What Do the Papers Sell?*

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February 2005

Abstract

We model the market for news as a two-sided market where newspapers sell news to readers who value accuracy and sell space to advertisers who value advert-receptive readers. We show that newspapers under-report or bias news that sufficiently reduces advertiser profits. Newspaper competition generally reduces the impact of advertising. In fact, as the size of advertising grows, newspapers may paradoxically reduce advertiser bias, due to increasing competition for readers. However, advertisers can counter this effect of competition by committing to news-sensitive cut-off strategies, potentially inducing as much under-reporting as in the monopoly case.

JEL Classification: L13; L82.

Keywords: Two-sided markets; advertising; media accuracy; media bias; media economics.

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*We thank Jacques Crémer, Guillaume Haeringer, Humberto Llavador, Jan Sarsanedas, Joel Sobel, and Xavier Vives, as well as participants at the IDEI-ZEI Media Conference in Toulouse, October 2004, and at the ASSET Conference in Barcelona, November 2004. Financial support from the Spanish Ministry of Science and Technology (Grants SEJ2004-03619 and BEC2003-00412) and Ramon y Cajal fellowships are gratefully acknowledged. Emails: Matthew.Ellman@UPF.Edu and Fabrizio.Germano@UPF.Edu.
1 Introduction

A free press is crucial to the effective working of any society and to democratic government in particular. According to the ideal market view, uncensored newspapers compete to attract readers by selling the most accurate news they can produce. Mullainathan and Shleifer (2004) point out that newspapers will bias news if readers prefer bias (e.g., confirming personal ideologies) and they show that newspaper competition cannot prevent this bias. In this paper, we identify a further source of bias – advertising – and a clear, positive role for competition.

We model the market for news as a two-sided market with readers who value accuracy on one side and advertisers who value access to advertiser-receptive readers on the other. We develop two main ideas. First, we show why advertisers may dislike accurate or in-depth reporting on certain topics. Our main result is that these preferences lead to inaccuracy in the monopoly case, but that newspaper competition resolves this problem. Paradoxically, we find that increased advertising can even improve accuracy through increased competition. Second, we show how advertisers can thwart this competition effect if able to credibly threaten to withdraw their contracts from papers that report too accurately on sensitive topics.

Advertising is numerically important. Mainstream U.S. newspapers generally earn well over 50 and up to 80\% of their revenue from advertising, and in Europe, this percentage lies between 40 and 50\% (see e.g., Baker, 1994, and Gabszewicz et al., 2001). The question is whether advertising influences reporting. In the rosiest view, advertising revenue simply allows newspapers to spend more on producing well-written and accurate news,\textsuperscript{1} but several media scholars including Baker (1994), Herman and McChesney

\textsuperscript{1} Advertising also allows readers to learn about consumer products and may even be enjoyable (see e.g., Baker, 1994, Gabszewicz et al., 2003), but most papers assume a “nuisance cost” (see e.g., Anderson and Coate, 2005).
(1997), Bagdikian (2000), and Hamilton (2004) are skeptical. They suggest that heavy dependence on advertising leads papers to bend news to the interests of advertisers, generating misrepresentation on some topics and possibly even a “dumbing-down” of general coverage. To investigate their conjecture, we need to identify the interests of advertisers, and analyze the interaction between advertiser and reader interests.

In Subsection 2.5, we sketch a microfoundation of advertiser preferences for under-reporting or bias on sensitive news topics such as for example the health costs of smoking. The underlying message (backed up by psychological and empirical evidence) is that news reporting can change the receptiveness of readers to advertising, by changing mood and salient concerns while reading, and because ongoing reporting can change beliefs and attitudes. For sensitive topics, the advertiser surplus per reader increases with under-reporting or appropriate bias.

One might hope that advertiser pressures will cancel each other out as advertisers of competing products try to encourage news criticizing competing products, but competing products are in competition precisely because they are similar. So many news stories affect competing producers in a similar way. For instance, a health report that puts people off smoking harms all tobacco companies together.\(^2\) In fact, advertiser news concerns are often mutually reinforcing, even for non-competitors: News on global warming can harm energy companies as well as car companies; news on corporate dishonesty can make people suspicious of advertising in general; news on famine and deprivation can discourage thoughts on all personal consumption.\(^3\) An alternative hope is that advertisers who dislike a common topic will face a free-rider problem in pressuring newspapers. However, our model shows that

\(^2\) Even a scandal about one company can have repercussions for its competitors. E.g., reports on child labor in Nike sports apparel led to the presumption or discovery that its competitors acted similarly.

\(^3\) Relatedly, some media monitors (e.g., Media Watch and Fair) and journalists complain that advertisers shun newspapers that contravene implicit norms of “business-friendliness.”
papers slant reporting because they internalize a share of advertiser surplus. We focus on the case of monopoly and duopoly newspapers. Also, to isolate the role of advertising, we assume that all readers strictly prefer more accuracy on all topics. Absent advertising, a monopoly newspaper therefore reports all news accurately (to maximize revenue from readers). Advertising induces under-reporting on any topic that is sufficiently disliked by enough advertisers: The monopolist performs a simple tradeoff between pleasing readers and advertisers; under-reporting occurs whenever the news sensitivity of advertiser surplus (whether from a single or many advertisers) exceeds that of reader surplus.

By contrast, absent advertising, competing newspapers may report less than the monopolist, because they seek to soften price competition by segmenting the market for readers. However, advertising raises the intensity of competition for readers, eventually precluding market segmentation and inducing competing newspapers to report all topics with full accuracy and minimal price. Even a single advertiser eventually suffers as its importance increases. This surprising weakness of advertisers is overturned when advertisers can negotiate with editors over their reporting strategies. For instance, Chrysler corporation wrote to the editors of over one hundred papers and magazines where they advertise (see Wall Street Journal, 4/30/97):

“In an effort to avoid potential conflicts, it is required that Chrysler corporation be alerted in advance of any and all editorial content that encompasses sexual, political, social issues or any editorial content that could be construed as provocative or offensive.”

Implicitly, Chrysler threatens to withdraw its ad contracts from media that report too much sensitive news. We model this in Section 5 by allowing each advertiser to commit to withdraw its ads from any newspaper that

\(^4\)Large fixed costs of producing news and establishing a reputation imply that local markets contain few serious newspapers (see e.g., Baker, 1994, Genesove, 2003).
reports above a chosen threshold or cut-off. Even though we continue to rule out collusion among advertisers, we find that advertisers with common news sensitivities optimally commit to the same thresholds. Furthermore, they increase the stringency of these demands as they grow in number or size, eventually forcing all newspapers to under-report or bias as heavily as in the monopoly case. Since this result extends to any actor able to threaten withdrawal of significant revenue from the paper (whether by cancelling ad contracts, subsidies, group subscriptions or finance), our model shows how governments and large firms can influence reporting even if reporting does not affect returns to advertising. This result complements recent work on media capture by governments (see Besley and Prat, 2001).

Our paper is one of many in a rapidly growing literature. Mullainathan and Shleifer (2004) present a compelling model of news bias, but do not allow for advertising. Gabszewicz et al. (2001) show how advertising increases the intensity of competition for readers, but they assume readers are ideological (i.e., biased as in Mullainathan and Shleifer) so advertising leads the two papers to converge on news with the same centrist ideology (“la pensée unique”). By contrast, in our analysis where readers value accurate news, the competition for readers can lead to full and accurate reporting. None of these papers consider news-sensitive advertisers.

Recent analyses extend in other directions. Dyck and Zingales (2003) suggest that journalists bias news as a way to “thank” their sources for privileged access to news; Patterson and Donbasch (1996) study journalists’ own biases; Balan et al. (2003) study media mergers when newspaper owners...

The paper proceeds as follows. Section 2 sets out the general model. Sections 3, 4 and 5 present our main results on monopoly, duopoly, and the impact of cut-off strategies, in the one topic case. Section 6 generalizes and Section 7 concludes. All proofs are in the Appendix.

2 The Model

We study the competition between profit-maximizing newspapers in a two-sided market: newspapers sell news to readers and space to advertisers. We focus on the content and accuracy of news. To characterize news reporting, we classify news stories into $K$ topics (e.g., the stock market, the environment, sports, and health). Then, each paper chooses how accurately to report news on each topic: $r \in [0, 1]^K$ with $r_k = 1$ if the paper reports fully on topic $k$ and $r_k = 0$ if it makes no report (or reports uninformatively) on $k$; see Subsection 2.5 for background and further interpretation.

2.1 Newspapers

There are $N$ competing newspapers. A typical paper, $n$, selects its reporting strategy $r_n \in [0, 1]^K$, its copy price charged to readers, $p_n$, and its prices $q^j_n$ for advertising by each type of advertiser, $j$ (i.e., we assume newspapers can price discriminate among advertisers but not readers).

2.2 Readers

Readers are interested in news, but vary in their degree of “interest” in each topic $k$. There are $I$ reader types, each characterized by a taste vector $s^i \in [0, 1]^K$ where $s^i_k$ represents $i$’s marginal value of news or increased accuracy
on topic $k$ (e.g., a value from useful information, or a value for knowledge or entertainment) and a reservation value $b^i \geq 0$. We assume that readers buy at most one newspaper. So a reader of type $i$ buys any paper $n$ that maximizes its utility

$$\sum_{k=1}^{K} s^i_k r_{n,k} - p_n$$

provided this maximized value exceeds $b^i$ (which is non-negative, since we assume no reader is willing to pay a positive price for a paper with $r = 0$). To avoid the degenerate case where newspapers cannot attract any readers even with zero prices and full accuracy ($p = 0, r = 1$), we assume $b^i \leq \sum_{k=1}^{K} s^i_k$ for some $i \in I$. There is an equal number (measure 1) of readers of each type, so denoting reader decisions by the probability $x^i_n \in [0,1]$ that reader $i$ buys or reads newspaper $n$, we can write paper $n$’s readership as $\sum_{i \in I} x^i_n$.

### 2.3 Advertisers

Advertisers are interested in reaching ad-receptive readers. They care about how many people read the papers where they advertise; they also care about the news reporting strategy in these papers, because news affects how readers respond to ads and hence the return to advertising. In 2.5 below, we present a microeconomic foundation for the following reduced-form utility of advertisers with an induced distaste for reporting on topics that reduce readers’ ad-receptiveness. Each of $J$ advertiser types is characterized by a distaste vector $t^j \in [0,1]^K$ defining its utility from advertising in newspaper $n$,

$$\sum_{i \in I} x^i_n \left(1 - \sum_{k=1}^{K} t^j_k r_{n,k}\right) - q^j_n,$$  \hspace{1cm} (1)$$

(see 2.5 for the case ($t < 0$) where advertisers instead value accuracy). We assume that these utilities are additively separable across newspapers, so
advertiser \( j \) chooses to advertise in paper \( n \) (denoted \( y^j_n = 1 \)) if it gives non-negative utility, and otherwise \( j \) chooses not to advertise there \( (y^j_n = 0) \). To study variation in the numerical importance of advertising relative to readers, we assume that there are \( \alpha^j \) advertisers of type \( j \). Below we also study an advertiser size parameter, \( a^j \).

We can now state the objective function for newspaper \( n \),

\[
\sum_{i=1}^{I} p_n x^i_n + \sum_{j=1}^{J} \alpha^j q^j_n y^j_n.
\]

This implicitly assumes a trivial marginal cost of reporting and printing for a newspaper paying the fixed costs of maintaining its network of reporters, editors and news sources; see Baron (2004).

2.4 Timing

We study the following five stage game: In stage 1 newspapers set their reporting strategies; In stage 2, newspapers set the copy price charged to readers; In stage 3, readers buy newspapers; In stage 4, newspapers set advertising prices; In stage 5, advertisers accept or reject the newspaper contracts. In each case, all players observe the outcomes of all previous stages before acting. We solve for subgame perfect equilibria. To simplify the exposition, we assume \( 1 - \sum_{k=1}^{K} t^j_k \geq 0, \forall j \in J \), which implies it is attractive to advertise even in a paper \( n \) that reports fully on all topics \( (r^j_{n,k} = 1, \forall k) \). Solving the subgame beginning at stage 4 reveals the following.

**Lemma 1** Newspapers charge advertising prices given by

\[
q^j_n = \sum_{i \in I} x^i_n \left( 1 - \sum_{k=1}^{K} t^j_k r^j_{n,k} \right)
\]

\(^6\)For instance, a paper buying access to the bundle of news stories from Reuters or Associated Press then selects which stories to include and which to exclude. Marginal costs of increased reporting and accuracy have little substantive impact on our results.
and all advertisers buy ads in all papers, \( y_n^j = 1, \forall j \in J, n \in N \).

Notice that newspapers compete for readers (who by construction seek at most one paper), but that advertiser preferences are additively separable across newspapers. So, given their ability to price discriminate in the advertising market, newspapers can extract the full advertising surplus.

### 2.5 Interpretation

Reporting strategies \((r)\) are best understood as measures of how newspapers report on average over an extended period of time. This is why newspapers can build up a reputation for reporting in a certain way; thus justifying the above time ordering. One interpretation of \(r\) is based on “accuracy”: Newspapers can select stories and adjust news presentation to generate bias (see e.g., Mullainathan and Shleifer, 2004, for a micromodel in which newspapers “slant” their reports by selectively suppressing certain types of facts). For instance, a newspaper might report on the environment whenever a scientist makes statements suggesting that global warming is minimal, and omit news suggesting global warming is a serious risk. Newspapers can thereby choose how much to bias reporting in a particular direction (e.g., towards under- or over-estimation of the risk of global warming). Our model generalizes this to the multi-dimensional case: we interpret \(1 - r_{n,k}\) as the degree of bias on topic \(k\) in a particular direction. For instance, with global warming as topic \(k\), \(1 - r_{n,k}\) represents the degree to which paper \(n\) under-estimates the global warming risk.\(^7\)

A second, related, interpretation of \(r\) is based on “intensity”: Newspapers select the frequency, length, prominence (e.g., frontpage headline), and

\(^7\)Allowing the opposite bias (\(r_k > 1\)) makes no difference, as papers never want to go against the tastes of both readers and advertisers. To study biased readers, \(r_k = 1\) could instead represent readers’ preferred bias. Note that if advertisers valued accuracy \((t < 0)\), they would then help de-bias news. Also, \(r_k, r_{k'}\) can represent bias on a fixed issue in different directions (such as up and down).
persistence with which they report on given topics.

The nature of advertisers’ induced preferences is an empirical question. Here, we sketch a foundation for the above preferences. We do not assume that advertisers care about news reporting per se, but they do care about the impact of news on reader behavior. Consider the intensity interpretation of $r$. Reporting intensity can affect reader behavior in two ways, one temporary, the other more permanent. First, news reporting can affect readers’ moods and attitudes while reading the paper and coming across its ads; for instance, a newspaper report on animal rights can activate anti-cosmetics attitudes, so that readers are unreceptive to ads of cosmetics companies (if believed to practice animal testing); or it is known that advertisers often choose to avoid advertising alongside depressing reports (see e.g., Baker, 1994, or Bagdikian, 2000). Second, newspapers play a significant role in shaping their readers’ long-term attitudes and beliefs; for instance, when a newspaper frequently reports on animal rights, pro-animal attitudes become chronically accessible to its readers, again possibly reducing the effectiveness of advertising cosmetics in that paper (see Chaiken et al., 1996; Cialdini, 1993, emphasizes the influential power of message repetition); Estée Lauder declined to advertise with the magazine Ms. arguing that it was generally not portraying the sort of “kept-woman mentality” that Estée Lauder was trying to sell (see Baker, 1994).

More specifically, we assume advertisers make profits $m$ per unit sold, where $m$ is the markup over unit cost. Let $z_{i,j}$ denote the expected quantity

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8We refer to Isen et al. (1978) and Forgas (1995) for psychological work on mood and Petty and Cacioppo (1986) on attitude change, but the following quotation of Patrick Le Lay (President of France’s major private television channel, TF1) illustrates the idea in an extreme case:

“We basically TF1’s job is to help a company like Coca-Cola sell its products. For a TV commercial’s message to get through, the viewer’s brain must be receptive. Our programs are there to make it receptive, that is to say to divert and relax viewers between two commercials. What we are selling to Coca-Cola is human brain time.” (James, 2004)
of goods purchased by reader type \(i\) from advertiser \(j\). Since reader \(i\) comes across \(j\)'s ad through paper \(n\) only if \(y_{jn}^j = 1\), we can write

\[
z_{i,j}^j = \bar{z}_{i,j}^j + \sum_{n \in N} x_{jn}^i \left( 1 - \sum_{k=1}^K t_{jn}^j r_{n,k} \right) y_{jn}^j,
\]

where \(\bar{z}_{i,j}^j\) is an ad-independent component. The key assumption is that advertising raises consumption, but to a lesser extent if the paper carrying the ad contains a lot of reporting on sensitive topics. Notice that no consumer reads the same ad twice (since each reader buys at most one paper), and that we assume reporting intensity affects responsiveness to the ad in a linear fashion. Advertisers get revenue from selling goods (whose prices we assume to be fixed). Their production costs are implicit in the markup \(m\), a fixed cost \(F\), and the advertising costs \(q_n^j y_{jn}^j\). We can thus write advertiser \(j\)'s overall profit function as

\[
\sum_{i \in I} \bar{z}_{i,j}^j + \sum_{i \in I} \sum_{n \in N} x_{jn}^i \left( 1 - \sum_{k=1}^K t_{jn}^j r_{n,k} \right) y_{jn}^j - \sum_{n \in N} q_n^j y_{jn}^j - F
\]

\[
= \bar{z}_{j}^j + \sum_{n \in N} \left( \sum_{i \in I} x_{jn}^i \left( 1 - \sum_{k=1}^K t_{jn}^j r_{n,k} \right) - q_n^j \right) y_{jn}^j - F.
\]

where \(\bar{z}_{j}^j\) is the aggregated ad-independent component and we normalize the markup \(m\) to 1. This implies the reduced form of Equation (1).

The accuracy interpretation of \(r\) has similar implications for advertiser news preferences. For instance, when a newspaper’s biased reporting induces readers to under-estimate the risk of global warming,\(^9\) advertisers know that these readers are less likely to develop beliefs that cars are harmful; so biased reporting can make readers more receptive to ads for cars, while accurate (or unbiased) reporting reduces the advertising payoff of car manufacturers.

\(^9\)See DeMarzo, Vayanos and Zwiebel (2003) for a formal model analyzing how biased reporting distorts people’s beliefs when some readers are boundedly rational. Repetition is key; see also Hawkins and Hoch (1992) on the “truth effect” in psychology.
A third possible interpretation is that \( r \) represents the “complexity” or “depth” of reporting. As suggested in the above quotation by Le Lay (footnote ??), critical thinking may distract people from advertisements and therefore make them less receptive to ads; see also Neisser (1979) for psychological evidence. This view suggests that \( t \) would then be positive on a very broad range of topics, so we can use it to explain the general “dumbing down” of coverage mentioned in the introduction. It also suggests a preference on the side of advertisers towards more entertainment and superficial programming, but we do not emphasize this issue here since we suspect that it is most relevant to other media outlets, such as television; see also Baker (1994) and Bagdikian (2000) for more related evidence.

The durable effects of news reporting on people’s beliefs and attitudes can explain why firms and governments might also care about a newspaper’s reporting strategy independently of whether they advertise there. The news strategy affects how readers respond to ads and opportunities encountered elsewhere. In particular, it can affect how people vote and whether they pressure for regulation of an industry or a monopolistic company. We analyze these advertising-independent effects in Section 5.

3 Monopoly

In this section, we study the case of a monopoly newspaper market \( (N = 1) \). Until the more general analysis of Section 6, we focus on the case with one type of advertiser and one topic (so \( J = K = 1 \)), and we assume the topic is sensitive to advertisers (so \( t > 0 \)), but of interest to all readers (so \( s^i > 0 \ \forall i \in I \)). Our goal is to understand how the newspaper’s equilibrium reporting level varies with the importance \( (\alpha) \) of advertising. Substituting the advertising prices from Lemma 1 into the monopolist’s objective function,
Expression (2), gives the monopolist’s reduced-form profit function:

$$\pi(p, r) = \sum_{i=1}^{I} px^i(p, r) + \alpha \sum_{i=1}^{I} x^i(p, r)(1 - tr)$$  \hspace{1cm} (3)

The first term represents reader revenue (from selling copies) and the second term represents advertising revenue (from selling space). Our main result here is that, for large enough \(\alpha\), the advertising revenue dominates and this drives accuracy downwards, though \(r\) must not fall so low that the paper loses all its readers. It helps to define

$$r^i_{\text{min}} = \frac{b^i}{s^i}.$$ \hspace{1cm} (4)

This is the minimal level of accuracy that enables a newspaper to retain type \(i\) readers at \(p = 0\).\(^{10}\)

**Example 1.** There are two reader types, \((s^1, b^1) = (1, \frac{3}{8})\), \((s^2, b^2) = (\frac{1}{8}, 0)\), and \(\alpha\) advertisers of type \(t = \frac{1}{2}\). When \(\alpha\) is small \((\alpha < 0.97)\), readers determine accuracy; the paper selects maximal accuracy \((r = 1)\) and sets a copy price of \(p = \frac{5}{8}\). This extracts the full surplus from type 1 readers, while type 2 readers are priced out of the market. As \(\alpha\) increases, the monopolist starts to earn more from advertising and is increasingly tempted to please advertisers by reducing \(r\) while increasing readership. When \(\alpha\) reaches 0.97, the newspaper cuts \(r\) from 1 to \(\frac{3}{7}\) and simultaneously cuts \(p\) to \(\frac{3}{36}\) so that all readers buy the paper. When \(\alpha\) reaches 4, the newspaper further reduces accuracy to \(r = \frac{3}{8}(= r^1_{\text{min}})\) and price to \(p = 0\); again all readers buy. Since it is impossible to further reduce accuracy without losing readers, this is the equilibrium outcome for all \(\alpha\) large \((\alpha \geq 4)\). See Figure 1. \(\square\)

\(^{10}\)One cannot force people to read, so \(p \geq 0\). However, if the newspaper could spend money to increase attractiveness to readers (e.g., with glossy pictures), for \(\alpha\) large, it may want to set \(r = 0\) even if all \(r^i_{\text{min}} > 0\). We do not pursue this setting.
The full accuracy outcome when $\alpha = 0$ holds more generally, because the monopolist has no opportunity cost (lost advertising revenue) of increasing accuracy and can extract at least part of the increased reader surplus. When $\alpha$ gets sufficiently large, the monopolist focuses on maximizing advertiser surplus, so it minimizes $r$ subject to retaining sufficient readers (as audience for advertisers). It therefore eventually sets $p = 0$ and $r = r^i_{\text{min}}$ for some reader $i$.

**Proposition 1** For $\alpha$ sufficiently small, a monopolist reports fully accurately, $r = 1$. For $\alpha$ sufficiently large, it sets $p = 0$ and reduces accuracy to the minimal level, $r = r^i_{\text{min}} < 1$, sufficient to attract reader type $\hat{i}$, where $\hat{i} = \arg \max_{i \in I} \pi(0, r^i_{\text{min}})$.

An immediate corollary is that if all readers have zero reservation values ($b^i = 0 \ \forall i \in I$), sufficiently large $\alpha$ leads the monopolist to reduce accuracy to zero. In general, however, it faces a tradeoff between reducing $r$ to raise advertiser surplus per reader, and increasing $r$ to increase readership. For instance, if advertising from car and energy companies are sufficiently important to a monopoly newspaper, the paper may under-report on global warming or bias its environmental reports to suggest that risks are minimal. Omitting this topic altogether, or biasing all reports to claim a zero risk, is rare because such a paper would lose credibility. We capture this credibility factor in the model through positive reservation values $b^i$.

Of course, if people have no way to judge or detect the degree of bias, papers can distort news arbitrarily and readers cannot reward papers for accuracy. The model would then predict extreme bias $r = 0$ for any $\alpha > 0$, but that is an extreme case. Readers usually have access to some external sources of information. So, over time, they get at least some idea of the degree to which newspapers under-report. On the other hand, our assumption that readers observe $r$ perfectly is also extreme. Advertisers have more at stake, so they will often observe $r$ more effectively than do (most) readers. This
difference in observation of \( r \) implies that advertising can have an even larger impact than suggested by its fraction of newspaper revenue.

The most important lesson from Proposition 1 is that advertisers affect news content through a market price mechanism. There is no free-riding problem among advertisers in that they do not undersupply pressure for reducing \( r \) in the hope that other advertisers will apply that pressure in their place. Were advertisers able to agree on their strategies cooperatively in stage 5, they would behave as a single advertiser of size \( a = \alpha \), whose utility from advertising in paper \( n \) is given by

\[
\alpha \sum_{i \in I} x_{n,i} \left( 1 - \sum_{k=1}^{K} t_{n,k} r_{n,k} \right) - q_{n};
\]

For this case, Lemma 1 must be adjusted: the paper would charge a price of \( q = \alpha \sum_{i \in I} x_{i} (1 - tr) \) to this advertiser, so the profit function and hence reporting choice are exactly as before.\(^{11}\)

4 Duopoly

In this section we analyze a duopoly newspaper market \((N = 2)\) under the same parametric assumptions as the monopoly case. When readers are homogeneous, competition for readers is so direct that papers now give full accuracy regardless of \( \alpha \). When readers are sufficiently heterogeneous, the newspapers may be able to differentiate vertically (also horizontally in the multi-topic case of Section 6). For low values of \( \alpha \), the newspapers segment the market and behave as local monopolists, so reporting decreases with \( \alpha \) as in Section 3. However, for sufficiently large \( \alpha \), market segmentation becomes impossible. This leads to the paradoxical result that increasing the number or size of advertisers may actually improve reporting accuracy.

\(^{11}\)Advertisers get a selective benefit from advertising in newspapers that under-reports, so there is no public good problem; newspapers can implicitly charge advertisers for under-reporting. Reporting outcomes would only change if collusion or size gave advertisers greater bargaining power relative to the papers; see Section 5.
4.1 Homogeneous Readers

Reader homogeneity precludes market segmentation. Bertrand price-setting generates perfect competition for readers, who get what they want, namely full accuracy at zero prices.

**Proposition 2** In a duopoly with only one reader type and any \( \alpha > 0 \), the unique subgame perfect equilibrium has full accuracy and zero prices, \( r_n = 1 \) and \( p_n = 0 \) for \( n = 1, 2 \).

This full accuracy result is important because it shows how effective competition can be in preventing bias, but its sharpness depends heavily on the homogeneity assumption as we now show.

4.2 Heterogeneous Readers

We first illustrate how heterogeneity can lead to a non-monotonic effect of the size of advertisers on accuracy, by adding a competing newspaper to the monopoly market analyzed in Example 1.

**Example 2.** This is identical to Example 1, except that now \( N = 2 \) instead of 1 (i.e., add one paper, so \( I = 2, \ J = K = 1; (s^1, b^1) = (1, \frac{3}{8}), (s^2, b^2) = (\frac{1}{5}, 0); t = \frac{1}{2} \)). For \( \alpha \) small (\( \alpha < 0.97 \)), the newspapers vertically differentiate their reporting strategies to soften their competition for readers.

The high accuracy newspaper is fully accurate and charges a higher price, while the low accuracy newspaper charges a lower price. Figure 2 shows how increasing \( \alpha \) leads the low accuracy paper to reduce its accuracy so that market segmentation is maintained; at \( \alpha = 0.5 \) it reduces accuracy to zero to raise advertiser profits (a local monopoly response). However, when \( \alpha \) gets too large (\( \alpha \geq 0.97 \)), market segmentation becomes impossible, since the value of each reader, given corresponding advertising profits, is too high. (In particular, newspaper 1 has an incentive to deviate by charging lower prices.)
Intense competition for readers follows such that the unique subgame perfect equilibrium has newspapers setting full accuracy and zero copy prices. □

To generalize this idea of vertical differentiation, we introduce a notion of reader diversity.

**Definition 1** Two reader types \((s^i, b^i) \in [0, 1]^2, i = 1, 2\), are **diverse** if the indifference curves yielding their respective reservation utility levels \((b^1 \text{ and } b^2)\) intersect in \((r, p)\) space at some \(r \in (0, 1]\) and \(p > 0\). Two reader types are **strongly diverse** if they are diverse and \(s^i - b^i > 2(s^{-i} - b^{-i})\) holds either for \(i = 1, -i = 2\) or \(i = 2, -i = 1\).

The first condition is satisfied whenever \(s^1 - b^1 > s^2 - b^2\) and \(b^1 s^2 > b^2 s^1\). The second stronger condition (also satisfied in Example 2) is sufficient to ensure that papers can segment the market for small \(\alpha\).

**Proposition 3** In a duopoly: (a) If there are two reader types and they are strongly diverse, then for sufficiently small \(\alpha\), the unique subgame perfect equilibrium involves vertical differentiation, with at least one newspaper providing less than full accuracy; (b) Sufficiently large \(\alpha\) always leads to full accuracy and zero prices in both papers.

This result does not necessarily depend on the number of advertisers and, in fact, also holds when a single advertiser gets very large (i.e., one can replace \(\alpha\) with \(a\)). It is somewhat paradoxical since it shows that increasing the overall size of advertisers eventually leads to full accuracy even though all advertisers prefer minimal accuracy. The underlying newspaper competition intensity effect is straightforward,\(^{12}\) but the result is overturned when advertisers have sufficient commitment power as we now show.

\(^{12}\)Notice that this result is fundamentally about competition and not the number of papers: a monopolist owning two newspapers would minimize accuracy on both papers when advertising gets sufficiently large (as in Section 3).
5 Advertisers Revisited

In this section, we analyze the effect of allowing advertisers to commit to cut-off levels of accuracy before newspapers fix their reporting strategies.

5.1 Adding Stage 0: Advertisers with Commitment

We make two natural modifications of the basic model. The first adjustment allows advertisers to win some share of the advertising surplus. In the basic model, newspapers extract the entire advertising surplus from advertisers by charging stage 5 prices that leave advertisers indifferent between advertising and not advertising. If an advertiser could commit before stage 4 to reject excessive prices $q^j_n$ at stage 5, it could win a share of the bilateral surplus from advertising in paper $n$, so we now study the representative intermediate case where this surplus is shared equally between the newspaper and the advertiser. Advertising prices fall to exactly half the value characterized in Lemma 1 and quantities are unchanged. Our results so far are qualitatively unaffected ($\alpha^2$ just replaces $\alpha$), but notice that now advertisers are strictly better off when $r$ is reduced in any paper.

The second adjustment is more interesting. We add a stage 0 at which advertisers set a cut-off level of accuracy $\bar{r}^j$, for $j \in J$, which commits them to set $y^j_n = 0$ if $r_n > \bar{r}^j$; Lemma 1 no longer holds here. We refer to this as the model with cut-offs.

We are interested in seeing whether this allows large advertisers to escape the competition logic that led to full accuracy as $\alpha$ or $a \to \infty$ in the duopoly case. The answer is yes. Consider first a single advertiser of size $a$ that sets $\bar{r} < 1$. For large $a$, there is a subgame perfect equilibrium of the continuation game with $r_n = \bar{r}$ and $p_n = 0$ for $n = 1, 2$, because competition is intense for $r_n$ restricted to $[0, \bar{r}]$, and deviating outside this range is dominated for large
a, since it generates zero advertising revenue.\textsuperscript{13} So, how will the advertiser set $\bar{r}$? For a fixed readership, the advertiser surplus is decreasing in $\bar{r}$, hence the advertiser minimizes $\bar{r}$ subject to the problem of satisfying $r^i_{\text{min}}$ for enough readers. In the limit as $a$ becomes large, reader profits become relatively insignificant, so the advertiser’s tradeoff becomes the same as that of the monopolist in Proposition 1.

When instead there is a large number ($\alpha$) of advertisers of the same type, advertisers face a minor coordination problem. If enough advertisers set the optimal level of $\bar{r}$, then the papers will accept this restriction and setting $r = \bar{r}$ is optimal. However, if all other advertisers make weaker threats, the papers will set $r > \bar{r}$ and the advertiser setting $r = \bar{r}$ will be unable to advertise at all. The advertisers effectively play an “assurance game” at stage 0. It is Pareto optimal for them to all set $r = \bar{r}$.

**Proposition 4** In a duopoly with cut-offs, for sufficiently large $\alpha$ or $a$, there exists a subgame perfect equilibrium with accuracy restricted as in the monopoly case, $r_n = \bar{r} = r^i_{\text{min}}$, $n = 1, 2$, as in Proposition 1.

We find that advertisers’ optimal cut-offs gradually become more extreme as the importance of advertising ($\alpha$ and $a$) grows. Our ongoing example provides a useful illustration.

**Example 3.** Adding stage 0 to Example 2 generally has a negative impact on accuracy. As $\alpha$ increases, advertisers can make increasingly stringent demands on newspapers. In particular, for low and intermediate $\alpha$, accuracy on the high quality newspaper 1 is set at the optimal cut-off level $r = \bar{r} = \frac{2(2-\alpha)}{4-\alpha}$, which may even fall below the monopoly level without cut-offs. Market segmentation now becomes impossible already at $\alpha = 0.63$, (again newspaper 1

\textsuperscript{13}There is also a subgame perfect equilibrium with $r_n = 1$ and $p_n = 0$ for $n = 1, 2$, but this is Pareto dominated for the newspapers (and for advertisers); hence we view the outcome with $r_n = \bar{r}$ and $p_n = 0$ as more plausible.
has an incentive to deviate by charging lower prices), but instead of jumping up to 1, \( r \) now goes to \( \bar{r} = 0.81 \), and prices fall to zero. Accuracy on both papers is now determined by \( r = \frac{2(2-\alpha)}{4-\alpha} \), (which coincides with the expression for the segmented case), until it hits the limiting monopoly value, \( r_{min}^j = r_{min}^1 = \frac{3}{8} \), and stays there for all \( \alpha \geq 1.54 \); newspaper prices stay at zero. See Figure 3. \( \square \)

### 5.2 Other Channels of Influence

As motivated at the end of Subsection 2.5, businesses and governments may care about news reporting even when they are not advertising in a given newspaper. To capture this possibility, we add a utility term of

\[
\sum_{i \in I} x_n^i \left( 1 - \sum_{k=1}^K T_j^k r_{n,k} \right)
\]

for each actor of type \( j \), independent of whether it advertises \( (y_n^j = 1) \) in paper \( n \) (hence the absence of the price term \( q_n^j \)). The advertising-independent distaste vector \( T_j \in [0,1]^K \) captures concerns such as politicians wanting to have news biased in their favor and large companies wanting to avoid criticism that might generate regulatory pressure or damage their reputations. Even if \( t^j = 0 \), we find that actors of type \( j \) can influence news content if they are sufficiently important.

The recent case of the largest Spanish electricity company, Endesa, is illustrative. After a recent spate of reports in the Spanish newspaper, La Vanguardia, criticizing Endesa’s service quality and price, Endesa began paying for a costly supplement in La Vanguardia. Observers claim that, while ostensibly a form of advertising, this is actually a hidden subsidy accompanied by a threat of withdrawal if La Vanguardia had continued its negative reporting. Our model can capture their argument as follows: Endesa sets an \( \bar{r} \) above which it will set \( Y_n = 0 \), where \( Y_n = 1 \) denotes subsidizing the supplement.
worth $A$ to La Vanguardia. This threat is as effective as the threat of an advertiser with surplus worth $2A$ in Proposition 4.\footnote{Notice that Endesa’s subsidy offer does not have the paradoxical competition effect of advertising as in Section 4.2; the factor 2 is specific to our 50:50 surplus sharing assumption.}

There are many ways to generate the subsidy $A$. The recent scandal of a government report candidly discussing media influence by politicians in Spain and Catalonia offers a useful case study. First, central and regional governments make \textit{explicit subsidies} (e.g., several major dailies receive very large subsidies from the Treasury and Social Security). Second, \textit{mass subscriptions} generate an additional, hidden subsidy. For instance, the Catalan News Agency that supplies news stories to TV and other media gets 40\% of its subscriptions from public institutions (compared to only 27\% for clients other than the Catalan Television Corporation). \textit{Cheap credit} from public (and private) institutions is the third main channel for effective subsidy.

Ownership, control rights (e.g., to appoint directors), and censorship are other more obvious and direct mechanisms for influence, but more subtle forms of influence are particularly problematic as they may go unnoticed. Our theoretical result (Proposition 4), applies to this case and suggests that large subsidies from parties with an obvious interest in news reporting should be viewed with suspicion, as they may restrict news accuracy. This hurts readers and causes undersupply of news. Two further mechanisms that restrict news reporting are “flak” (e.g., the threat of being sued) and the power of news sources (such as businesses, governments and officials) to control access to information; see Herman and Chomsky (1988) and Dyck and Zingales (2003). These mechanisms involve the threat of reduced newspaper profits via, respectively, legal costs and reduced news access. In all cases, the downward pressure on reporting is particularly problematic when readers’ willingness to pay for news is less than its social value, as is common when information has a strong public good aspect as in voting or in the gathering of evidence on companies’ or other parties’ social impact (e.g., concerning
the environment), and when readers have difficulty assessing news quality.

6 Multiple Topics and Advertiser Types

In this section we consider the cases of monopoly and duopoly in a market with two reader types and two or more advertiser types and topics. To simplify the boundary case analysis, we assume $b^i = 0$, $s_k > 0$ and $t^j_k < 1$ for all $i \in I, k \in K, j \in J$. It is then easy to prove that all our results generalize to the case with multiple topics and advertiser types except that heterogeneity of large advertiser types could potentially weaken the power of cut-off strategies.

6.1 Monopoly

The only substantive novelty is that with multiple topics, monopolists can charge a positive copy price at arbitrarily large $\alpha$, provided important advertisers do not dislike all the topics. Proposition 1 generalizes to:

**Proposition 5** If $\alpha^j$ is sufficiently small for all $j \in J$, a monopolist reports fully accurately on all topics, $r_k = 1$ for all $k \in K$. Since $r^i_{\min} = 0$ for all $i$, the level of accuracy is zero on any topic disliked by sufficiently many advertisers, $r_k = 0$ if $t^j_k > 0$ for any $j \in J$ with $\alpha^j$ sufficiently large.

6.2 Duopoly

The multiple topic case permits horizontal as well as vertical differentiation; market segmentation becomes even easier.

**Example 4.** Consider the case with three topics, two reader types with $((s_1^1, s_2^2, s_3^3), b^1) = ((\frac{2}{3}, \frac{1}{3}, \frac{1}{3}), 0)$ and $((s_1^2, s_2^2, s_3^2), b^2) = ((\frac{1}{3}, \frac{1}{3}, \frac{2}{3}), 0)$, and one advertiser type with $(t^1, t^2, t^3) = (0, \frac{3}{4}, 0)$. Horizontal differentiation occurs for any $\alpha < 0.83$. Each paper specializes in reporting fully accurately on one
of the two topics (1 and 3) that particularly interest readers. In addition, they also both report fully accurately on topic 2 (charging a monopolistic price of $\frac{1}{12}$) until $\alpha$ reaches 0.5, and at $\alpha = 0.5$, they both cut accuracy on topic 2 to zero (and cut $p$ to $\frac{2}{3}$) to raise advertising profits. When $\alpha$ is large ($\alpha \geq 0.83$), product differentiation is impossible and the papers report with full accuracy on all topics and set zero prices.

Adding stage 0, commitment by advertisers again permits them to gradually force reporting on topic 2 down to zero while the market is segmented. When it is no longer possible to sustain product differentiation, accuracy (and the cut-off levels set by the advertisers) jump up to $\bar{r}_2 = 0.44$ and again gradually drop down to zero. Figure 4 presents the accuracy levels on topic 2 in both cases; accuracy on topic 2 is generally below the level in the no-commitment case. □

**Proposition 6** If, in a duopoly, $\alpha^j$ is sufficiently large for some $j \in J$, then the unique subgame perfect equilibrium has $r_n = 1$ and $p_n = 0$ for $n = 1, 2$.

Any sufficiently important advertiser provokes a fully accurate subgame perfect equilibrium, until we introduce advertiser commitment power. Sufficient importance of advertising then takes us back to the monopoly case provided that the large advertisers share a common concern.

**Proposition 7** If in a duopoly with cut-offs there is one large advertiser type, say $j$, (i.e., where $\alpha^j$ and $\frac{2}{\alpha^j}$, $j' \neq j$, are all sufficiently large), then there is a subgame perfect equilibrium where all papers set zero accuracy on any topic disliked by the large advertiser, $r_k = 0$ if $t^i_j > 0$.

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15 This result relies on the assumption that both readers have a single ideal point in terms of reporting strategy, i.e., all readers prefer (possibly weakly) $r = 1$ to anything else. For the more general, symmetric preferences, $s^i, \bar{s} \in [-1, 1]^K, i \in I, j \in J$, our full accuracy equilibrium may not be subgame perfect and market segmentation may be sustainable even with large $\alpha$. Similarly, one can escape Gabszewicz et al.’s (2001) pensee unique convergence result. Except for the fact that our model is linear rather than quadratic, this framework generalizes both Gabszewicz et al. (2001) and Mullainathan and Shleifer (2004). We leave a fuller analysis to future research.
In summary, the commonalities of large advertisers combine additively in the results based on ad space pricing, but advertiser differences can inhibit coordinated use of cut-off threats.

7 Concluding Remarks

In this paper, we have developed two main ideas. First, we showed that even if advertisers have no commitment power, they can affect news reporting because newspapers appropriate a share of advertising surplus and therefore internalize advertiser concerns. Second, we showed that any actor generating substantial income for the newspaper can affect its reporting if able to commit to cut off its trade with the paper contingent on undesirable news reporting.

The first idea offers a complementary perspective to the work of Mullainathan and Shleifer (2004). By modeling advertisers as well as readers, we have identified a strong role for competition in reducing bias. The influence of advertising on news reporting is strong in the monopoly case. Things are very different in the duopoly case. The effect of advertising is weaker. Also, we found the paradoxical result that larger advertisers may actually reduce news bias. This paradoxical effect is related to Gabszewicz et al. (2001). In their model, advertising’s impact on the intensity of competition causes the papers to converge to a centrist ideology, just as parties converge to a central platform in one-dimensional Downsian competition for votes. By contrast, our model identifies a positive role for competition.

The second idea is important in two respects. On one hand, it qualifies the positive effect of advertising size on bias, by showing that with commitment power, sufficiently numerous or large advertisers can induce competing papers to bias news by as much as would a monopoly paper. The centrist ideology involves bias just as do the other ideologies, so convergence is undesirable. It prevents people comparing information from different papers; see Mullainathan and Shleifer (2004) on notions of conscientious readers and aggregate bias.

The source of the paradoxical result lies in the dependence of advertisers on a paper…
hand, it provides a formal foundation for the view that a whole range of actors (governments, political parties and large firms, as well as advertisers) can unobtrusively influence news reporting. Our results complement the empirical work of Reuter and Zitzewitz (2004) and are also relevant to Besley and Prat’s (2001) work on “media capture” by the government, since they show how governments can influence news without visibly interfering.

Our theory has clear policy implications. First and foremost, we have seen how media competition can prevent harmful effects of advertising on news reporting. Second, our analysis of commitment strategies suggests a serious risk of news bias when governments and businesses are free to pay subsidies to newspapers. Future work could tie down precise welfare implications from a consumer or electoral perspective.18

Ultimately, the media impact of advertising (and of other channels as discussed in Section 5.2) is an empirical matter. Our derivation of advertisers’ induced news preferences is central to our first set of results, namely that advertising can cause bias even when readers are unbiased and newspapers are profit-maximizing. Our theoretical framework suggests that empirical work should estimate the sensitivity and correlation of advertisers’ preferences over reporting in papers where they advertise, the financial value of ad contracts, and (most importantly) the competitiveness of the newspaper attracting readers, whereas readers do not care about advertising. Advertiser commitment powers counterbalance this effect. Another plausible counterforce arises when newspapers rely on advertising revenue to defray costs and compete in the market for readers. Readers then depend (indirectly) on advertisers to subsidize newspaper production. If all advertisers contract with a single newspaper, potential competitors will be unable to pay fixed costs of market participation. This extension (endogenizing the number of newspapers) is linked to Ferrando et al. (2004) whose formal analysis suggests that, “the financial dependence of the media industry on advertising constitutes one of the major vectors of concentration in this industry;” see also Baker (1994) and Bagdikian (2000).

18Strömberg’s (2001 and 2004) theoretical and empirical analysis is pertinent: He shows how politicians are more responsive to voters with better access to news, and notes that newspapers respond more to the news interests of readers of high value to advertisers; see also Baker (1994) and Hamilton (2004).
market. For testing our second set of results (based on cut-off commitments), all “subsidies” to newspapers should be measured. Estimating bias in news reporting has already become an important research topic in economics. We therefore believe it will soon be possible to test our specific predictions and evaluate the role of advertising in media bias.

**Appendix**

**Proof of Lemma 1.** In stage 4, newspapers make a take it or leave it offer to each advertiser and are therefore able to extract the full (newspaper-specific) advertising surplus per advertiser. They set prices equal to the advertiser surpluses, thus making the advertisers’ overall utilities as in Equation (1) equal to zero. □

**Proof of Proposition 1.** Reporting strategy \( r \) and copy price \( p \) are chosen at stages 1 and 2 to maximize the continuation payoff \( \pi(p, r) \) defined in Equation (3). When \( \alpha = 0 \), we get full accuracy \( (r = 1) \), because marginally raising \( r \) permits raising \( p \) at a rate of at least \( \min_{i \in I} s_i > 0 \) and has no cost.

For large \( \alpha \), we first prove that \( r = r_{i \min} \) for some \( i \in I \). Suppose to the contrary that \( r \in (r_{i1 \min}, r_{i2 \min}) \) for some pair of reader types, \( i_1 \) and \( i_2 \) with consecutive values of \( r_{\min} \). By reducing \( r \) towards \( r_{i1 \min} \) and reducing \( p \) by \( \max_{i \in I} s_i \) times the reduction in \( r \), the paper avoids losing any readers and it increases its advertising revenue at the rate \( \alpha t \sum_{i=1}^{I} x^i(p, r) \), while only decreasing reader revenue at the rate \( \max_{i \in I} s_i \sum_{i=1}^{I} x^i(p, r) \). Since \( t > 0 \), for sufficiently large \( \alpha \), the gain in advertising revenue dominates the lost reader revenue. This contradicts the optimality of the above \( r \) and proves the claim.

Given \( r = r_{i \min} \), if \( p > 0 \), reducing \( p \) to 0 strictly increases readership by at least 1 (the readers \( i \) with \( r_{i \min} = r \) start buying when \( p = 0 \)) and this raises advertising revenue by at least \( \alpha(1 - tr) \) which again dominates the loss in reader revenue of \( \sum_{i=1}^{I} px^i(p, r) \) for sufficiently large \( \alpha \) (notice that \( 1 - tr > 0 \) by the assumption in Subsection 2.4). The monopolist’s profits are
therefore given by $\pi(0, r^i_{\text{min}})$ and $i$ is chosen to maximize this. Hence $i = \hat{i}$ as stated. □

**Proof of Proposition 2.** If newspaper 2 sets $r_2 < r_1$ at stage 1, (newspaper) 1 wins all the readers in the continuation game so 2 gets zero profits (if $sr_1 > b_1$ since otherwise neither paper gets readers, and either one could gain by deviating to $r = 1$, say). To show this, we prove that the unique SPE of this continuation game has $x_1 = 1, x_2 = 0, p_1 = s(r_1 - r_2)$ and $p_2 = 0$: If 1 sets $p_1 > sr_1 - b$, then 2 would respond by setting $p_2$ marginally below $p_1 - s(r_1 - r_2)$, because this wins all the readers (pricing above $p_1 - s(r_1 - r_2)$ wins no readers at all), maximizing reader revenue and advertising revenue (given that $r_2$ is fixed). 1 would then get no readers and no profits, but by setting $p_1$ marginally below $sr_1 - b$, 1 can guarantee winning all the readers even if 2 sets $p_2 = 0$. So 1 must set $p_1 \leq sr_1 - b$. If the inequality is strict, 1 could always increase profits by raising $p_1$ marginally. It follows that $p_1 = sr_1 - b$. Also, $x_1 = 1$ here, because otherwise 1 would marginally reduce $p_1$ to win over the $1 - x_1$ remaining readers.

If newspapers set $r_1 = r_2$, then Bertrand price competition generates zero prices. If one paper sets a positive price, the other paper can either set a higher price and get no readers, set the same price and get some fraction (in $[0, 1]$) of the readers, or win all the readers by setting a lower price. Since a newspaper without readers makes no profits, and at least one paper can sharply increase its readership and profits by setting a price marginally below that of its competitor, competition drives prices down to zero.

So, given any pure strategy by (say) paper 1 with $r_1 < 1$, the other paper’s response takes all the readers and leaves 1 with no profits: if 2 sets $r_2 < r_1$, it gets no profits whereas it is guaranteed positive profits if it sets $r_2 > r_1$. $r_2 = r_1 < 1$ cannot be an equilibrium, because at least one paper could marginally raise $r$ and sharply increase its readership (and hence advertising profits if $\alpha > 0$) and marginally increase reader revenue. (The only case in which paper 1 might accept $r_1 < 1$ is if it gets no profits no matter what it
does. This cannot occur if \( r_2 < 1 \) because it could then dominate \( r_2 \), but if \( r_2 = 1 \) and \( \alpha = 0 \), then any \( r_1 \) is possible. Similarly, \( r_1 = 1 \) and any \( r_2 \) is a feasible equilibrium. Notice that all readers are reading a fully accurate paper in this case, but prices could be positive.) However, the equilibrium with \( r_1 = r_2 = 1 \) and zero prices is the only possible equilibrium, since given \( \alpha > 0 \) both papers make profits (a positive number of readers leads to positive advertising profits - we assume readers randomize when the papers are identical) and so neither is willing to set a lower value of \( r \) since it would lead to zero readers and therefore also zero overall profits.

**Proof of Proposition 3.** Part (a). Suppose \( \alpha = 0 \) and readers are strongly diverse with, say, type 1 readers having (\( \ast \)) \( s^1 - b^1 > 2(s^2 - b^2) \). The indifference curves of \( i = 1, 2 \) of newspaper offers that are just individually rational for each type are defined by the equations \( s_i r - p = b_i \) which, defining \( p^{IR_i}(r) = s_i r - b_i \) can be rewritten as \( p^{IR_i}(r) = p \). The diversity condition requires that these lines intersect in \((r, p)\) space at some \( r^0 \in (0, 1] \) and \( p^0 > 0 \). In particular, there exists \( \hat{r} \in (0, 1) \) for which \( p^{IR_2}(\hat{r}) = 2p^{IR_1}(\hat{r}) \) (notice that at the intersection point, \( p^0 = p^{IR_2}(r^0) = p^{IR_1}(r^0) \), and so \( 0 < \hat{r} < r^0 \) from (\( \ast \)) and since \( b^i, s^i \geq 0 \)). We claim that \( r_1 = 1 \) and \( r_2 = \hat{r} \) and the converse \( r_1 = \hat{r} \) and \( r_2 = 1 \), are the unique SPE reporting outcomes.

To see this, we begin by characterizing the continuation games after stage 1 given any pair of choices \( r_1, r_2 \). By symmetry, we can restrict to the case \( r_1 \geq r_2 \). If \( r_1 = r_2 \), then both papers attract both types and hence they have a sharp gain from a marginal price cut that wins the other paper’s readers, so we must have \( p_1 = p_2 = 0 \). Suppose then \( r_1 > r_2 \). Case (i): All readers buy from 1. Then 1 must set a price \( p_1 \) just low enough to attract all readers against \( p_2 = 0 \) (since 2 will have to cut to \( p_2 = 0 \) to get readers). So \( s_1 r_1 - p_1 = s_1 r_2 - 0 \), i.e., \( p_1 = s_1 (r_1 - r_2) \). 2 gets zero profits and 1 gets profits of \( 2p_1 = 2s_1 (r_1 - r_2) \). Case (ii): Type 1 readers buy from 1 and type 2 from 2. Then each paper maximizes its profits at \( p_1 = p^{IR_1}(r_1) \) and \( p_2 = p^{IR_2}(r_2) \) (reader indifference cannot be a binding constraint, because
with either type indifferent, price competition would allow one paper to win all readers). This segmentation is only feasible if 1 would have to at least half its price to attract type 2 readers and conversely (this is just sufficient to prevent each paper from deviations that double its readership). So we need (**) \( p^{IR_1}(r_1) \geq 2p^{IR_2}(r_1) \) and \( p^{IR_2}(r_2) \geq 2p^{IR_1}(r_2) \). Finally, notice that there is no case with type 2 readers buying from 1, and type 1 readers buying from 2, because \( s_1 > s_2 \) implies type 1 readers would then also prefer 1. Also, there is no case with no readers buying from 1, because 1 would then lower prices to win all the readers of at least one type.

Next consider stage 1 and suppose again \( r_1 \geq r_2 \). Case (1): \( r_2 = r_1 < 1 \). Here either paper could gain by deviating to \( r = 1 \) and attract all readers with \( p \) at or just below \( s_2(1 - r) \). Case (2): \( r_2 < r_1 < 1 \). Whether the market is segmented or not, 1 gains by deviating to \( r_1 = 1 \) because this at least weakly reduces price competition and always allows 1 to increase prices. Case (3): \( r_2 \leq r_1 = 1 \). Here 2 could set \( r_2 \leq \hat{r} \) so that the market is segmented (both conditions under (**)) are satisfied here because of strong diversity and construction of \( \hat{r} \), and \( r_2 = \hat{r} \) is dominant in this range, since 2's profits fall with \( r_2 \); 2 could also set \( r_2 > \hat{r} \), but this leads to zero profits (see argument above since either Case (i) or (ii) above must hold), whereas \( \hat{r} \) generates positive profits. Hence the unique SPE has \( r_1 = 1 \) and \( r_2 = \hat{r} \) or vice versa. Now note that for sufficiently small \( \alpha \), we can construct a similar SPE, since all payoffs are continuous in \( \alpha \) at \( \alpha = 0 \) and the inequalities of Definition 1 are strict.

Part (b). As \( \alpha \) further increases, the incentive to capture all readers increases. The segmentation equilibrium in (a) is unsustainable, because for sufficiently large \( \alpha \), the paper with higher \( r \) would compete to take all the readers. Once segmentation is ruled out, there is no equilibrium with \( r_1 \neq r_2 \), because in such equilibria the low \( r \) paper makes zero profits by (b) above (recall that all cases other than Case (i) above are now ruled out). Hence, the unique SPE has \( r_1 = r_2 = 1 \) and zero prices as in Proposition 2. □

28
Proof of Proposition 4. Given any \( \bar{r} \in [0, 1] \) and \( \alpha \) sufficiently large, there is a SPE with \( r_n = \bar{r}, \ n = 1, 2 \) and zero prices. By setting \( r > \bar{r} \), a paper gets all the readers, but even the full reader surplus is less than the quarter of the advertising surplus guaranteed from getting half the readers at \( \bar{r} \). This is the unique continuation equilibrium given \( \bar{r} \), because lower \( r_n \)'s are ruled out just as in the cases treated in Proposition 3’s proof. With \( \alpha \) sufficiently large, the advertisers choose \( \bar{r} \) to maximize their surplus \((\frac{1}{2} \sum_{i \in I} x_n(0, \bar{r})(1 - tr))\) at \( r_{\min}^* \), since the monopolist’s objective at \((\bar{r}, 0)\) only differs by \( 2\alpha \) times the advertiser surplus. Notice that in the limit, the equilibrium of this proposition Pareto dominates all the other ones for both advertisers and newspapers. \( \square \)

Proof of Proposition 5. The proof is almost exactly as in Proposition 1, because we can study variations in \( r_k \) for a single topic at a time. The multiple advertiser types pose no problem for the results about large \( \alpha_j \) because reducing \( r_k \) weakly raises revenue from all advertiser types. However, the zero price result would no longer hold if we allowed there to be some topics \( k \) that are not disliked by any large advertisers (i.e., \( t_j^k = 0 \) for all the advertisers \( j \) with \( \alpha_j \to \infty \)). \( \square \)

Proof of Proposition 6. This result extends Proposition 3(b). The idea of the proof is very similar. Take a stage 1 profile \( (r_1, r_2) \leq 1 \) with \( r_1, r_2 \neq 1 \), and suppose without loss that the subgame perfect continuation payoff for newspaper 1 is greater or equal to that of newspaper 2. We show that 2 then has an optimal deviation to set \( r_2' \geq r_1 \) with \( r_2' \neq r_1 \) (for any \( \alpha > 0 \)). So the two papers drive accuracy up to \( r_n = 1 \) in any subgame perfect equilibrium. To see this, fix \( r_1 \leq 1 \) with \( r_1 \neq 1 \) and consider the payoff function of newspaper 2,

\[
\sum_{i \in I} p_2 x_2^i + \sum_{j \in J} \alpha^j \left( \sum_{i \in I} x_2^i (p_2, r_2) \sum_{k \in K} (1 - t^j_k r_2^k) \right)
\]
since \( \bar{r}^j = 1 \) and \( t^j \in [0, 1)^K, j \in J \). The numbers of readers are characterized by the following lemma.

**Lemma 2** Under the assumptions of Proposition 6, if \( r'_2 \geq r_1 \) and \( r'_2 \neq r_1 \), then newspaper 2 captures all the readers, \((\sum_{i \in I} x^i_2(p, r_1, r'_2) = 2)\) and \(\sum_{i \in I} x^i_1(p, r_1, r'_2) = 0)\).

To see this, notice that because there are no reservation values for readers and \( s^i_k > 0 \) for all \( k \in K, i \in I \), newspaper 2 can attract all the readers by charging sufficiently low prices. Since \( \alpha^j \) is large for at least one advertiser, it will be in newspaper 2’s interest to charge a lower price to capture all the readers. \( \square \)

Now, given \( r_1 \), if newspaper 2’s continuation payoff at \( r_2 \) is less than or equal to newspaper 1’s payoff, 2 would gain by deviating to some \( r'_2 \) sufficiently close to \( r_1 \) with \( r'_2 \geq r_1 \) and \( r'_2 \neq r_1 \). This gives almost the same advertising profits as paper 1 scaled up by the total number of readers divided by the original number of readers of paper 1; the scale factor exceeds unity and advertising revenues dominate reader revenues; paper 2 would be getting more than paper 1 had. Hence there is no subgame perfect equilibrium with either \( r_n \leq 1 \) and \( r_n \neq 1 \). To see that the profile \((r_n, p_n) = (1, 0), n = 1, 2, \) is part of a subgame perfect equilibrium, notice that by Lemma 2, newspapers cannot have a profitable deviation by changing the level of accuracy since they would get zero readers and hence zero profits. At \( r_1 = r_2 = 1 \), prices charged in stage 2 will be zero; the argument of the proof of Proposition 2 (see paragraph 2) applies here as well. \( \square \)

**Proof of Proposition 7.** Under the stated assumptions, one can effectively neglect all but one advertiser. This result immediately extends Proposition 4. The proof uses Proposition 6 (in place of Proposition 3) to verify that \( r = \bar{r}^j \) and zero pricing constitutes the unique SPE for sufficiently large \( \alpha^j \). \( \square \)
References


Example 1: Optimal accuracy levels (solid line) and reader prices (dashed line)

Figure 1

Example 2: Equilibrium levels of accuracy (solid line) and reader prices (dashed line)

Figure 2

Example 3: Equilibrium levels of accuracy (solid line) and reader prices (dashed line)

Figure 3

Example 4: Equilibrium levels of accuracy on topic 2 without cutoffs (solid line) and with cutoffs (dashed line)

Figure 4