Competition for advertisers and for viewers in media markets*

Simon P. Anderson[†], Øystein Foros[‡], and Hans Jarle Kind[§]

Abstract

Standard models of advertising-financed media assume consumers patronize a single media platform, precluding effective competition for advertisers. Such competition ensues if consumers multi-home. The principle of incremental pricing implies that multi-homing consumers are less valuable to platforms. Then entry of new platforms decreases ad prices, while a merger increases them, and ad-financed platforms may suffer if a public broadcaster carries ads. Steiner's tendency to duplicate popular genres is reduced; platforms may bias content against multi-homing consumers, especially if consumers highly value overlapping content and/or second impressions have low value.

JEL Classification: D11, D60, L13.
Keywords: media economics, incremental ad pricing, overlap, multi-homing, duplication principle, media bias, genre choice.

*Thanks to Charlie Murry for insightful discussion; to Stephen Bruestle and Markus Reisinger for very detailed comments; to Fabrizio Germano, Lisa George, Jacques Cremer, Laurent Linnemer, Mark Armstrong, Martin Peitz, and Nicolas Schutz for comments and discussion, as well as participants of the Hunter College Media conference, CEPR Bologna, CRESSE Corfu, and ICT Mannheim.

[†]University of Virginia: sa9w@virginia.edu
[‡]NHH Norwegian School of Economics: oystein.foros@nhh.no
[§]NHH Norwegian School of Economics: hans.kind@nhh.no

1 Introduction

The intent of this paper is to evaluate the role of multi-homing media consumers in the performance of media markets. We first demonstrate how some puzzles in the received wisdom on media economics can be resolved by allowing for multi-homing consumers, and we then consider the impact of multi-homing consumers on market-induced media bias in genre selection.

Standard media economics models (e.g. Anderson and Coate, 2005, and many subsequent papers) restrict media consumers to attend at most a single media platform. That is, they watch just one TV channel, listen to just one radio station, surf only one web-site, or read only one magazine or newspaper. This is termed "single-homing" in the two-sided markets literature. Advertisers place ads on all platforms (they "multi-home"), but are cornered by the fact that each platform has exclusive market power in delivering its own consumers. This is the "competitive bottleneck" problem of Armstrong (2002, 2006).

The assumption that consumers single-home effectively closes down price competition for advertisers. We introduce competition for advertisers among platforms by allowing consumers to multi-home as well. An ad on a platform enables an advertiser to access consumers who are exclusively on that platform, as well as getting extra impressions on consumers shared with other platforms. We develop and invoke a "principle of incremental pricing", which describes the equilibrium behavior whereby platforms extract the incremental revenue value to advertisers from placing an ad.[1]

[1] Spence (1976) makes a similar point for (perfectly) price-discriminating producers of differen-

Under incremental pricing, multi-homing consumers are typically less valuable than single-homing consumers for platforms. For this reason several (possibly) anomalous predictions from single-homing media economics models are reversed: ad-financed platforms may suffer when a public broadcaster carries ads, platform entry decreases ad prices, while a merger increases them. In contrast, with single-homing consumers, profits for private platforms increase if public broadcasters are allowed to air ads, ad prices per consumer increase with more platforms, and mergers reduce ad prices.[2]

To analyze platforms' choice of genre, we first revisit the classical contributions of Steiner (1952). We show that even ad-financed media firms will compete by delivering media genre diversity. This is in contrast to Steiner's (1952) classic duplication result. Competing media firms have incentives to become differentiated in order to attract exclusive media consumers.[3]

We then allow genre choice from a continuum of options, using a formal spatial model a la Hotelling (1929). Strikingly, a two-platform monopoly and competition give the same choices. The social optimum is inside these locations (closer to the midpoint) when second impressions have no value. With valuable second impressions,

tiated products. The incremental pricing principle leaves surplus on the table for advertisers when benefits are sub-additive across platforms.

[2]These results follow because competition is effectively for media consumers, given the competitive bottleneck, and the "price" to consumers is ad nuisance. Then ad levels follow the predictions of standard differentiated substitutes models for product prices. Results for ad prices follow from the inverse relation between advertiser demand price per consumer and advertising level. All of these results reverse if ads are instead a benefit to consumers. There is no effect if consumers are ad-neutral. See e.g. Anderson, Foros, Kind and Peitz (2012), who provide an informal discussion of the effects of allowing multi-homing consumers.

[3]By the same token, multi-homing consumers might mitigate the tendency to duplicate on what Beebe (1977) labelled the "Lowest Common Denominator" (LCD) genres. Beebe's idea is as follows. Suppose viewers have diverse first preferences, but all would watch a reality show if nothing else were available. Then a monopoly would just offer the reality show, which is the LCD program type in this example. However, competition for advertisers may induce media platforms to put more weight on the genre preferences of single-homing consumers at the expense of those who might multi-home.

the two-genre monopoly solution moves closer to the middle to pick up now-valuable multi-homing consumers. The neutrality-to-market-structure result prevails: a two-platform monopoly and competition give the same locations. A merger will thus not affect genre diversity, but equilibrium genre choices are too extreme if second impressions are not worth much or if consumers value a second genre a lot.

Note that the traditional way of overturning Steiner's and Hotelling's duplication outcome (in a world of single-homing) is to introduce "price" competition through ad nuisance for consumers. The equilibrium ad level is zero if the platforms choose exactly the same genre, but they can avoid this "Bertrand paradox" outcome by differentiating their profiles (Tirole, 1988, terms such incentives the "Principle of Differentiation"). To highlight that the mechanism in the present paper is different, and hinges on the incentives to attract exclusive consumers, we assume away ad nuisance when analyzing choice of genres. Introducing ad nuisance would not change the qualitative results. In a similar vein, we also abstract from direct pricing of media to consumers.

An incremental pricing model in a platform context was first deployed by Armstrong (2002). He uses the setup to show the existence of asymmetric equilibria in media markets when newspapers choose prices, and advertising competition is winner-take-all in a readership game.[4] Ambrus and Reisinger (2006) were the first to recognize that introducing multi-homing consumers could substantially alter the predictions of the single-homing model. They considered monopoly and duopoly with a specific consumer model. The ensuing analysis has possible multiple equilibria, and in some of these the advertising levels are higher under duopoly than under monopoly.

[4] Armstrong (2002) also shows that ad prices go to zero in a symmetric set-up as the number of papers gets large.

Then competing media firms would benefit from advertising caps, which some countries impose on commercial broadcasters. Ambrus, Calvano, and Reisinger (2013) (henceforth ACR) supersedes Ambrus and Reisinger (2006), and provides new insight by introducing correlation of consumer tastes (with the result that ads can go up or down with entry).

Athey, Calvano, and Gans (2013) (hereafter ACG) formulates a two-period duopoly model with (exogenous) consumer switching between periods in order to generate overlap of media consumers across platforms.[5] Their main contribution is to tabulate a large variety of tracking and targeting possibilities, and their framework has the advantage of allowing for heterogeneous advertiser demands. However, to deal with the platform interaction problem, they basically assume exogenous ad levels.[6] Their model is thus not configured to deal with the puzzles on which we focus in the first part of the paper. Finally, neither ACR nor ACG analyze market media bias in genre selection and how multi-homing consumers affect platforms' choice of genre.

The rest of the paper is organized as follows. The next section presents the simple model of competition for advertisers and emphasizes the incremental pricing principle as characterizing the unique equilibrium, and section 3 draws out the implications. In section 4 we extend Steiner (1952) to allow for multi-homing consumers. In section 5 we deploy a spatial model to emphasize how locations are polarized by overlapped consumers. Section 6 concludes.

[5] Anderson and Coate (2005, Section 7) provide a rudimentary two-period analysis of multi-homing media consumers who are ad-averse.

[6] They derive characterization results in the neighborhood of no multi-homing. Their Appendix considers endogenous ad capacity choices, and finds that there may be no pure-strategy equilibrium.

2 A simple incremental ad pricing model

There are n media platforms, $i = 1, .., n$. Each sets a price per advertisement included in its TV program, radio show, web-site, magazine, or newspaper, and including ads entails no direct cost to the platform. Consumers (readers, viewers, surfers, or listeners), choose either zero, one, or more platforms. The "more" option constitutes the crucial added element of the current analysis over the standard "single-homing" set-up. Each platform has a base of exclusive consumers and a base of consumers common with other platforms. Let x^i denote the *exclusive* consumers on platform i, and let s^i_j be the consumers i *shares* with j other platforms. As will become apparent, it does not matter in equilibrium with which other platforms they are shared. The *total* number of consumers on platform i is $x^i + \Sigma_{j=1}^{n-1} s^i_j$. We first treat the number of platforms chosen by the consumers as exogenous, and then extend to endogenous demand (without needing to impose a specific structure on demand).

Assume that the mass of advertisers is A, and that each advertiser is willing to pay b for a successful single contact with a consumer. Each consumer reached k times is worth $b\left(1 + \Sigma_{j=1}^{k-1}\sigma_j\right)$, with $\sigma_j \in [0, 1]$ and $\sigma_1 \geq \sigma_2.... \geq \sigma_{n-1}$, so that the $(j + 1)\, th$ incremental impression is worth a (non-increasing) fraction σ_j of the first impression. At some junctures we shall assume only a second impression has value, and for simplicity we will denote this as σ (which thus stands for σ_1).

For example, suppose there is an independent probability p that the ad on any given platform is registered by a consumer, and that a registered ad gives an expected pay-off to an advertiser of 1. Then $b = p$. An ad aired to the same consumer on another platform raises the chance the ad is registered by $(1 - p)\, p$, so that $\sigma_1 = (1 - p)$. An ad on a $(j + 1)$th such platform raises the chance by $(1 - p)^j\, p$, so $\sigma_j =$

$(1-p)^j$.[7]

In keeping with the literature, we assume that all consumers intrinsically are equally attractive to all advertisers, but that it is only the first impression on any given platform which has any value. Each advertiser puts at most one ad per platform, so the number of advertisers on a platform is the same as the number of ads there.[8] If only the number of impressions mattered (and not where they are framed), advertisers would simply place j ads on the same platform, with a total price of $b\left(1+\Sigma_{j=1}^{n-1}\sigma_j\right)x^i$ so we are back to the case where only exclusives count. Then, further impressions reaching any shared consumer on another platform would be worthless, and so basically the analysis is the same as the case $\sigma_j = 0$, modulo the renormalization of the per ad/per viewer price from b to $b\left(1+\Sigma_{j=1}^{n-1}\sigma_j\right)x^i$.[9]

All parameters in the game (b, A, n, the σ's, etc., along with the program types as subsumed into consumer demands when we treat those as endogenous) are known to all agents.

2.1 Incremental pricing

Incremental pricing here refers to pricing at the incremental value added to an advertiser's revenue from an ad on a platform, over the revenue the advertiser gets without that ad. Suppose for the moment that the number of consumers on each platform and their types (exclusive and common) is given.

[7] Another way to see this is to note that the chance of a hit with $j+1$ ads is $1-(1-p)^{j+1}$. So the incremental value of the $(j+1)$th ad is $b\sigma_j = \left(1-(1-p)^{j+1}\right) - \left(1-(1-p)^j\right) = p(1-p)^j$.

[8] ACR assume that a producer's marginal benefit of advertising its product on a given platform is strictly decreasing in the number of slots it buys. Other things equal, this implies that each producer will advertise on all available channels.

[9] E.g., when at most two impressions have value, a platform can charge a sum $b(1+\sigma)x^i$ for placing 2 ads.

The equilibrium outcome is surprisingly simple, even though platform best replies involve various different regimes, running the gamut from perfect substitutes through complements. We illustrate with a simple duopoly. Suppose $x_1 > x_2$ (so platform 1 has more exclusives). Let the number of common (shared) consumers be $s > 0$, and assume that the value of a second impression is zero ($\sigma = 0$). If advertisers had to make an exclusive choice (as per classic discrete choice models), then a Bertrand pricing equilibrium would yield a zero price for platform 2, while 1 charges $P_1 = b(x_1 - x_2)$, the value of its superiority. But, advertisers do not need to choose exclusively. However, for a high $P_2 \in (bx_2, b(x_2 + s)]$, the best reply $P_1 = b(x_1 - x_2) + P_2 - \varepsilon$ still involves undercutting of perfect substitutes.[10] Above the upper bound ($b(x_2 + s)$), 2 prices itself out of the market regardless of 1's action, and so 1 sets its monopoly price $P_1 = b(x_1 + s)$. For lower $P_2 < bx_2$, 2 best-reply prices at incremental value and will sell to all advertisers regardless of 1's action. Given that 2 necessarily has all advertisers on board, 1 can do no better than charge its incremental value $P_1 = bx_1$. Thus the reaction functions are flat (at incremental value) when the rival prices at its incremental value, and flat (at monopoly price) when the rival prices above its monopoly price, and entail undercutting (slope 1) in between. The unique equilibrium is thus incremental value pricing for both. The principle generalizes to more platforms and positive values of repeated impressions: the only equilibrium is for each platform to price at incremental value, $b\left(x^i + \Sigma_{j=1}^{n-1}\sigma_j s_j^i\right)$ to its $x^i + \Sigma_{j=1}^{n-1} s_j^i$ consumers.

Proposition 1 *(**Incremental Pricing I**) Assume that the number of exclusive and shared consumers are exogenously given on each platform. At the unique equilibrium, each platform charges its ad price equal to its incremental value.*

[10] We shall shortly see that the lower bound of this range, bx_2, is the incremental value.

Proof. Incremental pricing is an equilibrium because if each other platform k prices at $b\left(x^k + \Sigma_{j=1}^{n-1}\sigma_j s_j^k\right)$ per ad, then the best reply for any platform i is to price at its incremental value. Any higher price would attract no advertisers, while any lower price could be raised without losing any advertisers. To show uniqueness, first note that any equilibrium has all platforms active. Otherwise an inactive platform (at any allocation induced by ad prices) can surely do better by charging the value of its exclusive consumers. Given all platforms must be active at any candidate equilibrium, there can be no undercutting and all advertisers must be on each platform. If all advertisers are on each other platform, any platform i must be optimally charging its incremental value. This we already argued is an equilibrium for all to do so, and hence is the unique solution. ■

We next allow the numbers of consumers to be endogenously determined.

2.2 Incremental pricing equilibrium with endogenous viewership

Assume now that the consumer allocation depends on the ad levels (which equal the number of advertisers there) expected on platforms. Consumers may like or dislike ads individually or in aggregate; all we assume is that the consumer allocation is uniquely determined by (expected) ad levels.

The equilibrium concept is this. First, platforms set prices per ad, each one rationally anticipating the price per ad of the other platforms. Second, advertisers observe these prices, and then choose from which platform(s) to buy ads, anticipating viewer numbers and sharing patterns across platforms. Media consumers do not observe the ad prices, but rationally anticipate ad levels, and choose which platform(s) to join.

This assumption seems to be a reasonable description of many market interactions. Consumers rarely observe ad prices, and so they do not react if ad prices change. Instead, consumers just form expectations over ad levels. Thus, platforms cannot attract ad-averse viewers by committing to low ad levels (through high ad prices). The assumption that prices are set per ad reflects the idea that rates are set without conditioning on realized viewer numbers,[11] and that platforms simply choose a price for putting the ad in the magazine (say): think for example of newspapers charging a fixed price for a full-page ad. This does not mean that ad prices are independent of (predicted) consumer numbers! Indeed, as we shall see, larger consumer numbers will command larger ad prices (modulo the composition of consumer types between exclusives and shared).

For what follows, we shall write the number of exclusive consumers on platform i as $x^i(\mathbf{a})$ when consumers expect a vector $\mathbf{a}$ of ad levels on platforms, and we let $\mathbf{A}$ denote the vector with each element equal to A (the mass of advertisers). Likewise, let the number of consumers on platform i shared with j other platforms be $s_j^i(\mathbf{a})$ when consumers expect a vector $\mathbf{a}$ of ad levels on platforms, and $s_j^i(\mathbf{A})$ be the analogous number when all platforms choose A ads.

Proposition 2 ***(Incremental Pricing II)*** *There exists a unique equilibrium, at which each platform sets a price per ad of* $b\left(x^i(\mathbf{A}) + \Sigma_{j=1}^{n-1}\sigma_j s_j^i(\mathbf{A})\right)$, $i = 1, ..., n$. *Each advertiser places an ad on each platform. The number of media consumers in each category is* $x^i(\mathbf{A})$ *and* $s_j^i(\mathbf{A})$, $i = 1, ..., n$, $j = 2, ..., n-1$. *Thus each platform is able to price to advertisers only the value of its exclusive consumers plus the incremental*

[11] Although there are examples of contracts where there is some compensation for advertisers should actual consumer numbers fall short of predicted levels. NBC's Olympics contracts involved some provision for viewer numbers falling short of predictions.

value associated to the shared ones it delivers.

Proof. The result follows from the proof of Proposition 1 above that it is a unique equilibrium for each platform to set an ad price $b\left(x^{i}\left(\mathbf{a}\right)+\Sigma_{j=1}^{n-1}\sigma_{j}s_{j}^{i}\left(\mathbf{a}\right)\right)$ for any expectations of $\mathbf{a}$; all advertisers will then buy ads on i and therefore consumers must rationally expect that $\mathbf{a}=\mathbf{A}$. ■

This Proposition naturally extends the first one. Notice that if consumers are ad averse, then platforms could want to commit to ad levels below A. But they have no way to do so because consumers rationally expect they will ramp up ad levels to A for any given consumer allocation.[12] Clearly, it is not realistic that all advertisers are on all platforms (although one is struck by seeing the same advertisers appearing in similar media, e.g. Time and Newsweek when it was still available). We make the strong assumptions that consumer attractiveness to advertisers is uncorrelated with consumers' preferred platforms, and that all advertisers have the same values for contacts (the b's and σ's). This way we most starkly demonstrate how competition for advertisers under multihoming dramatically changes equilibrium outcomes. In an extension paper (Anderson, Foros, and Kind, 2014, work in progress) we introduce heterogeneity of advertisers' willingness-to-pay for consumers, applying the duopoly vertical differentiation model drawn from Gabszewicz and Wauthy (2003).[13] We show that multi-homing on both side of the market may arise, with an asymmetric equilibrium where one platform attracts a larger audience than its rival, even though the firms are intrinsically identical. In equilibrium, different advertisers will buy ad space on different platforms.

[12] Note that advertisers are actually indifferent about placing their ads given all their incremental surplus is extracted. However, it cannot be an equilibrium for some not to be present on all platforms: any platform in such a situation would just drop its ad price to ensure full participation.

[13] We do not allow for endogenous choice of genre.

3 Implications of incremental pricing

We here look at three cases where allowing for multi-homing gives very different predictions from the (benchmark) single-homing model. For simplicity, assume for this section that $\sigma_j = 0$ for $j > 1$ so that impressions beyond the first incremental one have no extra value, and call σ_1 simply σ. In this case, any consumer shared with more than one other platform will have no market value. Accordingly, let s^i ($=s_1^i$ in the earlier notation) denote the number of consumers platform i shares with just one other platform; where pertinent, let s^{ik} ($=s^{ki}$) be the number of consumers common to only platforms i and k. The arguments generalize quite easily to when more than two impressions are valuable.

3.1 Public broadcaster

One puzzle for the single-homing model is that it predicts that a commercial ad-financed TV channel prefers that a public broadcaster carries ads in its programs.[14] This is inconsistent with the fact that ad-financed platforms typically lobby against removing advertising restrictions on public broadcasters. But when consumers multi-home, allowing the public broadcaster to air commercials necessarily introduces competition between the broadcasters in the ad market. Consider the case of $n-1$ private ad-financed platforms and one public one, label it n. At the outset the public broadcaster is not allowed to air ads. Private broadcaster i can charge b for its $(x^i + s^{in})$ consumers not viewed on any other private platform, because the overlapped ones cannot be reached by ads through the public platform, plus $b\sigma$ for the $\Sigma_{k\neq\{i,n\}} s^{ik}$

[14] If ads are desirable to consumers, the opposite prediction holds, but it is difficult to imagine TV ads are valued more than programming.

shared with the other private ones. Now let the public platform air ads, and let it behave competitively in the advertising market. Assume first that consumer numbers are unchanged. In equilibrium, incremental pricing implies an ad price for each platform of $b\left(x^i + \sigma \Sigma_{k \neq i} s^{ik}\right)$. The private platform now charges less overall (if $\sigma < 1$) because it has lost the exclusive ability to deliver the s^{in} consumers to advertisers, and is therefore worse off. The argument readily extends to valuable impressions beyond the second: consumers are "downshifted" into less valuable categories once they are shared with another active player (the public platform).[15]

Proposition 3 *Assume that consumer allocations are exogenous. Then commercial platforms' profits fall if a public platform is allowed to carry ads.*

This result is opposite from the conventional wisdom from the single-homing consumer model, but is consistent with the opposition that private broadcasters in the UK, France and Germany show against proposals to allow (more) ads in public channels (as already noted by Ambrus and Reisinger, 2006), but breaks with the predictions in most of the traditional literature on media economics. ACG resolve the puzzle nicely by assuming that viewers must allocate a fixed amount of viewing time across the available TV channels. If the public TV channel has no commercials, the advertisers' ability to reach the viewers is thus more limited. This increases the advertising price. Interestingly, Reisinger (2012) finds a similar result in a setting where he supposes that both advertisers and consumers single-home.

[15] In this case, when the public broadcaster airs no ads, private platform i's profit is $\pi_i = b\left(\tilde{x}^i + \Sigma_{j=1}^{n-2} \sigma_j \tilde{s}_j^i\right) A$, $i = 1, ..., n-1$, where $\tilde{s}_j^i$ denotes the number of consumers i shares with j other private firms, and $\tilde{x}^i$ denotes the number of i's exclusives, counting in that group any shared just with the public platform. When platform n airs ads, private platform i's profit falls to $\pi_i = b\left(x^i + \Sigma_{j=1}^{n-1} \sigma_j s_j^i\right) A$, where $\tilde{x}^i \geq x^i$, etc., so incremental values are reduced.

Consider now the impact of endogenous consumer choice. As we show, doing so allows commercial platforms' profits to rise or fall depending on the number of consumers gained and the value of overlap. For clarity, suppose there is but one private platform (1). We denote old (O) as the case where the public channel is banned from airing ads, and new (N) as the outcome where it is allowed to do so. Suppose that $x_N^1 + s_N^1 > x_0^1 + s_0^1$, so 1's viewer base expands because of ad nuisance on 2.[16] The private platform, 1, is better off with no ads on platform 2 (the Old situation) if $x_0^1 + s_0^1 > x_N^1 + \sigma s_N^1$. In the classic single-homing consumers case this does not hold because $s_0^1 = s_N^1 = 0$ and $x_0^1 < x_N^1$ when consumers lost from 2 are picked up by 1. We then have the "puzzle" that the private platform likes it when the public platform, 2, carries ads. Multi-homing may reverse this (platform 1 prefers the Old situation) if σ is small enough and 1 does not pick up many consumers. As an illustration, this happens if $\sigma = 0$ and $x_0^1 + s_0^1 > x_N^1$, i.e., if the shared base was large enough and not too many exclusives are gained. Thus either case can happen, with a profit decrease more likely the smaller the value of overlaps.

3.2 Merger

Next consider a merger between two private platforms, 1 and 2, from n platforms. First consider exogenous consumer allocations. The ad price prior to merger is $b\left(x^i + \sigma s^i\right)$ where s^i is the number of shared consumers for platform i. A merged entity can charge a price for access to the consumers of both platforms of $b(x^1 + x^2 + \sigma s^1 + \sigma s^2 + (1-\sigma)\, s^{12})$ where s^{12} is the number shared between the two merging platforms. To see that this is the unique equilibrium, note that this is the incre-

[16] This holds, for example, in a discrete choice model enhanced to include choices of several options, such as in Gentzkow (2007).

mental value accruing to the merged entity, and that the other platforms continue to charge their incremental values. The post-merger outcome yields a higher price per ad and strictly more profits for $(1-\sigma)\,s^{12} > 0$ (so, for $s^{12} > 0$ and $\sigma < 1$): the overlap is converted from being priced at individual incremental value to joint incremental value. After merger, the combined entity can fully charge for the overlapped consumers between the two platforms that are exclusive to that pair. The argument extends readily to the case when the consumer allocation is endogenous. Quite simply, A ads are aired on each platform, and so the consumer allocation is unaffected by the merger.

Proposition 4 *A merger between platforms strictly increases advertising prices when they have some overlapping consumers.*

Higher prices here contrast with lower prices predicted by the standard benchmark model. An alternative way of seeing the benefits of a merger (to the participants) is as follows. Take the simple case when only exclusive consumers are valued ($\sigma = 0$). The number of exclusives is "super-additive" in the sense that the number of exclusive consumers reached under merger is greater than the sum of exclusive consumers *prior* to the merger. This super-additivity gives rise to a motive to merge even in the absence of consumer price effects.

3.3 Platform entry

Finally, consider increasing the number of platforms. We show that the ad price $P^i = b(x^i(A) + \sigma s^i(A))$ goes down with entry if $x^i(A)$ and $x^i(A) + s^i(A)$ go down (as might be expected when consumers are ad-averse: exclusive consumers are lost and not offset by more shareds). Let a subscript O denote the old viewer number, and an N denote a new (post-entry) one. Then $P_N^i < P_O^i$ as $(x_O^i + \sigma s_O^i) > (x_N^i + \sigma s_N^i)$, which clearly holds if both $x^i(A)$ and $s^i(A)$ go down. So consider $s^i(A)$ going up. We wish to show that $(x_O^i + s_O^i - (1-\sigma)\, s_O^i) > (x_N^i + s_N^i - (1-\sigma)\, s_N^i)$: this must hold because $s_N^i > s_O^i$ (and $\sigma < 1$).

We next show that the ad price per viewer goes down as long as the number of shared consumers does not go down proportionately more than does the number of exclusives.[17] We wish to show that

$$\frac{x_O^i + \sigma s_O^i}{x_O^i + s_O^i} > \frac{x_N^i + \sigma s_N^i}{x_N^i + s_N^i}, \text{ or } \frac{x_O^i}{x_N^i} > \frac{s_O^i}{s_N^i}.$$

It therefore suffices that the number of exclusives goes down, and the number of shared viewers does not rise. More keenly, rewriting the last condition as $\frac{\Delta_s}{s_O^i} > \frac{\Delta_x}{x_O^i}$, where $\Delta_s = s_N^i - s_O^i$, etc., we have the result claimed:

Proposition 5 *Suppose that $x^i(\mathbf{A})$ and $x^i(\mathbf{A})+s^i(\mathbf{A})$ both decrease with entry. Then entry decreases the price per ad. Moreover, the price per ad per consumer decreases if the number of shared consumers goes up with entry or if it falls proportionately less than does the number of exclusives.*

ACR analyze the obverse facet, namely how entry affects an incumbent's advertising level. One interesting result in ACR is that the advertising level might increase. This hinges on the fact that a monopoly platform which increases its advertising volume by definition loses only exclusive viewers, while a platform which faces competition loses both exclusive and non-exclusive viewers. The latter have a relatively

[17] Armstrong (2006, p.669) also draws the distinction between price per ad and price per ad per consumer.

low value in the advertising market. Other things equal, this means that it is relatively more expensive for a monopoly to lose viewers than for a duopolist. ACR use this insight to explain why CNN increased its advertising volume subsequent to the entry of Fox News; it had little to gain from upholding its "low" monopoly advertising volume to maintain a large audience, because a large share of these would be low-value multi-homers.[18]

4 Competition for advertisers and genre selection

The classic Steiner (1952) work underscored duplication in program format offerings. To take a simple example, suppose that 70% of readers will only read sports (segment A), and 30% will only read news coverage (segment B). If there are only two magazines, both will offer sports and the other readers will be left unserved. We invoke the symmetry assumption in Steiner (1952) that readers are shared equally if there are two platforms in the same segment. Hence duplication (and an unserved minority) prevails as long as

$$v_A/2 > v_B, \tag{1}$$

where v_i is the readership in segment $i = A, B$. The example exemplifies the concept of "preference externalities" termed and documented by Waldfogel (2009): majority tastes override minority ones in a market-place of few alternatives.

Now suppose that a fraction s of consumers multi-home, and assume that they

[18] ACR argue that viewer preferences for the programs broadcast by CNN and FOX are negatively correlated, while viewer preferences across e.g. sports channels are positively correlated. A sports channel which increases its advertising level might therefore lose exclusive viewers, just as in a standard single-homing context, implying that entry reduces the ad volume. Their empirical evidence is consistent with this prediction.

multi-home in the same segment in which content is duplicated: country-music aficionados are not likely to listen to opera, although they might listen to more than one country station if two country stations are broadcast. Assume that such multi-homers are worth nothing due to incremental ad pricing (i.e., $\sigma = 0$). Then duplicating on the top segment nets $v_A (1-s)/2$ exclusive consumers. Duplication is only profitable if $v_A (1-s)/2 > v_B$, so a larger s reduces the likelihood of wasteful duplication. Thus multi-homing can improve the resource allocation.

This benefit is muted when second impressions are valuable. If they are worth $\sigma \leq 1$ of a first impression, then duplication arises if[19]

$$v_A (1-s)/2 + \sigma s v_A > v_B, \tag{2}$$

where the LHS is the incremental value of the second platform, namely its exclusives plus the σ-weighted value of shareds (up to the constant b).[20] Suppose that (1) holds but not (2), so that

$$v_A \left(\frac{1 - s(1-2\sigma)}{2} \right) \leq v_B < \frac{v_A}{2}. \tag{3}$$

[19] We are assuming that there is no price discrimination over different consumer groups: platforms cannot track which consumers multi-home. As we here show, the ability to track consumers makes no difference to the outcome. So consider then (briefly) the case when individual viewers can be tracked and competed for individually. Then each shared viewer is priced at her incremental value, σb, and exclusives are priced as before at b. Hence the outcome is just the same as buying a bundle of viewers.

[20] A slower derivation of the equilibrium ad prices when there are 2 channels in a segment follows. Each channel delivers a fraction $\frac{1-s}{2}$ of the viewers exclusively, and s shared viewers, for a total of $\frac{1+s}{2}$. These are worth b each for an advertiser buying an ad on only one channel. Buying ads on both channels nets $1-s$ exclusives (single impressions) worth b each, plus s shared worth $b(1+\sigma)$ each, for a total value of $b(1-s) + b(1+\sigma)s = b(1+\sigma s)$. The incremental value, i.e., $b(1+\sigma s) - b\left(\frac{1+s}{2}\right) = b\left(\frac{1-s}{2} + \sigma s\right)$, is the ad price per (undiscriminated) viewer – the ad price is this times v_A, as used above. Note that the price is below b unless $\sigma = 1$ AND $s = 1$.

In this case, duplication arises under single-homing (the classical Steiner result) but not under multi-homing.[21] A necessary condition for duplication to be less likely under multi-homing is therefore that $s(1-2\sigma) \geq 0$. Inspection of (3) yields:

Proposition 6 *The likelihood of duplication under competition is increasing in σ, and increasing in s if $\sigma < 1/2$. If $s > 0$ and $\sigma < 1/2$ duplication is less likely when consumers multi-home.*

If $\sigma > 1/2$, then a consumer is worth more from two second impressions than one exclusive first one. In that case, multi-homing actually increases the likelihood of duplication. Otherwise, it takes the pressure off Waldfogel's tyranny of the majority.

Consider now a merger which results in a monopolist with two platforms. A two-platform monopolist faces a much smaller incremental value entering segment A than does a competitor. The only extra value it gets is the value of the second impressions on the multi-homing consumers, namely $\sigma s v_A$, which is below the competitive incentive (unless $s = 1$) because of business stealing under competition (conversion of some consumers to exclusives). Hence, a two-platform monopolist will duplicate if

$$\sigma > (b/s)(v_b/v_A)$$

Thus, the monopoly has a greater propensity than competing firms to serve both segments, but weaker incentives than in the original Steiner analysis.[22]

[21] Under free-entry, the second market gets served if entry cost is less than bv_B. Then the problem of duplication is in wasting fixed costs, modulated by a counteracting social benefit from multiple impressions. Of course, there may also be some benefit to diversity within a segment, but we close that down here: see Section 5 for a development.

[22] Beebe (1977) extended Steiner's (1952) model to allow consumers to have second (or third, etc.) preferences. The idea is that consumers will consume a second preference if the first is not available,

5 A spatial competition model with genre selection

To gain more insight into the question of how multihoming consumers might affect the choice of genres, we extend the Steiner analysis to allow for a continuum of genre options. We do so by using an augmented Hotelling model with two platforms. Consumer ideal points are distributed on $[0,1]$ according to a quasi-concave density function $f(\cdot)$, which is symmetric about $1/2$, with cumulative distribution $F(\cdot)$. Remarkably, we find that with multihoming consumers, the genre choices are independent of whether the platforms compete or merge. A second result is that because platforms are interested in chasing exclusive consumers, the majority may be poorly served when they overlap platforms.

5.1 Single-homing consumers

Consider first the standard assumption of single-homing consumers (no multi-homing). Let the surplus of a consumer with ideal point at z be $R - t|z - z_i|$ when consuming media product (genre) $i = 1, 2$ located at z_i. Assume that the market is not fully covered ($R < t/4$ suffices), and let $z_2 \geq 1/2$. When the inter-platform interval is covered, platform 1 serves consumers up to $\frac{z_1+z_2}{2}$, and the left-most point it serves is $z_1 - \frac{R}{t}$. Thus, its profit is $\pi_1 = b\left[F\left(\frac{z_1+z_2}{2}\right) - F\left(z_1 - \frac{R}{t}\right)\right]$. Platform 1's location derivative (for $z_1 < z_2$) is consequently $\frac{b}{2}f\left(\frac{z_1+z_2}{2}\right) - bf\left(z_1 - \frac{R}{t}\right)$. Equilibrium loca-

but otherwise the framework is like Steiner's. Beebe's main point is that a monopoly platform might provide content that no consumer likes most, but will attend if nothing else is available – Lowest Common Denominator (LCD) programming. In an earlier version of this paper we show that the presence of multi-homing consumers may mitigate LCD duplication. Exclusive consumers' tastes will be strongly represented in platforms' offerings, while multi-homing consumers' preferences will be under-weighted.

tions consequently entail Minimum Differentiation if $f(1/2) > 2f\left(\frac{1}{2} - \frac{R}{t}\right)$, i.e., when the density is steep enough. Otherwise, setting $z_2 = 1 - z_1$ yields a symmetric interior solution at which

$$\frac{1}{2} f\left(\frac{1}{2}\right) - f\left(z_1 - \frac{R}{t}\right) = 0, \tag{4}$$

which implicitly determines platform 1's location at a symmetric equilibrium. Each platform trades off picking up half a unit of market length worth the value of the number of consumers at the market mid-point with losing a unit of length worth the number of consumers on its outside. The lower the "transport" costs and the greater the consumers' reservation price (R), the closer will the platforms locate.

At the duopoly equilibrium, (4), consumers at the mid-point obtain a strictly positive surplus. This cannot be optimal for a monopoly operating two platforms. It will instead locate to cover the maximal market each side of the mid-point (i.e., at $z_1 = \frac{1}{2} - R/t$, yielding zero consumer surplus at $z = 1/2$). These locations are thus *further apart than under competition*, as the monopolist internalizes business-stealing on its sibling genre.

5.2 Multi-homing consumers

We now introduce the multi-homing option for consumers. The more preferred genre for a consumer is the closer one. Suppose that the incremental consumer surplus from adding the less preferred genre is $(R - t|z - z_i|)\alpha$ where $\alpha \in [0, 1]$. This formulation is motivated in Anderson, Foros, and Kind (2013)[23]: loosely, α is the discount to

[23] Anderson, Foros and Kind (2013) allow for multi-homing consumers in a traditional Hotelling market structure. There is no advertising - the model has no two-sided market structure.

surplus of consuming a second (less preferred) platform.[24]

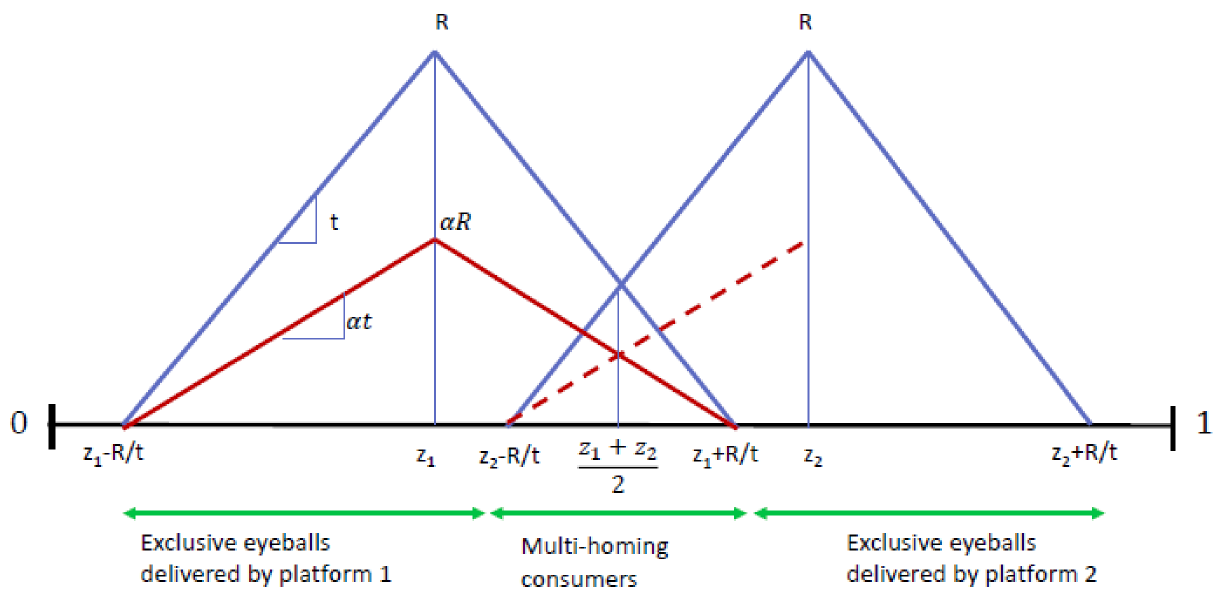

Figure 1: Multi-homing consumers

Figure 1 shows the valuations for first choices as the upper triangles. The lower triangles show the incremental surplus from a second option. The overlap region is where both the first and second surpluses are positive (the first choice is always the closer media platform).

Suppose first that $\sigma = 0$. Then overlapped consumers are worthless, and so platforms avoid picking up *any* of them by locating far enough away from the rival that there are *no* overlapped consumers. That is, equilibrium locations satisfy $z_1 + 2\frac{R}{t} = z_2$.

[24]The discount reflects overlapping story content in the magazine/newspaper example. Thus a consumer never consumes two units of the same magazine (because then $\alpha = 0$). Ambrus and Reisinger (2006) use a somewhat similar construct. Peitz and Valletti (2008) provide an appealing alternative framework for modeling multi-homing.

Under symmetry, then $z_1 = \frac{1}{2} - \frac{R}{t}$, which is the same as for a two-platform monopoly.[25] The reason is as follows. A two-platform monopoly wants the largest market base, so it ensures that the middle consumer is indifferent between consuming and not. Hence, it sets up R/t from the center. Competition is the same because moving in just picks up worthless multi-homers, while losing valuable single-homing consumers on the outside. *The equivalence of market structures is a striking difference from the Steiner analysis.* Another key difference is that the most popular tastes (at the market center) garner no surplus. Far from overserving the most popular preferences (the Steiner result), here they are neglected. Instead, the intermediate taste types do best, while the minorities in the far wings are still unserved. Finally, the social optimum locations are closer in than the equilibrium ones because social welfare adds consumer surplus to (joint monopoly) profits, and consumer surplus is locally increasing as locations move toward the center. In summary:

Proposition 7 *Consider a Hotelling model with quasi-concave symmetric consumer density and endogenous multi-homing. If a second impression has no value ($\sigma = 0$), then competing platforms as well as a two-platform monopoly locate at $(z_1, z_2) = \left(\frac{1}{2} - \frac{R}{t}, \frac{1}{2} + \frac{R}{t}\right)$. No consumer multi-homes in equilibrium, and the consumer at the market center gets no surplus.*

As we show next, for $\sigma \in (0, 1)$, the equilibrium locations are unique, and converge as σ rises. This is the interesting case, as platforms get close enough that there are multi-homing consumers. Platform 1's left-most consumer, when interior, is as above. But its furthest (right-most) consumer is given by applying its analogous "monopoly"

[25] There are also asymmetric location equilibria satisfying $z_1 + 2\frac{\tilde{R}}{\tilde{t}} = z_2$ for $\sigma = 0$. However, symmetric locations constitute the unique equilibrium for $\sigma > 0$.

condition using the marginal consumer's incremental value from adding 1. Similarly, its first (left-most) overlapped consumer is given by applying its *rival's* monopoly condition using incremental values! Pulling this together, platform 1's problem is to maximize $\pi_1 = b\left(\sigma\left(F\left(z_1 + \frac{R}{t}\right) - F\left(z_2 - \frac{R}{t}\right)\right) + F\left(z_2 - \frac{R}{t}\right) - F\left(z_1 - \frac{R}{t}\right)\right)$. See Figure 1. Setting the locational profit derivative to zero gives

$$b\sigma f\left(z_1 + \frac{R}{t}\right) - bf\left(z_1 - \frac{R}{t}\right) = 0.$$

Compared to the single-homing case, the second term is the same (because it is on the margin between monopoly and not participating).[26] The first term is quite different: the problem has reduced to an (asymmetric) monopoly problem because the multi-homing decision is incremental and has obliterated the margin between single-homers.

The larger the value σ of a multi-homing consumer, the larger the weight given to the inside margin. The solution is independent of the other firm's location: it increases in σ and only attains the center (minimum differentiation) for $\sigma = 1$. Intuitively, given multi-homing of consumers, the marginal profit of moving towards the rival is independent of its location; only the gain from attracting extra multi-homers compared to the cost of losing some exclusives matters. Though the co-location at $\sigma = 1$ may look like traditional minimum differentiation, it is for quite non-standard reasons. The two platforms are in the middle of the market because this is each one's monopoly position!

We next substantiate the claim that a two-platform monopoly has the same outcome as under competition. This might seem surprising, since the value of a multi-

[26] The second derivative is negative (for all $z_1 < 1/2$) as long as $f(\cdot)$ is concave, which condition therefore suffices for a concave profit function – this condition is used below.

homer for a monopoly is $(1+\sigma)b$ while it is only σb for a competing firm. However, the benefit for a monopoly of turning an exclusive into a multi-homer is σb, which is equivalent to the value of a multi-homer for duopolist. The first-order conditions are thus the same in the two cases, so we have the same result. Summing up:

Proposition 8 *Consider a Hotelling model with quasi-concave symmetric consumer density and endogenous multi-homing. Equilibrium platform positions are independent of market structure (monopoly or competition). Platform positions are independent of α, and get closer the higher is σ. The platforms minimally differentiate iff $\sigma = 1$.*

As regards the social optimum, it remains *inside* the equilibrium as long as the benefit from a second platform is large enough. This contrasts with the usual single-homing result of insufficient differentiation. To find the social optimum relative to the equilibrium, we need to find the consumer surplus derivative from moving closer to the middle. This is the change in total transport cost,[27] which, under symmetry (so the median consumer is half-way between the platforms) is

$$-\left(F\left(z_1\right)-F\left(z_1-\frac{R}{t}\right)\right)+\left(\frac{1}{2}-F\left(z_1\right)\right)+\alpha\left(F\left(z_1+\frac{R}{t}\right)-\frac{1}{2}\right).$$

The first term here is the loss in getting further from the consumers on the outside; the middle term is the gain getting closer to those on the inside who have 1 as their more preferred platform; the last term is the gain for getting closer to those with 1 as

[27] Changes in the active consumer support can be ignored because marginal consumers get zero surplus; likewise, switchers between single- and multi-homing get the same surplus from each option at the margin.

the less-preferred platform (so they are attributed a transport cost discounted by α). The consumer problem, taking symmetric locations, is readily shown to be concave for the relevant range $z_1 \in \left[\frac{1}{2} - \frac{R}{t}, \frac{1}{2}\right]$ when $f(\cdot)$ is concave.[28] Under symmetry, then the solution for the consumer surplus maximum is where

$$\left(\frac{1}{2} - 2F(z_1) + F\left(z_1 - \frac{R}{t}\right)\right) + \alpha\left(F\left(z_1 + \frac{R}{t}\right) - \frac{1}{2}\right) = 0.$$

Applying the implicit function theorem,

$$\frac{dz_1}{d\alpha} = \frac{-\left(F\left(z_1 + \frac{R}{t}\right) - \frac{1}{2}\right)}{-2f(z_1) + f\left(z_1 - \frac{R}{t}\right) + \alpha f\left(z_1 + \frac{R}{t}\right)};$$

both the top and bottom are negative, so the whole is positive, which means that higher α gives more central solutions. Note that for $\alpha \to 1$ the solution is at the middle ($z_1 = \frac{1}{2}$).

Hence, if the consumer density function is concave, then both the consumer surplus and firm profit functions are concave, and so total welfare is a concave function. Then, if the consumer surplus derivative is negative at the equilibrium, then the full social optimum (consumer surplus plus firm profits) is outside the equilibrium (cf. Proposition 6), using the second part of the previous Proposition. Because the consumer surplus and profit problems have parameters (σ and α) that are specific to them, we can state:

Proposition 9 *Consider a Hotelling model with a symmetric concave consumer density function and endogenous multi-homing. For any $\sigma < 1$, there exists a value of*

[28] The second derivative is $-2f(z_1) + f\left(z_1 - \frac{R}{t}\right) + \alpha f\left(z_1 + \frac{R}{t}\right)$. This is less than $-2f(z_1) + f\left(z_1 - \frac{R}{t}\right) + \alpha f\left(z_1 + \frac{R}{t}\right)$, which is negative by concavity of $f(\cdot)$.

$\alpha < 1$ *such that optimal locations are in closer than the equilibrium ones.*

Conversely, if σ is large enough, then there exists α low enough that equilibrium platform locations are too far apart. Thus, platforms locate too far apart when the value of overlap is low (see also Proposition 7) and when the consumer benefit from multi-homing is high.

6 Concluding remarks

Standard models of advertising-financed media platforms assume single-homing consumers, giving rise to a "competitive bottleneck" (Armstrong, 2002, 2006) with no effective competition for advertisers. Direct competition for advertisers ensues if consumers multi-home, where multi-homing consumers are less valuable for platforms. Such competition for advertisers fundamentally changes results in the recent literature on two-sided media platforms (e.g., Anderson and Coate, 2005) as well as the classical contribution of Steiner (1952), which predicts that competition leads to content duplication. With multi-homing consumers, the emphasis turns to exclusive consumers rather than just consumer numbers as platforms chase exclusive consumers. Then platforms can want to differentiate from rivals in order to deliver exclusive eyeballs to advertisers. More generally, we show that platforms locate too far apart if consumers value overlapping content a lot, and/or second impressions have low value. Because exclusive consumers are more valuable for the platforms, their tastes will be strongly represented in platforms' offerings, while overlapped consumers' preferences will be under-weighted.

Introducing competition for advertisers also provides lessons for competition policy, and it is necessary to look at both sides of the market in, for instance, merger analyses. As accentuated above, ad-financed media platforms will compete by delivering media genre diversity in order to attract exclusive eyeballs. This moderates the conventional pro-merger effect in media markets; i.e. that common ownership increases genre diversity.

Empirical evidence on how mergers affect diversity is mixed, and the hypothesis that mergers increase diversity cannot be rejected; see e.g. Berry and Waldfogel (2001) and Sweeting (2010) for radio, George and Oberholzer-Gee (2011) and Baker and George (2010) for television, and George (2007) for newspapers.[29] However, prevailing wisdom among policy makers runs the other direction. They often invoke the goal of diversity to justify restrictions on ownership concentration in media markets, although indeed one must carefully distinguish diversity of viewpoints from diversity of genres. The main economic rationale behind restriction on ownership in media is supply-side media bias (e.g., Gentzkow and Shapiro, 2008, Besley and Prat, 2006). For demand-side media bias, Mullainathan and Shleifer (2005) show how tougher competition may lead to more media bias (media platforms may become more radical than the population).

A recent empirical paper on ideological diversity in the US newspaper market is Gentzkow, Shapiro, and Sinkinson (2012).[30] About 15% of the readers in their data set multi-home. Consistent with the theoretical assumption in the present paper and in ACR, they find that exclusive readers are significantly more valuable than over-

[29] George and Oberholzer-Gee (2011, p. 3) summarize the empirical literature: "... results suggest that business stealing and ownership effects are important in media markets. Regulations designed to foster competition by limiting ownership concentration might thus serve to reduce diversity".

[30] The conceptual underpinnings to their empirical analysis are founded in models of overlap like this paper.

lappers, and that advertising competition depends crucially on the extent of multi-homing. Gentzkow et al. do not specifically consider choice of genre or mergers, but their empirical analysis reveals that joint ownership reduces entry. However, fixing the number of market participants, they do not find any clear relationship between ownership structure and differentiation. This fits well with our theoretical results.

We have assumed that advertiser willingness to pay is independent of which other advertiser contacts a media consumer (and ergo prospective product consumer). If instead advertiser demands were interdependent, another virtue to platforms from delivering exclusive consumers might come into play. Specifically, the older literature on competing advertisers within industries (e.g. Butters, 1977, Grossman and Shapiro, 1984) specifies that ads are sent randomly. But, if ads are channeled through media, advertisers have an incentive to place ads on platforms with little consumer overlap in order to relax price competition by diminishing the overlap footprint of consumers knowing about rival products. They are less able to do this when (some) consumers multi-home; this conduit delivers a further premium to media platforms for delivering exclusive consumer bases.

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