What Do the Papers Sell?

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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 a monopoly newspaper under-reports or biases news that sufficiently reduces advertiser profits, whereas in the duopoly case, newspapers may paradoxically increase accuracy as the size of advertisers grows. We then show how advertisers can thwart this competitive effect on newspaper accuracy by committing to certain cut-off strategies, potentially inducing the same level of under-reporting as in the monopoly case.

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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 much more 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 adver 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., 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, but media scholars such as Hamilton (2004) and Herman and McChesney (1997) are skeptical. They suggest that heavy dependence on advertising leads papers to bend news to

\[1\text{Advertising also allows readers to learn about consumer products and may even be enjoyable (Gabszewicz et al., 2003), but most papers assume a “nuisance cost.”}\]
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 give examples and a microfoundation of advertiser preferences for under-reporting or bias on topics such as depressing news, global warming, corporate malpractice and 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, because it can affect mood and salient concerns while reading, and ongoing reporting can affect beliefs and attitudes: The advertiser surplus per reader increases with under-reporting or bias on the sensitive topics.

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. 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. An alternative hope is that advertisers who dislike a common topic will face a free-rider problem in pressuring newspapers. Our model shows that papers adjust reporting because they internalize a share of advertiser surplus.

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2Even 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.

3Relatedly, some media monitors (e.g., Media Watch and Fair) and journalists complain that advertisers shun newspapers that contravene implicit norms of “business-friendliness.”
We focus on the case of monopoly and duopoly newspapers. Also, to isolate the role of advertising, we assume that all readers strictly prefer maximal 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.

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 the following 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 re-

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4Large fixed costs of producing news and establishing a reputation imply that local markets contain few serious newspapers; see e.g., Genesove (2003).
ports above a chosen threshold or cut-off.\textsuperscript{5} 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 both newspapers to under-report or bias as much as in the monopoly case. This provides a compelling foundation for Reuter and Zitzewitz’s (2004) data suggesting that editors of investment magazines bias news (e.g., mutual fund rankings) to favor mutual funds that advertise with them. 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 (2004)) 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 want to influence reader ideology, and Baron (2004) considers journalists

\textsuperscript{5}E.g., WNET (a television station) lost its corporate contracts after airing a documentary critical of multinational corporations; see Herman and Chomsky (1988).

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 $q_{nj}$ 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 make the standard assumption that readers buy at most one newspaper. So a reader of type \( i \) buys any paper \( n \) that maximizes its utility

\[
\sum_{k=1}^{K} s_k^i r_{n,k} - p_n
\]

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 \( b^i \leq \sum_{k=1}^{K} s_k^i \) 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

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

from advertising in newspaper \( n \) (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 \( n \):

\[
\sum_{i=1}^{I} p_n x^i_n + \sum_{j=1}^{J} \alpha^j q^j_n y^j_n. \tag{2}
\]

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).\(^6\)

### 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

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

and all advertisers buy ads in all papers, \( y^j_n = 1, \forall j \in J, n \in N \).

\(^6\)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.
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 related interpretation of \( r \) is based on “intensity”: Newspapers select the frequency, length, and prominence (e.g., frontpage headline) with which they report on given topics.

\(^7\)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).
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;\(^8\) 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). 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 reducing the effectiveness of advertising cosmetics in that paper (see Chaiken et al. (1996); Cialdini (1993) emphasizes the influential power of message repetition).

More specifically, we assume advertisers make profits $m$ per unit sold, where $m$ is the markup over unit cost. Let $z_{ij}$ denote the expected quantity of goods purchased by reader type $i$ from advertiser $j$. Since reader $i$ comes across $j$’s ad through paper $n$ only if $y_{jn} = 1$, we can write

$$z_{ij} = \bar{z}_{ij} + \sum_{n \in N} x^i_n \left( 1 - \sum_{k=1}^K t^j_{n,k} r_{n,k} \right) y^j_n,$$

\(^8\)We 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:

“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))
where $\bar{z}^{ij}$ 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 $q^j_n y^j_n$. We can thus write advertiser $j$’s overall profit function as

$$\sum_{i \in I} \bar{z}^{ij} + \sum_{i \in I} \sum_{n \in N} x^i_n \left( 1 - \sum_{k=1}^{K} t^i_{r,n,k} \right) y^j_n - \sum_{n \in N} q^j_n y^j_n - F$$

$$= \bar{z}^j + \sum_{n \in N} \left( \sum_{i \in I} u^i_n \left( 1 - \sum_{k=1}^{K} t^i_{r,n,k} \right) - q^j_n \right) y^j_n - F$$

where $\bar{z}^j$ 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, 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.

A third possible interpretation is that $r$ represents the “complexity” or “depth” of reporting. As suggested in the above quotation by Le Lay (footnote 8), 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

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9See 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.
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.

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 the popular pressure for regulation of an industry or a monopolistic company. We analyze this 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:

\[
\pi(p, r) = \sum_{i=1}^{I} px_i(p, r) + \alpha \sum_{i=1}^{I} x_i(p, r)(1 - tr) \quad (3)
\]

The first term represents reader revenue (from selling copies) and the second term represents advertising revenue (from selling space). Our main result 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

\[ r_{\text{min}}^i = \frac{b^i}{s^i} \]  \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.** Consider the case with two reader types, \((s^1, b^1) = (1, \frac{3}{5})\), \((s^2, b^2) = (\frac{1}{5}, 0)\), and \( \alpha \) advertisers of type \( t = \frac{1}{2} \). When \( \alpha \) is small (\( \alpha < 0.48 \)), readers determine accuracy; the paper selects maximal accuracy (\( r = 1 \)) and sets a copy price of \( p = \frac{5}{8} \). This extracts the surplus from the type 1 readers – 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 0.48, the newspaper cuts \( r \) from 1 to \( \frac{3}{7} \) and simultaneously cuts \( p \) to \( \frac{3}{56} \) so that all readers buy the paper. When \( \alpha \) reaches 2, the newspaper further reduces accuracy to \( r = \frac{3}{8} (= r_{\text{min}}^1) \) 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 large \( \alpha \) (i.e., for all \( \alpha \geq 2 \)).\( \square \)

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 sets \( p = 0 \) and \( r = r_{\text{min}}^i \) 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

\(^{10}\)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 \( r_{\text{min}}^i > 0 \). We do not pursue this.
to the minimal level \( r = r^*_{\min} < 1 \), sufficient to attract reader type \( \hat{i} \), where 
\[
\hat{i} = \arg\max_{i \in I} \pi(0, r^i_{\min}).
\]

An immediate corollary is that if all readers have zero reservation values 
\( (b^i = 0 \forall \hat{i} \in I) \), 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 then predicts 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. Adjusting our model to capture this (by adding noise in the observability of \( r \)) would increase the importance of our analysis, because advertising is then likely to 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 $a^j \left[ \sum_{i \in J} x^i_n \left( 1 - \sum_{k=1}^{K} t^i_k r_{n,k} \right) \right] - q^i_n$.

For this case, Lemma 1 must be adjusted: the paper would charge a price of $q = \alpha \sum_{i \in J} x^i (1 - tr)$ to this advertiser giving exactly the same profit function and hence reporting choice 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.

## 4.1 Homogeneous Readers

Reader homogeneity precludes market segmentation. Bertrand price-setting generates perfect competition for readers, who and they 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 $n = 1, 2$.

\(^{11}\)The intuition is that each advertiser gets a selective benefit from rewarding (with more ads) newspapers that under-report that topic. Reporting outcomes only change if collusion or size gives advertisers greater bargaining power relative to the papers; see Section 5.
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. Consider a situation identical to that of Example 1, except that \( N = 2 \) instead of 1 (i.e., add one further newspaper, so \( I = 2, J = K = 1 \); \( s^1, b^1 = (1, \frac{9}{8}), s^2, b^2 = (\frac{7}{8}, 0); t = \frac{1}{2} \)). For small \( \alpha \) (\( \alpha < 0.48 \)), 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 1a shows how increasing \( \alpha \) leads the low accuracy paper to reduce its accuracy so that market segmentation is maintained; at \( \alpha = 0.25 \) it reduces accuracy to zero to raise advertiser profits (a local monopoly response). However, when \( \alpha \) gets too large (at \( \alpha = 0.48 \)), market segmentation becomes impossible. The value of each reader, given corresponding advertising profits, is too high. Newspapers then compete to full accuracy, and copy prices drop to zero. See Figures 1a and 1b. \( \square \)

To generalize this idea, 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 \( b^1 \) and \( b^2 \) intersect in \((r, p)\) space at some \( r \in (0, 1] \) and \( p > 0 \).

Definition 2. Two reader types \( (s^i, b^i) \in [0, 1]^2, i = 1, 2 \), are strongly diverse if 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 stronger condition of Definition 2 (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 (i.e., perfect competition).

This result 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 competition intensity effect is straightforward, but the result is overturned when advertisers have sufficient commitment power as we now show.

## 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 allow 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

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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).
excessive prices \( q_n \) 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. Advertising prices fall to exactly half the value characterized in Lemma 1 and quantities are unchanged. Our results so far are qualitatively unaffected (\( \frac{\alpha}{2} \) 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 can set a cut-off level of accuracy \( \bar{r} \), which commits them to set \( y_n = 0 \) if \( r_n > \bar{r} \); Lemma 1 no longer holds. We refer to this as the model with cut-offs.

We are interested in 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 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 sufficiently large \( a \)) since it generates zero advertising revenue. (There is a subgame perfect equilibrium with \( r_n = 1 \) and \( p_n = 0 \) for \( n = 1, 2 \), but this is Pareto dominated for the newspapers; hence we view the outcome with \( r_n = \bar{r} \) and \( p_n = 0 \) as more plausible). The remaining question is how the advertiser will set \( \bar{r} \). For a fixed readership, the advertiser surplus is decreasing in \( \bar{r} \), so the advertiser minimizes \( \bar{r} \) subject to the problem of satisfying \( r_{\min}^i \) for enough readers. Given that with a large, reader profits become relatively increasingly insignificant, the advertiser’s tradeoff in the limit becomes the same as that of the monopolist as 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. But 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, and it is Pareto optimal for them to all set \( r = \bar{r} \); we view this as a plausible prediction.

**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: \( r_n = \bar{r} = r^i_{\min}, n = 1, 2, \) as in Proposition 1.

For intermediate values of \( \alpha \) and \( a \), the loss of advertising custom is less important relative to winning revenue from readers so advertisers will be ignored if their cut-offs are too demanding. 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 makes no difference to pricing and accuracy for low \( \alpha \) (in this particular example, reporting strategies are fully dictated by the need to segment the market). Market segmentation again becomes impossible after \( \alpha = 0.48 \), but instead of jumping up to 1, \( r \) now jumps up to \( \bar{r} = 0.68 \) and prices fall to zero. As \( \alpha \) increases, advertisers can make increasingly stringent demands and both papers have accuracy \( r = \bar{r} \), decreasing gradually (according to \( r = \frac{2(1-\alpha)}{2-\alpha} \)) until it hits the limiting monopoly value, \( r^i_{\min} = r^1_{\min} = \frac{3}{8} \), and stays there for all \( \alpha \geq 0.77 \); prices stay at zero. See Figure 2. □

### 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

\[
\sum_{i \in I} x^i_n \left( 1 - \sum_{k=1}^{K} T^j_k r_{n,k} \right)
\]
for each actor of type $j$, *independent* of whether it advertises ($y^j_n = 1$) in paper $n$ (hence the absence of the price term $q^j_n$). 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.\(^3\)

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. Central and regional governments make explicit subsidies: e.g., several major dailies receive very large subsidies from the Treasury and Social Security; mass subscriptions generate an additional, hidden subsidy. For example, 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). Credit from public institutions (and also private institutions) is the third main channel for effective subsidy.

Ownership, control rights (e.g., to appoint directors), and censorship are

\(^{13}\)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.
other more obvious and direct mechanisms for influence, but more subtle forms of influence are particularly problematic as they may go unnoticed.\textsuperscript{14} Our theoretical result (Proposition 4) suggests that large subsidies from parties with an obvious interest in news reporting should be viewed with suspicion, because they may restrict news accuracy. This hurts readers and causes undersupply of news; advertisers with commitment power can influence reporting by more than desired under the utilitarian welfare function of our model. 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 and in the gathering of evidence on companies’ social impact (e.g., concerning health and 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 $b^i = 0$, $s^k_i > 0$ 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:

\textsuperscript{14}Advertising is particularly important, since the influencing actor derives a direct benefit from advertising as well as from the influence unlike financial subsidies.
**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 $r_{\text{min}}^i = 0$ for all $i$, the level of accuracy is zero on any topic disliked by sufficiently many advertisers, $r_k = 0$ if $t_k^j > 0$ 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 $(s_1^1, s_2^1, s_3^1), (b^1) = ((\frac{2}{5}, \frac{1}{3}, \frac{1}{7}), 0)$ and $(s_1^2, s_2^2, s_3^2), (b^2) = ((\frac{2}{5}, \frac{1}{3}, \frac{1}{2}), 0)$, and one advertiser type with $(t_1^1, t_2^2, t_3^3) = (0, \frac{3}{14}, 0)$. Horizontal differentiation occurs for any $\alpha < 0.25$; each paper specializes in reporting accurately on one of the two topics (1 and 3) that particularly interest readers. They both report fully accurately on topic 2 (and charge a monopolistic price of $\frac{11}{12}$) until $\alpha$ reaches 0.25, at which point they both cut accuracy on topic 2 to zero (and cut $p$ to $\frac{2}{3}$) to raise their advertising profits. When $\alpha$ is large ($\alpha > 0.42$), 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, for sufficiently large $\alpha$, to gradually force reporting on topic 2 down to zero. Figure 3 presents both cases: the reporting outcome $r$ is the same until $\alpha$ reaches 0.42; then $r$ jumps up to 1 and stays there in the no-commitment case; while in the commitment case, $r$ jumps up to 0.44 and gradually falls to 0 and stays there. □

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

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

**Proposition 7** In a duopoly with endogenous $\bar{r}$ and one large advertiser type $j$ (i.e., with $\alpha_j$ and $\bar{\alpha}_j$ sufficiently large for all $j' \neq j$), there is a subgame perfect equilibrium where all papers set zero accuracy on any topic disliked by the large advertiser, $r_k = 0$ if $t_k^{ij} > 0$.

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 key 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. In the duopoly case, the effect is weaker. We also found the paradoxical result that larger advertisers may even reduce news bias. This paradoxical effect is related to Gabszewicz et al. (2001). In their model, advertising’s impact on competitive intensity 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 adopt the same news bias as would be induced in a monopoly paper. On the other hand, it provides a formal foundation for the view that a whole range of actors (advertisers, but also political parties and large firms) 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.

15 The centrist ideology involves bias just as do the other ideologies. So convergence is undesirable, since it prevents people comparing information from different papers; see Mullainathan and Shleifer (2004) on notions of conscientious readers and aggregate bias.

16 The source of the paradoxical result lies in the dependence of advertisers on a paper 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.”

17 Strömberg’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 Hamilton (2004).
Ultimately, the media impact of advertising 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 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. □

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 $\alpha = 0$, $r = 1$ 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 $r = r_{\text{min}}^i$ for some $i \in I$: Suppose to the contrary that $r \in (r_{\text{min}}^{i_1}, r_{\text{min}}^{i_2})$ for some pair of reader types, $i_1$ and $i_2$ with consecutive values of $r_{\text{min}}$. By reducing $r$ towards $r_{\text{min}}^{i_1}$ 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 $r$ and therefore proves the claim.

If $p > 0$, reducing $p$ to 0 strictly increases readership by at least 1 (the readers $i$ with $r_{\text{min}}^i = r$ 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 $\alpha$ (since $1-tr > 0$ by the assumption in Subsection 2.4). The monopolist’s profits are therefore given by $\pi(0, r_{\text{min}}^i)$ 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 $sr_1 > b_1$ else neither paper gets readers - if not, neither paper gets any readers and either gains 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 $r_2 = 1$ (which is feasible given that $r_2 = 1$ is 2’s optimal response to any $r_1 < 1$) 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 robust equilibrium because if $\alpha > 0$ both papers make profits (because having readers leads to advertising profits - we assume readers randomize when the papers are identical) and so neither is willing to set a lower value of $r$ which implies zero readers and therefore zero profits (even from advertising).

**Proof of Proposition 3.** (3(a)) Suppose $\alpha = 0$ and readers are strongly diverse with, say, type 1 readers having (1) $s^1 - b^1 > 2(s^2 - b^2)$. The indifference curves of $i = 1, 2$ of offers that are just individually rational for each type are defined by the equations $p^{IR_i}(r) = s_i r - b_i$. The diversity condition requires that these lines intersect in $(p, r)$ space at some $p > 0$ and $r \in (0, 1)$. Notice that this implies $s_1 > s_2$. $r < 1$ $\iff$ $\frac{b_1 - b_2}{s_1 - s_2} < 1$ but from (1) we know $s_1 - s_2 > b_1 - b_2 + s_2 - b_2$, so if $s_1 < s_2$ then dividing by $s_1 - s_2$ would imply $1 < \frac{b_1 - b_2}{s_1 - s_2} - \frac{s_2 - b_2}{s_2 - s_1}$ which is false since $s_2 > b_2$ else the intersection price $p = s_2 \left(\frac{b_1 - b_2}{s_1 - s_2}\right) - b_2 < s_2 - b_2 < 0$. It follows that there exists $\hat{r} \in (0, 1)$ for which $p^{IR2}(\hat{r}) = 2p^{IR1}(\hat{r})$ (to see this, note that the ratio $\frac{p^{IR2}(\hat{r})}{p^{IR1}(\hat{r})} = 1$ at the intersection point and $= \infty$ at $r = p^{IR1^{-1}}(0)$ ($> 0$ since $b_1 > 0$)). 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 any pair of choices $r_1, r_2$. By symmetry, we can restrict to the case $r_1 \geq r_2$. (a)
If both papers attract both types, they have a sharp gain from a marginal price cut that wins the other’s readers, so we must have \( p_1 = p_2 = 0 \). Since this means equal prices, we must also have \( r_1 = r_2 \). Furthermore, if \( r_1 = r_2 \) then each paper’s best response is to just undercut the other, so \( p_1 = p_2 = 0 \).

(b) We now look at the possibilities with \( r_1 > r_2 \): (b(i)) If all readers buy from 1, then 1 must set \( p_1 \) just low enough to attract all readers against \( p_2 = 0 \) (since 2 would be willing to cut to \( p_2 = 0 \) to try to get readers). So \( s r_1 - p_1 = s r_2 \) at \( s = s_1 \), i.e., \( p_1 = s_1 (r_1 - r_2) \). 2 gets zero profits and 1 gets profits of \( 2p_1 = 2s_1 (r_1 - r_2) \); (b(ii)) If type 1 readers buy from 1 and type 2 from 2, then each paper maximizes its profits at \( p_1 = p^{IR1} (r_1) \) and \( p_2 = p^{IR2} (r_2) \) (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 (2) \( p^{IR1} (r_1) \geq 2p^{IR2} (r_1) \) and (3) \( p^{IR2} (r_2) \geq 2p^{IR1} (r_2) \); (b(iii)) 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 buying from 1 and type 2 from 2 would then also prefer 1; (b(iv)) 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.

Now we study stage 1, looking again for equilibria with \( r_1 \leq r_2 \) : (A) If \( r_1 = r_2 < 1 \) then either paper could gain by deviating to \( r = 1 \) and attract all readers with \( p \) at or just below \( s_2 (1 - r) \); (B) If \( r_2 < r_1 < 1 \), then 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; (C) If \( r_1 = 1 \), then 2 could set \( r_2 \leq \hat{r} \) so that the market is segmented (both conditions (2 and 3) 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 (since (b(i)) must hold if (b(ii)) does not 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, we can construct a similar subgame perfect equilibrium, since all payoffs are continuous in $\alpha$ at $\alpha = 0$.

(3(b)) As $\alpha$ continues to increase the incentive to capture all the 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 $r_1 < r_2$ nor its converse, because in such equilibria the low $r$ paper makes zero profits by (b) above (recall that all cases other than (b(i)) are now ruled out). Hence, the unique SPE has $r_1 = r_2 = 0$ and zero prices as in Proposition 2. □

**Proof of Proposition 4.** Given any $\bar{r} \in [0, 1]$, 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 after $\bar{r}$, because lower $r_n$ are ruled out just as in the case where $\bar{r} = 1$, treated in Proposition 3’s proof. For sufficiently large $\alpha$, the advertisers choose $\bar{r}$ to maximize their surplus $(\frac{1}{2} \sum_{i \in I} x_{n i}^i (0, \bar{r}) (1 - t \bar{r}))$ at $r_{min}^j$ - to see this note that the monopolist’s objective only differs by $\frac{1}{2\alpha}$ times the reader surplus from $(\bar{r}, 0)$. (Notice that in the limit, the equilibrium of this proposition Pareto dominates all the other ones for both advertisers and newspapers.) □

**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 $\alpha^j \to \infty$). □

**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,

\[
\sum_{i \in I} p_2 x^i_2 + \sum_{j \in J} \alpha^j \left( \sum_{i \in I} x^i_2(p_2, r_2) \sum_{k \in K} (1 - t^j_k r_{2,k}) \right)
\]

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, after \((r_1, r_2)\), if newspaper 2’s continuation profits were less than or equal to newspaper 1’s profits, newspaper 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 so 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 since the argument (paragraph 2) in Proposition 2 applies here too. □

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

**References**


Example 2: Equilibrium levels of accuracy

Example 2: Equilibrium prices for readers

Example 3: Equilibrium levels of accuracy

Example 4: Equilibrium levels of accuracy on topic 2