmidt 2009).

[2] For example, Bergemann and Bonatti (2011, p. 417) take as part of their motivation the observation that "For … daily newspapers, the very business model is under the threat of extinction due to competition from the Internet for the placement of advertising."

print newspapers has fallen precipitously, the price in television and magazines has been flat or trending upward during most of the Internet's growth, with the exception of declines around the recessions of 2001 and 2007.

For newspapers specifically, the data clarify the dimensions of the recent downturn. Contrary to most popular accounts,[3] the growth of the Internet has not obviously caused a large decline in newspaper readership. Readership has fallen steadily since the Internet was introduced in the mid-1990s, but it had been falling at almost the same rate since 1980, and the small acceleration of this trend accounts for a drop in readership of only about 10 percent. This is consistent with more systematic evidence in Gentzkow (2007) and Liebowitz and Zentner (2012), suggesting that online-offline substitution is relatively limited, as well as survey evidence showing that the Internet currently accounts for less than 10 percent of total time spent consuming news (Edmonds 2013).

The recent downturn in newspapers' fortunes has thus been almost entirely driven by the declining price of attention in print. A key component is the large drop in classified advertising revenue, which seems clearly related to competition from Craigslist and other online competitors (Seamans and Zhu 2013). Nonclassified advertising revenue per hour has also fallen much faster for newspapers than other media, however, possibly reflecting the shift of other ad categories such as local retail and movie listings online.

In the final section, I turn to historical data to examine two other dramatic changes in the market for news: the introduction of television in the 1940s and 1950s, and the introduction of radio in the 1920s and 1930s. In both episodes, the new medium captured, within a decade, over an hour per adult per day of consumer attention and roughly 20 percent of the advertising market. However, neither episode was associated with a clear drop in the price of attention on incumbent media.

The theoretical results in this paper are most closely related to Athey and Gans (2010), Bergemann and Bonatti (2011), and Athey, Calvano, and Gans (2013), all of whom also stress the importance of targeting for online-offline competition. My model captures some of the key intuitions in this literature, while abstracting from others, such as market thickness effects and endogenous advertising quantities. Other closely related theory work includes Ambrus, Calvano, and Reisinger (2013) and Anderson, Foros, and Kind (2013). The empirical results are closely related to studies of online and offline advertising prices by Chandra and Kaiser (2013), Sridhar and Sriram (2013), Zentner (2012), and Goldfarb and Tucker (2011), as well as to the discussion of newspaper finances in Varian (2010).

I. Theory

There are two media firms indexed $j \in \{1, 2\}$, two potential advertisers indexed $a \in \{1, 2\}$, and a unit mass of each of two consumer types, $c \in \{1, 2\}$. I consider a "pre-Internet" market, where each firm operates one newspaper, and a "post-Internet" market, where each firm operates one newspaper and one website. Each consumer allocates one unit of time across the available outlets. Consumers of type c have a preference for news from firms with the same type ($j = c$), and advertisers of type a get higher payoffs from advertising to consumers of the same type ($c = a$).

I do not model demand explicitly, but take the distribution of consumer types across media as exogenous. Share α of each type are "single homing," devoting all their time to one outlet of their own type. Share $1 - \alpha$ are "multihoming," devoting half their time to an outlet of their own type and half their time to an outlet of the opposite type. In the post-Internet market, single-homing consumers read a newspaper with probability η and a website with probability $1 - \eta$. Multihoming consumers also choose a newspaper with (marginal) probability η for both their same-type and opposite-type outlets. The correlation between the media chosen for the same-type and opposite-type outlets is ρ.[4]

[3] To take one example, a report from the USC Annenberg School (2012, p. 13) predicts that continuing substitution from print to online will lead "most major US daily newspapers … as print editions [to] be gone in about five years."

[4] Thus, letting $\Pr(a, b)$ denote the probability a multihoming consumer chooses same-type medium a and opposite-type medium b, we have:

$$\eta = \Pr(n, n) + \Pr(n, w) = \Pr(n, n) + \Pr(w, n),$$

and

$$\rho = \frac{\Pr(n,n)\ \Pr(w,w) - \Pr(n,w)\ \Pr(w,n)}{\eta(1 - \eta)}.$$

Advertiser a receives profit 1 for the first impression to each same-type consumer ($c = a$), and profit $\phi < 1$ for each subsequent impression. Advertisers receive no profit from impressions to opposite-type consumers.

Each newspaper has physical space for exactly one advertisement. All readers of the newspaper must see the same ad. The marginal cost of printing ads is zero. Each website also has physical space for exactly one advertisement, but these ads are targeted, so the website can show different ads to different consumers. Consumer types are observable to websites. I refer to the ad locations available on each outlet (one on each newspaper, and one for each consumer type on each website) as ad "slots."

In the first stage of the game, firms simultaneously announce advertising prices p_j. In the pre-Internet market, these are simply the prices p_j^n to place an ad in their newspaper. In the post-Internet market, these are vectors of prices for each of the three slots: p_j^n, $p_j^{w,own}$ (online slot for consumers $c = j$), and $p_j^{w,opp}$ (online slot for consumers $c \neq j$). In the second stage, advertisers simultaneously announce which slots they wish to place their ads in. They may request ads in no outlet, or in any combination of the available slots. If both advertisers wish to place ads in a given slot, the slot is allocated at random.

This model is designed to capture two key features of advertising market. First, prices depend on the extent of "multihoming" by both consumers and advertisers. Second, prices depend on the ability of outlets to target ads to the consumers who value them the most.

The model embeds many strong assumptions. The exogenous demand process abstracts from both subscription pricing to consumers and potential utility or disutility to consumers of ads, as well as from quality choice by media outlets. The specific demand pattern rules out consumers reading a newspaper and a website from the same firm (this would introduce some minor complications related to bundle pricing), and assumes the overall frequency of multihoming $(1 - \alpha)$, the effectiveness of ads, and the shares of the two consumer types are the same online and offline.

Solving for the equilibrium of this game is straightforward. First, note that no firm will ever charge an advertiser less than its marginal willingness to pay for a particular ad slot (holding fixed the other ads the advertiser is placing), and it will not charge them more. Thus, prices in any equilibrium must equal marginal willingness to pay. Second, it is possible to show that in both the pre-Internet and post-Internet markets, any equilibrium must involve each advertiser requesting ads only in the same-type newspaper. (If there were an equilibrium where advertiser a requested ads in newspaper $j \neq a$, firm j could raise its price to a level just above a's marginal willingness to pay and be guaranteed demand from the other advertiser.) Third, it is straightforward to show that, in the post-Internet market, each advertiser requests ads in both online slots that target its own-type consumers.

It will be useful to let $s = \alpha + (1 - \alpha)/2$ denote the share of time spent on each outlet that comes from same-type consumers. Note that this is the same for pre-Internet newspapers, post-Internet newspapers, and websites. It will also be useful to introduce notation for the (time-weighted) share of same-type consumers on each outlet that are "exclusive," in the sense that they are not exposed to advertisements through the competitor's website. I denote these shares x^n and x^w, for newspapers and websites respectively.[5]

PROPOSITION 1: *In the unique pre-Internet equilibrium, prices are $p_j^n = s$ for both j, and each advertiser advertises in the same-type newspaper.*

In the unique post-Internet equilibrium, prices are for both j:

$$p_j^n = \eta s[x^n + (1 - x^n)\phi]$$

$$p_j^{w,own} = (1 - \eta)s[x^w + (1 - x^w)\phi]$$

$$p_j^{w,opp} = (1 - \eta)(1 - s)\phi,$$

and each advertiser advertises in the same-type newspaper and in both slots to their same-type consumers online.

Our primary object of interest is the price of attention—the price each outlet obtains per unit of consumer time.[6] It is immediate that the price

[5] These are $x^n = 1 - \dfrac{(1 - \alpha)(1 - \rho)(1 - \eta)}{1 + \alpha}$ and $x^w = 1 - \dfrac{(1 - \alpha)(1 - \eta + \eta\rho)}{1 + \alpha}$.

[6] In the pre-Internet market, the total consumer attention at each newspaper is 1 and so this is simply s. In

of attention can be either higher or lower online than offline.

COROLLARY 1: *The post-Internet price of attention is higher online than offline if and only if* $\rho < \frac{\phi}{(1-\phi)}$.

The relative price of attention online and offline depends on the strength of two competing effects. On one hand, online prices are higher because of targeting. Websites earn positive revenue from opposite-type consumers, while newspapers earn no revenue from such consumers. Because all impressions to opposite-type consumers are second impressions, this effect is increasing in ϕ. On the other hand, offline prices may be either higher or lower due to relative competitiveness—i.e., the different shares of consumers x^n and x^w that are exclusive. This effect depends on ρ: as ρ increases, x^n grows, x^w falls, and online prices fall relative to offline prices.

The comparison of pre-Internet to post-Internet prices also follows immediately from Proposition 1. Note that, since total attention per firm is equal to 1 both before and after the Internet, the average price also determines total firm revenue.

COROLLARY 2: *The introduction of the Internet unambiguously reduces the price of attention in newspapers, and reduces the average price of attention if and only if* $\phi < 0.5$.

The price of attention in newspapers falls because some same-type consumers now see same-type ads on the competitor's website. This drop in price is larger the smaller is x^n and the smaller is ϕ. If either $x^n = 1$ or $\phi = 1$, the price of attention in newspapers is unchanged. The change in the average price of attention depends on two effects. First, ads are more efficient because of targeting. The value of this is increasing in ϕ. Second, the Internet increases competition, since it is no longer the case that own-type consumers are all exclusive. The cost of this is decreasing in ϕ. When $\phi = 0$, there is no added gain to targeting and the only effect of the Internet is increased competition. When $\phi = 1$, there is no cost of added competition and the only effect of the Internet is the gain due to better targeting. When $\phi = \frac{1}{2}$, these two effects exactly cancel out and the Internet has no effect on the average price of attention.

It is straightforward to extend this model to capture (i) differences in the effectiveness of online and offline ads, (ii) differences in the share of the two consumer types online and offline, and (iii) additional online outlets not affiliated with print newspapers (which would lead the Internet to increase total exposure of consumers to ads).

the post-Internet market, it is p_j^n/η in newspapers and $(p_j^{w,own} + p_j^{w,opp})/(1-\eta)$ online.

II. Data

For detailed description and sources, see the online Appendix.

A. *Advertising Revenue*

Data for non-Internet media 1934–2007 come from a series compiled by Robert Coen of the McCann advertising agency. I supplement these with data for recent years from Kantar Media and the Newspaper Association of America, and for earlier years from Douglas Galbi.

Data for the Internet 2001–2012 come from eMarketer. Data for 1995–2001 are linearly interpolated. Estimates of online newspaper revenue are from the Newspaper Association of America.

B. *Time Use*

Media hours in 2008 come from the Video Consumer Mapping Study (VCMS). Media use was directly recorded by observers who shadowed participants for two days. I compute average minutes per day as minutes of exclusive use plus half of minutes concurrent with other activities.[7]

I combine these data with a number of other series, each of which I scale to match the VCMS data in 2008. For print newspapers and magazines, I use total circulation (implicitly fixing

[7] The goal is to approximate time spent paying attention to media. Time concurrent with other activities could include time we would want to include in this definition (listening to the radio while driving or watching TV while eating), as well as time we would not want to include (socializing with the television on in the background). For simplicity, I therefore include half of the concurrent minutes.

Table 1—The Price of Attention

	Minutes per person per day		Advertising revenue per hour	
	2008	2012	2008	2012
Newspapers				
Print	9.54	8.24	$2.78	$1.57
Online	0.63	0.54	$3.79	$4.24
Internet	26.12	37.17	$0.68	$0.68
Magazines	3.95	3.64	$2.58	$2.07
Television	205.4	209.8	$0.27	$0.26

Notes: Minutes per person per day is for American adults 18 and older. Advertising revenue per hour is total amount advertising revenue divided by total annual minutes in 2012 dollars.

reading time per copy at the 2008 value). For television, I use time use data from the American Time Use Study and Aguiar and Hurst (2007), as well as data on the share of households with televisions 1946–1965 from Sterling (1984). For radio, I use estimates of time use 1931–1970 and the share of households with radios 1922–1931 from Sterling (1984). For Internet, I use data from comScore for 2008–2012 and data on Internet penetration from the Pew Research Center. For online newspapers, I use data from comScore and Nielsen, reported by the Newspaper Association of America.

III. Empirical Results

A. *Is Attention Worth Less Online than Offline?*

Table 1 shows total minutes per person per day by medium and advertising revenue per hour in 2008 and 2012. Revenue per hour is higher in online newspapers than in print newspapers. Although both total and per-consumer advertising revenue is significantly lower online than in print, as is often emphasized, the total time spent reading online newspapers in both years was less than a tenth of the total time spent reading print newspapers. In the online Appendix, I show that the print-online comparison is robust to using alternative time use measures.

Advertising revenue per hour in magazines is similar to that for newspapers. The price of attention is lower for the Internet as a whole than for online newspapers, consistent with online newspapers attracting higher-income and more educated readers of particular value to advertisers, and also with online newspapers being able to better target ads given their detailed information on reader characteristics. The price of attention is even lower for television, perhaps reflecting the very limited targeting of television ads.

B. *Has the Internet Reduced the Price of Attention?*

Figure 1 shows the evolution of time use and advertising revenue per hour around the introduction of the Internet. Panel A shows that both time online and online advertising as a share of total advertising have grown at a roughly constant rate from 1995 to 2012. Panel B shows that time spent reading newspapers has fallen steadily over this period, but also that time spent reading newspapers fell at almost exactly the same rate between 1980 and 1995. Time spent reading magazines began to decline in 1990, with the trend accelerating around 2000. Time spent watching television was flat from 1995–2005, and increased slightly from 2005–2012.

Panel C shows that advertising revenue per hour has followed a very different path for different media. Both television and magazines saw increases from 1995–2000, and moderate declines from 2000–2012, punctuated by sharp drops around the recessions in 2001 and 2008. The result was that the price of attention in 2012 on these media was roughly equal to what it was before the Internet was introduced. Newspapers, by contrast, followed a very similar path to television up until 2001, then diverged sharply, with revenue falling by half between 2005 and 2012.

In the online Appendix, Figure A.1, I show a breakdown of the recent decline for newspapers between national, local retail, and classified advertisements. Classified revenue per hour fell by roughly two thirds between 2005 and 2012, consistent with competition from Craigslist and related sites being a key driver. However, national and retail revenue also fell by roughly half over the same period, more than twice the drop for television and magazines.

C. *Did Historical Media Reduce the Price of Attention?*

Figure 2 shows the evolution of time use and advertising revenue per hour around the introduction of television. Panel A shows the rapid growth of television time use and advertising from 1948–1960, followed by more gradual

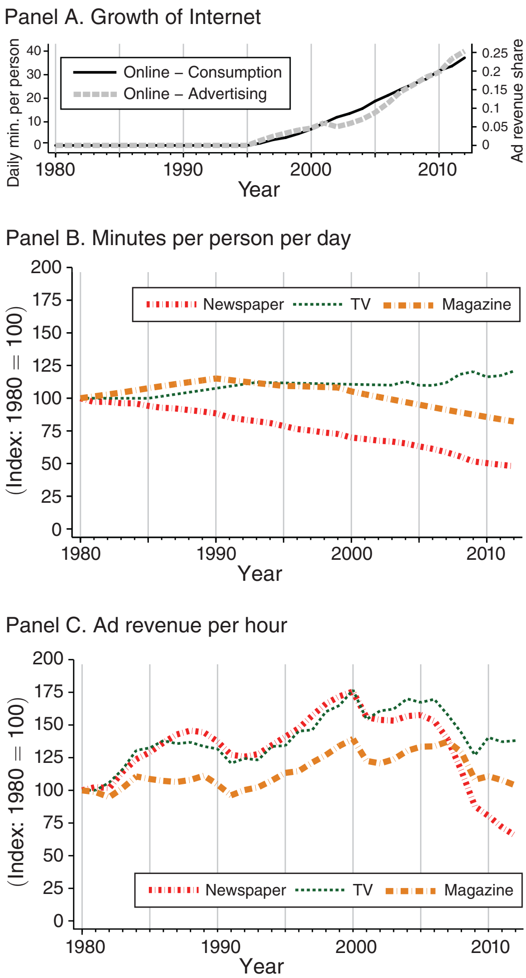

FIGURE 1. INTRODUCTION OF INTERNET

Notes: Panel A shows online minutes per person per day and online advertising revenue as a share of total online, television, newspaper, and magazine revenue. Minutes per person per day is for American adults 18 and older. Advertising revenue per hour is total annual advertising revenue divided by total annual minutes in 2012 dollars.

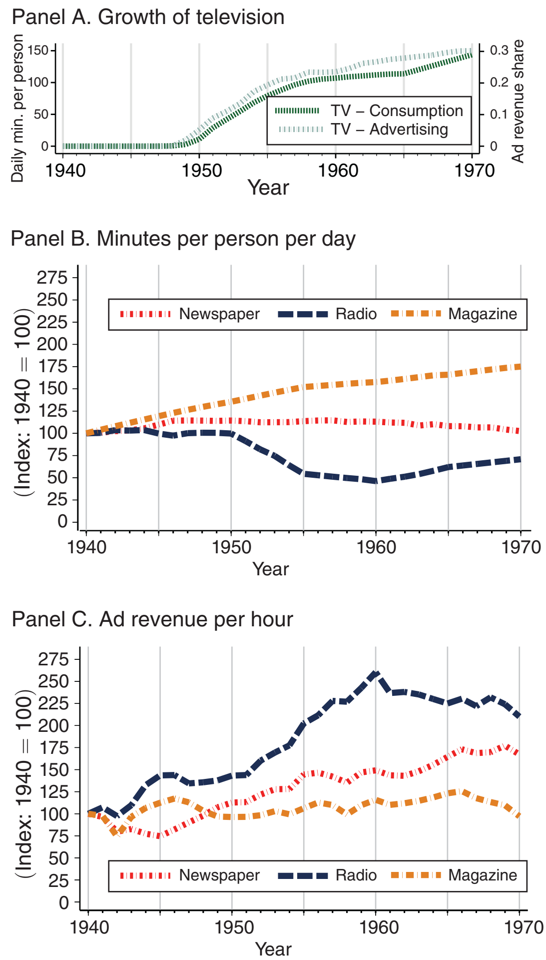

FIGURE 2. INTRODUCTION OF TELEVISION

Notes: Panel A shows television minutes per person per day and television advertising revenue as a share of total television, newspaper, magazine, and radio revenue. Minutes per person per day is for American adults 18 and older. Advertising revenue per hour is total annual advertising revenue divided by total annual minutes in 2012 dollars.

growth thereafter. Panel B shows that television's introduction was associated with a sharp drop in time devoted to radio, a more gradual decline in time devoted to newspapers, and increasing time devoted to magazines. Panel C shows that the growth of television was not associated with any aggregate decline in the price of attention. Advertising revenue per hour grew dramatically in both radio and newspapers between 1948 and 1960, while revenue per hour for magazines was roughly constant.

Similar results for the introduction of radio are presented in the online Appendix, Figure A.2. The figure shows no decline in the price of attention for newspapers during the period of radio's growth, with the exception of a drop around the beginning of the Great Depression.

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