The Impact of the Internet on Advertising Markets for News Media

by

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In this paper, we explore the hypothesis that an important force behind the collapse in advertising revenue experienced by newspapers in the past decade is the greater consumer switching facilitated by online consumption of news. We introduce a model of the market for advertising on news media outlets whereby news outlets are modeled as competing two-sided platforms bringing together heterogeneous, partially multi-homing consumers with advertisers with heterogeneous valuations for reaching consumers. A key feature of our model is that the multi-homing behavior of the advertisers is determined endogenously. The presence of switching consumers means that, in the absence of perfect technologies for tracking the ads seen by consumers, advertisers purchase wasted impressions: they reach the same consumer too many times. This has subtle effects on the equilibrium

1 Introduction

The issue of whether the Internet will destroy the news media is currently a big news topic. The news industry as a whole has seen large declines in advertising revenue, while traditional media has simultaneously faced increased competition for attention from new media (including web-only news, blogs and news aggregators). Policy-makers have expressed concerns that declining revenue per consumer as well as fragmentation in the media might undermine incentives to invest in quality journalism.

While new technologies and competition can often explain why revenue may be redistributed among industry players, the adverse impact of the Internet on the news media is widespread: industry-wide revenue has declined.[1] This represents an economic puzzle because, in many respects, the fundamental drivers of supply and demand appear to be as favorable for the industry if not more favorable than before. We argue that this is true despite assertions to the contrary in the popular press that advertising revenues are being destroyed by the Internet because of the flood of available advertising space. From the *New York Times*,

> *online ads sell at rates that are a fraction of those for print, for simple reasons*
>
> *inventory*
> *the onli*
> *(Rice, 2010)*

While there may be space for every advertiser on the Internet, those ads must still be viewed by an actual consumer. The attention of those consumers is still limited, and scarcity limits the

[1] According to the Newspaper Association of America (www.naa.org), since 2000 total advertising revenue earned by its member US newspapers declined by 57% in real terms to be around $27 billion in 2009. Much of this decline was in revenue from classifieds but total display advertising revenue fell around 40%. In contrast, circulation over the same period declined by 18%. Ad revenue as a share of GDP also declined by 60%. According to ComScore, total US display advertising revenue online was around $10 billion in 2010 which includes all sites and not just newspapers.

available advertising capacity. Since advertisers compete for scarce consumer attention, it is unlikely that the price of ads will go to zero.

It has been observed that internet-provided services (such as classified ads and movie listings) have displaced revenue streams from services that previously were provided by newspapers. However, the decline in advertising revenue is much larger than the loss due to classifieds.[2] Another change brought on by the Internet that could be considered as a problem for newspaper advertising revenues is that the Internet had created new types of advertising opportunities (e.g., internet search ads). However, observers and regulators have noted that these new forms of advertising are complements rather than substitutes for the kinds of advertising typically used by the news media.[3]

On the positive side of the equation, the Internet has enabled improved measurement of advertising performance and created new opportunities to improve the targeting of advertising to consumers (Evans, 2009).[4] Another change in fundamentals is that the delivery of content and advertising has become less costly.

side of the market when selling advertisers access to those consumers. Thus, advertising revenue reflects monopoly prices, independent of the number of outlets. Indeed, competition amongst media outlets in this model would lead to higher ad prices, as those outlets scale back levels of annoying advertising as they compete to attract consumers. In contrast to the predictions of the model, however, there is evidence that competition is associated with falling ad prices including mergers that increase them (Anderson, Foros and Kind, 2010).

Another prediction of the benchmark model is that ad revenue per consumer should equalize across outlets (that is, attention is worth the same regardless of where it is allocated); in contrast, there is evidence that larger outlets command a premium.[5] Finally, rather than welcome policy moves to require public broadcasters to raise revenue from ads rather than be subsidized,

> *Newspaper readers are better than Web visitors. Online readers are a notoriously fickle bunch, and apparently are getting more so by the day. Web visitors barely stick around, yet they are counted in broad traffic statistics as if they were the same as the reader who lingers over his Sunday paper. (Farhi, 2009)*

This reflects the proposition that the web enables consumers to more readily switch between outlets. In the offline world, consumers of print and other media would face some constraints in accessing news and other content from multiple sources. This is not to say that consumers literally allocated all of their attention to one outlet, but just that their ability to switch between outlets and bundle a variety of content was limited in comparison to their options today. Thus, while consumers may have spent 25 minutes reading the morning print newspaper, they may spend on average 90 seconds on a news website (Varian, 2010). This is not a reduction in the amount of consumption, but instead a reduction in ‗loyalty' to any one outlet. Web browsers make it easy for consumers to move between outlets while free access removes other constraints. But, going beyond this, intermediaries such as search engines, aggregators and social networks facilitate switching. Indeed, we examined empirically the news consumption patterns of several million internet users, and found that among users who consumed at least 10 news articles per week, the concentration of a user's consumption among different news outlets, as measured by a news consumption Herfindahl index, was strongly and negatively associated with the users' frequency of using Google news and Bing news.[7]

Second, consider the problem of imperfect tracking. We postulate that outlets have a superior ability to track the behavior of consumers within their outlets rather than between them.[8] When consumers are each loyal to a single outlet, imperfect tracking would not be an issue for

[7] See also Chiou and Tucker (2010) for additional evidence that news aggregators facilitate consumer switching between outlets.

[8] This is consistent with current practice (Edelman, 2010).

advertisers. To reach many consumers, advertisers could purchase impressions on a wide number of outlets (i.e., multi-home) and achieve those goals. However, when consumers switch between outlets, advertisers have a harder task. An advertiser who multi-homes will find that it impresses the same consumer more than once, potentially wasting expensive advertising.[9] Maximizing the –reach‖ of advertising now carries the additional cost of paying for wasted impressions. In contrast, an advertiser who single-homes will miss some proportion of consumers entirely.

We show that consumer switching and imperfect tracking together interact to generate an outcome whereby an increase in consumer switching (holding fixed the number of outlets and their market shares) leads to a reduction in impression prices, as advertisers are not willing to pay as much due to the potential waste. For similar reasons, increasing the number of outlets also reduces total advertising revenues. However, in the absence of switching, our model reduces to the standard media economics model, whereby outlets set monopoly prices to advertisers irrespective of the competition among outlets.

With only a few exceptions, the literature on two-sided markets assumes that each side of the market either fully single-homes or fully multi-homes.[10] While most models in the media economics literature assume that consumers single-home – that is, choose to allocate attention to only one outlet – there are some that have considered what happens when consumers multi-home. Gabszewicz and Wauthy (2004) and Anderson and Coate (2005) considered this but demonstrated that advertisers would all single-home in this case resulting in no change in overall advertising revenues.[11] Recently, Ambrus and Reisinger (2006) considered a model of

[9] Some advertisers target an optimal number of impressions per consumer that is greater than one. Imperfect tracking makes it difficult to target that optimal number of impressions, however, for concreteness in our model we

horizontally differentiated outlets whereby only some share of consumers multi-homed; specific

consumer switching, command a higher impression price than its rival. This is because the marginal advertiser who is a single-of fewer consumers.[15] Relatedly, we demonstrate that paywalls unilaterally imposed by an outlet can have the effect of reducing their positional advantage or giving their rivals a positional advantage in advertising markets. As a result, we identify additional competitive costs to outlets from introducing paywalls.

2 Model Set-up

We begin by setting out the fundamentals of consumer and advertiser demand and behavior that drive our model. These are the core elements that do not change as consumers face lower costs of switching between outlets. We then consider benchmarks before turning to the equilibrium outcome in the advertising market in the following section.

2.1 Consumer Attention and Advertiser Value

Consumers both allocate scarce attention to media consumption and are potential purchasers of products and can be matched with firms through advertising. Consumers are assumed to purchase products at a slower rate than they consume media; e.g., a consumer might purchase one soda in a day but have numerous opportunities to consume media over that same period of time. A sodaimpressed by a_i ads. Thus, Ta_i is the total (maximum possible) amount of *advertising inventory* introduced to the market by outlet i and it is achieved if a consumer visits that outlet for all T periods.[17]

An advertiser who puts an impression in front of a consumer in a period receives a value (strictly, the expected value of a lead), $v \quad [0,V]$.[18] v is the same for all consumers and independent of the number of consumers receiving an impression. The value to the advertiser does not increase if the same consumer sees more than one ad impression from a given advertiser. Advertisers are heterogeneous in their valuations, and the cumulative distribution function of advertiser valuations is $F(v)$.[19] If Ta_i is the total supply of consumer attention, and advertisers are ranked by value in terms of rationing of access to consumer attention, then the marginal advertiser, v_i, is defined by $1 \quad F(v_i) \quad Ta_i$. We restrict attention, therefore, to cases where $\max_i a_i \quad 1/T$ so there is an interior solution.

2.2 Outlet Demand and Advertising Inventory

How do consumers allocate attention to different media outlets? We assume that whenever a consumer has an opportunity to choose, outlet i is chosen with probability x_i. Thus, x_i is a measure of an outlet's intrinsic quality.[20] If a consumer chooses an outlet, $i \quad \{1,...,I\}$, and has no opportunity to switch thereafter, outlet i's advertising inventory would be $x_i a_i T$.

[17] If advertisers placed only a single ad on an outlet, Ta_i is also the maximum quantity of advertisers who could possibly reach an *individual* consumer that stays with outlet i for all periods.
[18] We assume that all advertising is equally effective regardless of the quantity, and we assume away consumer disutility of ads (cf: Anderson and Coate, 2005).
[19] An alternative specification might have advertisers desiring to reach a specific number of consumers (Athey and Gans, 2010) or a specific consumer type (Athey and Gans, 2010; Bergemann and Bonatti, 2010).
[20] In our baseline model it is exogenous, but in Section 5.1 we endogenize the quality

We assume, however, that an opportunity for a consumer to switch outlets arrives (independently) each period with probability, α.[21] For convenience, throughout this paper we assume that $T = 2$ so, in effect, there is, at most, a single opportunity to switch. Thus, the total expected amount of attention going to i is $x_i + x_i(1-\alpha) + x_i\alpha(1-x_i) + \alpha x_i x_i = 2x_i$. We let $D_i^l = x_i - \alpha x_i(1-x_i)$ denote the share of consumers loyal to i (i.e., single-homers) and $D_{ij}^s = 2\alpha x_i x_j$ denote the share consumers who switch between outlets i and j (i.e., multi-homers) in any given period. When there are no switching opportunities (i.e., $\alpha = 0$), $D_i^l = x_i$ and $D_{ij}^s = 0$ for all $\{i, j\}$. In this model, if outlets have asymmetric capacity, then different consumer "switching types" will generate different advertising capacities. Consumers loyal to an outlet i will generate $2a_i$ in advertising inventory while a consumer switching between outlets i and j will generate $a_i + a_j$ in advertising inventory.

2.3 Benchmark

Given this set-up, it is useful to consider an efficient outcome for the allocation of advertisers to consumers. A first-best allocation would ensure that highest value advertisers are allocated with priority to scarce advertising inventory. Let v_i denote the marginal advertiser allocated to consumers loyal to outlet i and let $v_{s,ij}$ denote the marginal advertiser allocated to consumers who switch between outlets i and j. An efficient allocation of advertisers to consumers involves allocating all advertisers with $v \geq v_i$ to outlet i's loyal consumers and those

[21] Here we treat this probability as independent of history (i.e., outlets a consumer may have visited earlier) or the future (i.e., outlets that they may visit later). In Section 5.2, below, we explore the implications of relaxing this assumption.

with $v \quad v_{s,ij}$ to those who switch between *i* and *j*. Thus, the marginal advertisers will be determined by: $2a_i \quad 1 \quad F(v_i)$ and $a_i \quad a_j \quad 1 \quad F(v_{s,ij})$.

A consumer who is loyal to outlet *i*, will generate $2a_i$ in advertising inventory. Advertisers will choose to advertise to a consumer so long as their value exceeds the impression price. Consequently, the price per impression to a single-homer on outlet *i*, p_i, will be determined by $1 - F(p_i) = 2a_i$ or $p_i = P(1-$. In contrast, a multi-homing consumer, switching between outlets *i* and *j*, generates $a_i \quad a_j$ units of advertising inventory and so the price per impression on them is determined by $1 - F(p_{ij}) = a_i + a_j$. Note that this is an efficient allocation of advertisers to consumer. Note also that if $a_i \quad a_j$, then $p_i \quad p_j \quad p_{ij}$ while if $a_i \quad a_j$, then $p_i \quad p_{ij} \quad p_j$.

In a given period, outlet *i* receives all of its loyal consumers, D_i^l, and half of the switchers between it and a given outlet *j*, D_{ij}^s. Given this specification, the producer surplus attributable to outlet *i*'s is: $_i \quad _{j \ i} P(a_i \quad a_j)a_i D_{ij}^s \quad P(2a_i)2a_i D_i^l$. From this, it is clear that outlet surplus is impacted upon by the type of consumers it attracts only if its ad capacities differ from other outlets. If $a_i \quad a$ for all *i*, then $_i \quad P(2a)a \quad _{j \ i} D_{ij}^s \quad D_i^l \quad 2x_i P(2a)a$. Note that these profits do not depend on the shares of loyal and switching customers.

3 Market Equilibrium

We now turn to consider the market equilibrium that arises when tracking is not perfect.

3.1 Tracking technologies

There are many possibilities when one considers imperfect tracking that treats internal and external tracking asymmetrically. For instance, one could image a technology that provided **perfect internal tracking**, whereby no consumer receives more than one impression from an advertiser on a given outlet. In t

$2D_1^l \quad D_2^l \quad \tfrac{3}{2}D^s$ impressions. Table 1 lists the expected advertiser surplus associated with various advertising purchases, (n_1, n_2) where n_i is the number of impressions purchased per customer on outlet i over the two attention periods. For simplicity, we have assumed that $D_1^l \quad D_2^l \quad D^l$ and that the impression price, p, is the same across both outlets.

Table 1

Advertiser Choice	**Expected Number of Impressions Purchased**	**Expected Reach**	**Expected Advertiser Surplus**
Single home: (1,0) or (0,1)	$D^l \quad \tfrac{1}{2}D^s \quad \tfrac{1}{2}$	$D^l \quad \tfrac{1}{2}D^s \quad \tfrac{1}{2}$	$(D^l \quad \tfrac{1}{2}D^s)(v \quad p)$
Intense single home: (2,0) or (0,2)	1	$D^l \quad D^s$	$(D^l \quad D^s)v \quad (2D^l \quad D^s)p$

Multi

loyals on another outlet but not wasting any impressions. On the other hand, it may decide to multi-home, and even go further, increasing the number of impressions across all outlets. This increases their number of wasted impressions in return for impressing a greater proportion of switchers.

Given the two period structure of attention, one might think that this dilemma could be resolved by *coordinating on a time period*. For instance, an advertiser could pay for impressions only in the first period across all outlets and none in the second. However, this would require that consumers were overlapping completely in time in terms of the reading habits.[26] There is nothing in the two period structure that requires such synchronization, and we find it unrealistic for online browsing. Consequently, we assume that coordination of impressions in a given period of time is not possible.[27]

3.2 Pure Single-Homing Consumers

To begin, it useful to assume – as does most of traditional media economics – that consumers are all loyal and single-home on a single outlet (e.g., Anderson and Coate, 2005); that is, where = 0. When there is no switching, outlets have a monopoly over access to a share of consumers and advertising pricing will reflect that.[28]

[26] In the context of coordinating attention, the Superbowl commands such a large share of attention at a given period of time that advertisers can be assured of impressing that share of consumers. Consequently, the coordination opportunity afforded by this may be a reason why ad space commands such high payments per viewer during that event. We explore a similar effect below.

[27] One might wonder whether a pay-per-click model of advertising would alleviate the advertiser‘s dilemma. The answer is no: whatever the payment model, displaying one advertisement necessarily displaces another. For this reason, most pay-per-click advertising networks charge advertisers a price per click that is inversely proportional to the click-through rate of the ad. Thus, the overall payment of the advertiser is –per impression‖—an ad that is not clicked on often (perhaps because it is wasted, if the advertiser multi-homes) has to pay a proportionally higher price per click to justify displacing another advertiser.

[28] Note that this is the usual assumption in many models of media competition. For example, Anderson and Coate (2005) assume that broadcasters compete for viewers and then are able to earn an advertising revenue, $R(a)$ per consumer contingent upon the number of ads shown to them.

To see this, recall our assumption that advertisers place the same marginal value per consumer on reaching any number of consumers. Given that there are no fixed costs of advertising with different outlets, an advertiser, *v*, will multi-home, advertising on any outlet whose impression price, p_i, is less than *v*.

Table 2: Advertiser Indifference Points

Choice	Additional expenditure	Value from additional reach	Indifferent advertiser $D^s \quad \frac{2}{3}$	Indifferent advertiser $D^s \quad \frac{2}{3}$
From (0,0) to (1,0)	$p/2$	$v(D^l \quad \frac{1}{2}D^s)$	$v_i \quad p$	$v_i \quad p$
From (1,0) to (1,1)	$p/2$	$v(D^l \quad \frac{1}{4}D^s)$	$v_{12} \quad \frac{2}{2 \quad D^s} p$	-
From (1,0) to (2,0)	$p/2$	$v\frac{1}{4}D^s$	-	$v_{ii} \quad \frac{1}{D^s} p$
From (1,1) or (2,0) to (2,1)	$p/2$	$v\frac{1}{4}D^s$ or $v\frac{1 \quad D^s}{2}$	$v_3 \quad \frac{2}{D^s} p$	$v_3 \quad \frac{2}{1 \quad D^s} p$

Note that no advertiser will choose a rate of 4 (intense multi-

$$_{i} \quad \begin{cases} \max \left(\dfrac{2a_i \quad (F(v_3) \quad F(v_{12}) \quad \tfrac{3}{2}(1 \quad F(v_3)))}{2a_i \quad (F(v_3) \quad F(v_{12}) \quad \tfrac{3}{2}(1 \quad F(v_3))) \quad 2a_j \quad (F(v_3) \quad F(v_{12}) \quad \tfrac{3}{2}(1 \quad F(v_3)))}, 0 \right) & \text{if } V \quad v_3 \\ \max \left(\dfrac{2a_i \quad (1 \quad F(v_{12}))}{2a_i \quad (1 \quad F(v_{12})) \quad 2a_j \quad (1 \quad F(v_{12}))}, 0 \right) & \phantom{\text{if }} V \quad v_3 \end{cases} \tag{2}$$

That is, $_i$ is outlet *i*'s spare capacity after sales to multi-homing advertisers and we assume that single-homers are allocated in equilibrium to each outlet according to their spare capacity (if any). Under symmetry, note that $_i \quad \tfrac{1}{2}$.

This allows us to prove our first proposition.

Proposition 1. *Outlet (and aggregate) demand is decreasing with D^s around $D^s \quad 0$.*

The proof is relatively straightforward. Note first, that as $D^s \quad 0$, v_3 . Thus, around $D^s \quad 0$, no advertiser chooses to purchase more than two impressions across outlets. Note also that at $D^s \quad 0$, $v_{12} \quad v_i \quad p$ and, total demand for an outlet, $q(p) \quad 1 \quad F(p)$. If $D^s \quad 0$ while $v_3 \quad V$, then $v_{12} \quad v_i \quad p$ and $q(p) \quad 1 \quad F(p) \quad \tfrac{1}{2} \quad F(v_{12}) \quad F(p)$. Thus, outlet demand falls; that is, for any given price, *p*, fewer impressions are purchased.

3.4 Switchers and Outlet Profit

We are now in a position to examine the impact of a greater share of switchers on outlet profit. To solve for the market equilibrium, each outlet's demand has to equal its supply. For an outlet, its total supply of advertising inventory is given by:

$$2a_i D_i^l \quad a_i D^s \tag{3}$$

It will often be convenient in what follows to express variables in a per customer basis. In this case, advertising inventory on outlet *i* is $2a_i$.

Given this supply, we now consider possible equilibrium allocations of advertisers to outlets. First, is it possible that $_1 \quad _2 \quad 0$ and there are only multi-homing advertisers in the market? For this to be an equilibrium, the willingness to pay of a multi-homing advertiser for an impression on an outlet must exceed the willingness to pay of a single-homing advertiser for an impression on an outlet. That is, the following two inequalities must hold:

$$(D_1^l \quad \tfrac{1}{4}D^s)v_{12} \quad (D_1^l \quad \tfrac{1}{2}D^s)p_1 \quad (D_1^l \quad \tfrac{1}{2}D^s)(v_1 \quad p_1) \tag{4}$$

$$(D_2^l \quad \tfrac{1}{4}D^s)v_{12} \quad (D_2^l \quad \tfrac{1}{2}D^s)p_2 \quad (D_2^l \quad \tfrac{1}{2}D^s)(v_2 \quad p_2) \tag{5}$$

Note that the marginal advertiser on each outlet would have to be a multi-homer and so $v_i \quad v_{12}$. Note also that because the ‗just excluded advertiser' (with value v_{12}) would be willing to pay that for a single impression on an outlet, $p_i \quad v_{12}$ for each outlet. It is clear that as goes to zero, the willingness to pay of the just excluded advertiser to single-home exceeds the willingness to pay of the marginal multi-homing advertiser for its marginal impression. That is, the LHS of (4) and (5) becomes negative w equilibrium will arise if $1 \quad F(V(1 \quad \frac{1}{2}D^s)) \quad 4a$. Note, however, that as D^s approaches 0, this equilibrium allocation cannot arise.

Using this, we can prove the following.

Proposition 2. *Equilibrium prices and profits are decreasing in* D^s *around* $D^s \quad 0$.

This directly follows from Proposition 1 and (3); that is, aggregate demand decreases while supply stays constant for each outlet. Intuitively, when there are switchers, as we move from no-switching, the marginal impression of a higher valued advertiser (on a second outlet) is out-bid by the first impression of the just excluded advertiser. Consequently, the marginal advertiser in the market is of lower value as D^s rises. Note also that this implies that the total number of advertisers purchasing impressions increases.

While Propositions 1 and 2 characterize changes in prices and profits as the number of switchers increases from $D^s \quad 0$, it is also the case that a greater number of switchers changes the composition of advertiser choices. In particular, an increase in D^s increases v_{12} (with marginal multi-homers becoming single-homers) and decreases v_3 (with high value multi-homers increasing their frequency on one outlet). Depending upon the rate

Figure One: Outlet Profits as a function of D^s ($a \quad 0.4$)

It is important to note, however, that the result that profits will rise with D^s relies on ad

constrained to be no greater than ¼, then that is the resulting equilibrium and no asymmetric outcome occurs.

3.6 Asymmetric outlets

Asymmetric capacity choices can lead to differential prices but do not confer absolute positional advantages on outlets. We now consider what happens when outlets have different content quality with one outlet being able to generate a higher readership share than the other; in particular, when $x_1 > x_2 \Rightarrow D_1^l > D_2^l$. In this case, we demonstrate that outlet 1 commands a positional advantage in the advertising market that leads to it being able to earn higher impression prices than outlet alongside having a higher readership share.

To see this, observe that, if there is sufficient capacity on both outlets, single homing advertisers will sort on to outlet 1 first. This is because, for a given *v*, if impression prices were the same on each outlet (equal to *p*) then $(D_1^l + \frac{1}{2}D^s)(v - p) > (D_2^l + \frac{1}{2}D^s)(v - p)$. However, as impression prices will differ in equilibrium (specifically, it must be the case that $p_1 > p_2$ if there are single homers on outlet 2), the marginal single-homer on outlet 1 will be given by $v_1 = \frac{2(D_2^l p_2 - D_1^l p_1) - D^s(p_2 - p_1)}{2(D_2^l - D_1^l)}$ while $v_2 = p_2$. Note that $v_1 - v_2 \propto (2D_1^l - D^s)(p_2 - p_1) > 0$.[34]

It is important to emphasize that it is the existence of switching consumers (i.e., $D^s > 0$) that generates this sorting. If there are no switchers, then the marginal advertiser on each outlet is competing with a multi-homing advertiser for their marginal impression. In this case, as there are no diminishing returns to additional impressions, a higher value multi-homing advertiser will outbid a smaller value single-homing advertiser for that slot. It is only when there are switchers

[34] Of course, there may be no single-homers on outlet 2 which will alter this intuition as we discuss below.

that single-homing advertisers – competing against one another – determine the impression price on an outlet.

Some set of advertisers will multi-home with one impression on each outlet. The marginal multi-homing advertiser will be determined by:

$$
\begin{aligned}
&(D_1^l \quad D_2^l \quad \tfrac{3}{4}D^s)v_{12} \quad (D_1^l \quad \tfrac{1}{2}D^s)p_1 \quad (D_2^l \quad \tfrac{1}{2}D^s)p_2 \\
&\max\ (D_1^l \quad \tfrac{1}{2}D^s)(v_{12} \quad p_1),(D_2^l \quad \tfrac{1}{2}D^s)(v_{12} \quad p_2)
\end{aligned} \tag{9}
$$

Note that if $p_1 \quad p_2$ or there are single-homers on outlet 1, then $(D_1^l \quad \tfrac{1}{2}D^s)(v_{12} \quad p_1) \quad (D_2^l \quad \tfrac{1}{2}D^s)(v_{12} \quad p_2)$ implying that $v_{12} \quad \frac{D_2^l \quad \frac{1}{2}D^s}{D_2^l \quad \frac{1}{4}D^s}p_2$. Of course, it is also possible that some advertisers will multi-home with 2 impressions on one outlet. Note that, in this case, the outlet receiving the additional impression will be outlet 2 as it has the smallest number of loyal consumers. Hence, $v_3 \quad \frac{2(2D_2^l \quad D^s)}{4(1 \quad D_2^l \quad D_1^l) \quad 3D^s}p_2$.

Given this, market clearing implies that the following equations (for each outlet) be simultaneously satisfied:

$$
\underbrace{1 \quad F(v_1)}_{\text{Demand for 1}} \quad 2a \tag{10}
$$

$$
\underbrace{2(1 \quad F(\min\{v_3,V\})) \quad F(\min\{v_3,V\}) \quad F(v_{12}) \quad F(v_1) \quad F(v_2)}_{\text{Demand for 2}} \quad 2a \tag{11}
$$

The following proposition characterizes the equilibrium outcome when ad capacities are symmetric. The derived profits are found by solving (10) and (11) for outlet prices and substituting them into outlet profits while checking to see what allocations of advertising choices these imply (in the same manner as those derived in Proposition 3).

Proposition 5. *Assume that F(.) is uniform on* [0,1], $a_1 \quad a_2 \quad a$ *and* $x_1 \quad x_2$.
equilibrium profits are as follows:

(i) *For* *or* $\frac{2 \; x_1 \; (2 \; x_1 \;)}{4 \; x_1 \; (2 \; x_1 \;)} \; a \; \frac{1}{2}$,

$_1 \; 2(1 \; a) \; x_1 \; \frac{4(3 \; 4a)(1 \; x_1)}{4 \; x_1 \; (2 \; x_1 \;)} \; 2a$ *and* $_2 \; x_2 \frac{x_1 \; (2 \; x_1 \;)}{4 \; x_1 \; (2 \; x_1 \;)}(3 \; 4a)2a$;

(ii) *For* $\frac{x_1}{8} \; a \; \frac{8 \; x_1 \; (8 \; x_1 \;)}{8(2 \; x_1 \;)}$, $_1 \; x_1 \frac{4}{4 \; x_1}(1 \; 2a)2a$ *and* $_2 \; x_2 \frac{2(2 \; x_1 \;)}{4 \; x_1}(1 \; 2a)2a$

(iii) *For* $\frac{x_1}{8} \; a$, $_1 \; x_1(1 \; \frac{2a}{x_1})2a$ *and* .

The asymmetric outlet case operates similarly to the symmetric outlet case but with an important difference: in general, the ‗larger' outlet in terms of readership share can command a premium for its ad space. This is a known puzzle in traditional media economics as it is usually thought that consumers are equally valuable regardless of the outlet they are on. Here, because ads are tracked more effectively internally, placing ads on the larger outlet only involves less expected waste than when you place ads on the other outlet or spread them across outlets. Hence, the larger outlet can command a premium.

However, we also find one exception to this pattern when (a,) are large (Proposition 5 (i)). In this case, outlet 2 is a more attractive outlet for high value advertisers who multi-home with an additional impression on one outlet. These advertisers out bid single homing advertisers on outlet 2. Hence, the lowest value advertisers reside, in that case, on outlet 1 that, in turn, implies that, in equilibrium,

4.2 The Impact of Mergers

The evaluation of mergers between media outlets has always posed some difficult issues for policy-makers. On the one hand, if it is accepted that outlets have a monopoly over access to their consumers, then such mergers are unlikely to reduce to competitive outcomes in advertising markets. On the other hand, it is argued that a merger may indeed reduce competitive outcomes in advertising markets, increasing ad revenue, and stimulating outlet‘s incentives to attract consumers. While a full delineation of these views is not possible here, the analysis thus far can speak to the question of whether a merger between outlets would reduce competitive outcomes (i.e., increase total revenue) on the advertising side of the media industry.

To begin, suppose that a merger between two outlets allows them to improve inter-outlet tracking. In this case, this will reduce the number of wasted and missed impressions in the advertising market. While impression prices would rise, so would allocative efficiency. As noted earlier, a move to perfect tracking will generate, for a fixed ad capacity, the first best outcome. Interestingly, by Proposition 6, it is not clear that outlets would choose to merge in order to facilitate this. While allocative efficiency may rise, total advertising profits could fall in cases where D^s and a are sufficiently high.

Alternatively, it may be that the technology is not readily available to improve inter-outlet tracking (even with common ownership). In this case, if the merged outlet charges a single price to advertisers on each outlet, the total ad revenue generated will be the same as the case where both outlets are separately owned. That follows because we have assumed that ad capacity is exogenous, so there is (by assumption) no mechanism for exercising market power: the number of outlets affects equilibrium outcomes only through the impact on tracking and thus the efficiency of advertising on multiple outlets. A full analysis of mergers would thus need to consider the extension of our model to endogenous capacity; something beyond the scope of the current paper.

Another constraint that joint ownership relaxes is on the contracting side. A single entity can discriminate between single-homers and multi-homers. To see this, suppose that, on each outlet, the monopoly owner can commit to an ad capacity allocated to multi-homers, a_m, and an ad capacity allocated to single homers, a_s. Price discrimination is achieved by charging all advertisers the same price for their first impression on one of the outlets and a different price for their second impression. Suppose also that no advertiser wants to purchase multiple impressions on one outlet and that outlet readership quality is symmetric. The price the outlet can charge multi-homers, p_m for their second impression and single-homers, p_s, for their single impression are determined by:

$$\text{and } a_s \quad \tfrac{1}{2}(v_{12} \quad v_i) \tag{12}$$

where it is assumed $F(v)$ is uniform on [0,1], $v_i \quad p_s$ and v_{12} is determined by: $v_{12} \quad \frac{2}{2 \quad D^s} p_m$ given the symmetric readership assumption. Solving for prices and substituting into the profit function, $(p_s \quad p_m)a_m \quad p_s a_s$, gives:

$$\tfrac{1}{4}\ (1 \quad 2 \qquad)(2 \qquad) \qquad \tfrac{12 \quad ^s}{2}(1 \qquad) \tag{13}$$

Maximizing with respect to and subject to $a_s \quad a_m \quad 2a$ yields:

$$\text{——} \text{ and } a_s \quad \frac{D^s}{2(4 \quad D^s)}(1 \quad 4a) \tag{14}$$

so long as $16a \quad D^s$.[36] Profits are: $\frac{64 \ (2 \quad ^s)(1 \ 2 \ ) \quad ^{s2}}{^{s2} \quad 32(4 \quad ^s)}$ which are greater than profits in the absence of price discrimination.

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[36] If this condition does not hold, the outlet would not choose to price discriminate.

Price discrimination allows the outlet to separate advertisers‘ types exploiting a sorting condition: higher types value attention relatively more. With differential prices comes a different allocation of attention. Specifically, note that, for a given D^s with no discrimination we achieve allocative efficiency; i.e., there is no way to re-allocate attention to different advertisers to increase total surplus. What the price discrimination analysis shows is that a monopoly will introduce a further allocative distortion. Although characterizing this –rent-extraction / allocative efficiency of user attention‖ trade-off is beyond the scope of this paper, we believe this issue is important and should be addressed at the level of merger control.

4.3 The Impact of Blogs and Public Broadcasting

One of the factors that traditional newspapers have argued are contributing to their decline is the rise of blogs and also competition from government-subsidized media. Both of those types of outlets have in common that they either do not accept advertising or accept very little of it. Somewhat in contradiction to this position, newspapers and television broadcasters have objected to plans to allow public broadcasters to sell advertisements rather than rely on subsidies. This latter objection remains a puzzle from the perspective of traditional media economics, because requiring competing public broadcasters to sell ads will cause more annoyance for their consumers and benefit other outlets. Here we explore the impact of competition from non-advertising media outlets.

$$D_{ib}^{s} \qquad x_b(1 \quad x_b) \tag{17}$$

Given this, we can prove the following:

Proposition 7. *For* $\quad 0$ *and exogenous* $a_1 \quad a_2$*, equilibrium impression prices are increasing in the popularity of the ad-free outlet,* x_b.

Intuitively, an increase in x_b has two effects. First, it decreases the effective supply of advertising capacity in the market. Because blog readers do not see advertisements, as attention is diverted to blogs, less attention is available for ads to be placed in front of. Second, unlike switchers between mainstream outlets, switchers between blogs and mainstream outlets do not contribute to the wasted impressions problem. Consequently, a greater share of blog readers increases the share of blog-mainstream switchers as well and so improves the efficiency of matching. This increases the demand for advertisements. These two effects – a decrease in supply and an increase in demand – combine to raise equilibrium impression prices. It is instructive to note that, even under perfect tracking, the supply-side effect remains and so impression prices would be expected to rise with blog readership share in that case too.

Nonetheless, in terms of the impact on overall outlet profits, the price effect of an increased blog share may not outweigh the quantity effect (in terms of lost readers). If it is the case that we are comparing a situation where one output sells advertising to one where it does not (absent any quantity changes in readership), then it is clear that advertising-selling outlets prefer the situation where its rival is prohibited from selling ads. This resolves the puzzle posed by traditional media economics.

5 Strategic Implications

We now examine the implications of our model for various strategies that might be pursued by media outlets.

5.1 Incentives to compete for readers

We now turn to examine a simple game designed to illustrate the incentives to compete for readers under imperfect tracking versus perfect tracking. We suppose that prior to consumers and advertisers making any choices, outlets can invest an amount, $c(\ _i)\ \ \frac{1}{2}\ \ _i^2$ which generates a probability $\ _i\ \ (0,1)$ of being a high rather than a low quality outlet. The probabilities are independent across outlets. Therefore, if outlets choose $(\ _1,\ \ _2)$ then with probability $\ _1(1\ \ \ _2)$ only outlet 1 has high quality and so $x_1\ \ x_2$ while with probability $\ _2(1\ \ \ _1)$ the reverse is true. With probability $\ _1\ _2\ \ (1\ \ \ _1)(1\ \ \ _2)$ both outlets have the same quality (high or low as the case may be) and $x_1\ \ x_2$.

Proposition 8. *For a given* x_i *achieved by a uniquely high quality outlet, the equilibrium level of* $_i$ *is higher under imperfect tracking than under perfect tracking so long as a is not too high.*

The proof involves a simple comparison of equilibrium quality choices and is omitted. The cost of being a low competing against a high quality outlet rises with the number of switchers. This differential creates a strong incentive to compete for a quality position.

5.2 Magnet content

The analysis thus

this situation, $D_f^l \quad 0$ and outlet *f* only has consumers who are switchers. Thus, while outlet 1 supplies ad capacity of $D_1^l 2a \quad D^s a$ into the market, outlet *f* only supplies $D^s a$.

The following table identifies the surplus to an advertiser with value *v* from pursuing different choices.

Advertiser Choice	**Frequency-Based Tracking**
Single home on 1, 1 impression	$(D_1^l \quad \frac{1}{2} D^s)(v \quad p_1)$
Single home on 1, 2 impressions	$(D_1^l \quad D^s)v \quad (2D_1^l \quad D^s)p_1$
Single home on	

to capture an additional $\frac{1}{4}D^s$ by purchasing an impression on outlet *f*, it will also want to do this by purchasing two additional impressions on outlet *f*.

This still leaves four choices that might be undertaken by advertisers. Importantly, as a low valued purchasers who now become the marginal advertisers in the market at a price of p_f. Consequently, $p_f \quad p_1$ but as x_f rises outlet 1's profit falls as does total profits from advertising in the industry. This changes when contrast, traditional, in-depth, news outlets such as Turner International, Fox Interactive and CBS Digital Attracted between 11 and 18 billion impressions.

5.3 Paywalls

Paywalls have been proposed as a means by which outlets with falling advertising revenue may restore profitability. Of course, there are several different types of paywalls that

on rivals in advertising markets as well as increasing their readership. These consequences may explain the low use of paywalls for online news media.

5.4 First Look versus Last Look Advertising

Thus far, we have modeled advertising markets with outlets offering a single and common product to all advertisers. While different tracking technologies altered the nature of the product offering, we did not consider multiple product offerings that would allow outlets to engage in price discrimination.

In this section, we explore one aspect of alternative products that might be offered; specifically, that advertisers bid separately for ‗first look' and ‗last look' consumers. A first look ad for a consumer is an ad placed in front of the consumer when they first visit an outlet. In contrast, a last look ad is one placed in front of consumers at the end of the relevant attention period. In the context of our model, a first look ad would be one consumers see in period 1 whereas a last look ad is one consumers see in period 2. It assumed here that outlets can track consumers perfectly and so distinguish, at any point of time, first and last (second) look consumers. Outlets offer advertisers the following deal: –over the two attention periods, we willthat a ɇ Ĭ

If it did this, their expected surplus would be $v \quad (D_1^l \quad D^s)\, p_{1st} \quad (D_2^l \quad D^s)\, p_{1st}$

predictions await thoughtful empirical testing but are thusfar consistent with stylized facts associated with the impact of the Internet on the newspaper industry.

While the model here has a wide set of predictions, extensions could deepen our understanding further.

In this situation, even if there are no switching consumers, advertisers on the general outlet will be paying for wasted impressions.

While this situation may be expected to generate outcomes similar to when readership shares are asymmetric, the effects can be subtle. A general outlet may have fewer consumers who are of value to advertisers but also may have a larger readership.[39] Also, when consumers switch between outlets, the switching behavior is information on those hidden characteristics. Thus, switching behavior may actually increase match efficiency. Consequently, the effects of tailored content, self-selection and incentives to adopt targeting technologies that overcome these are not clear and likely to be an area where future developments can be fruitful.

[39] Levin and Milgrom (2010) argue that targeting may be limited because it conflicts with goals of achieving market thickness (see also Athey and Gans, 2010).

This derivation assumes that $v_{12} \quad 1$. If this was not the case and if $p_1 \quad p_2$ then the market clearing conditions for the asymmetric equilibrium would become:

$$2a_1 \quad 1 \quad v_{12} \tag{29}$$

$$2a_2 \quad 2(1 \quad v_{12}) \quad v_{12} \quad v_2 \tag{30}$$

as only outlet 2 sells additional impressions to some multi-homers. Thus, outlet 1's price would remain as in (26) while outlet 2's pricing condition would satisfy (substituting v_{12} into (30)):

$$p_2 \quad \frac{2D^s}{2 \quad D^s}(1 \quad a_2) \tag{31}$$

This would be an equilibrium so long as $v_{12}(p_2) \quad 1$ or in addition to the ad capacity asymmetries as identified earlier. It is easy to confirm in this case that $p_1 \quad p_2$.

7.2 Proof of Proposition 6

When D^s is low, outlet 1's profits under no tracking are $\frac{2(2 \quad D^s)}{4 \quad D^s}(1 \quad (a_1 \quad a_2))a_1$ whereas outlet 1's profits under perfect tracking are . Profits under perfect tracking exceed those under no tracking if: $(a_1 \quad a_2)D^s(4 \quad D^s) \quad (1 \quad 2a_1)(4 \quad D^s) \quad 2(2 \quad D^s)(1 \quad (a_1 \quad a_2))$. With $a_1 \quad a_2$, this becomes: $D^s \quad 0$.

When D^s is high, outlet 1's profits under no tracking may be $\frac{D^s(2 \quad D^s)}{4 \quad D^s(2 \quad D^s)}(3 \quad 2(a_1 \quad a_2))a_1$. Comparing these to the profits under perfect tracking and imposing $a_1 \quad a_2 \quad a$, perfect tracking will yield higher profits if: $\frac{2(1 \quad 2a)}{1 \quad a} \quad D^s(2 \quad D^s)$. Examining the case where $D^s \quad \frac{1}{2}$, note that these profits will be an equilibrium if the equilibrium price they are based on $\frac{2(2 \quad D^s)}{4 \quad D^s}(1 \quad 2a)$ is less than ¼. That is, if $\frac{6}{7}(1 \quad 2a) \quad \frac{1}{4} \quad a \quad \frac{17}{48}$. At $D^s \quad \frac{1}{2}$, we have $\frac{2(1 \quad 2a)}{1 \quad a} \quad \frac{3}{4} \quad a \quad \frac{5}{13}$ so for $a \quad [\frac{17}{48}, \frac{5}{13}]$, perfect tracking yields superior profits but for $a \quad \frac{5}{13}$, profits are higher under no tracking.

Multi-home, 1 impression each	$(D_1^l \quad D_2^l \quad \frac{3}{4}D_{12}^s \quad \frac{1}{2}(D_{1b}^s \quad D_{2b}^s))v$ $p(D_1^l \quad D_2^l \quad D_{12}^s \quad \frac{1}{2}(D_{1b}^s \quad D_{2b}^s))$
Multi-home, 2 on *i* and 1 on *j*	$(D_i^l \quad D_j^l \quad D_{12}^s \quad D_{ib}^s \quad \frac{1}{2}D_{jb}^s)v$ $(2D_i^l \quad D_j^l \quad \frac{3}{2}D_{12}^s \quad D_{ib}^s \quad \frac{1}{2}D_{jb}^s)p$
Multi-home, 2 impressions on each	$(D_i^l \quad D_j^l \quad D_{12}^s \quad D_{ib}^s \quad D_{jb}^s)v$ $(2D_i^l \quad 2D_j^l \quad 2D_{12}^s \quad D_{ib}^s \quad D_{jb}^s)p$

The main difference between this case and the previous two outlet model is that some advertisers may choose to multi-home with two impressions on each outlet so as to impress a greater share D3(e)-1m it-3(e)4(h ing)8 tean er asn-8(ed)-11 rrsmautlet s. Ieand, sh-110y mm-3(e)4(t)-318y ,

7.4 Proof of Proposition 9

Case 1: . Suppose that $(D_1^l \quad \frac{1}{2}D^s)p_1 \quad D^s p_f$. Then consider a candidate equilibrium where high value advertisers sort as single-homers (2 impressions) on 1, then single-homers (2 impressions) on *f* and finally as single

$$p_1 \quad \frac{6D_1^l(1 \quad 2a) \quad D^s}{3(2D_1^l \quad D^s)} \tag{47}$$

$$p_f \quad \tfrac{2}{3} \quad a \tag{48}$$

(recalling that we assume that $a \quad \tfrac{1}{4}$). It is easy to demonstrate that $p_f \quad p_1$ and that $x \; 1 \quad (1 \quad \tfrac{1}{x})^n \quad x(1 \quad e^{\;n/x})$

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Farhi, P. 2010. –Build that Pay Wall High,‖ *American American*