The Market for News

Sendhil Mullainathan
MIT and NBER

Andrei Shleifer
Harvard University and NBER *

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Abstract

We investigate the market for news under two assumptions: that readers hold beliefs that they like to see confirmed, and that newspapers can slant stories toward these beliefs. We show that, on the topics where readers share common beliefs, one should not expect accuracy even from competitive media: competition results in lower prices, but common slanting toward reader biases. However, on topics where reader beliefs diverge (such as politically divisive issues), newspapers segment the market and slant toward the biases of their own audiences, yet in the aggregate a conscientious reader could get an unbiased perspective. Generally speaking, reader heterogeneity is more important for accuracy in media than competition per se.

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1 Introduction

Several recent books have accused mainline media outlets of reporting news with a heavy political bias. Goldberg (2002) and Coulter (2003) argue that the bias is on the left, and provide numerous illustrations of their argument, while Alterman (2003) and Franken (2003) argue that the bias is on the right, with equally numerous illustrations. We examine theoretically the determinants of accuracy in media, including competition and the audiences' prejudices. We argue that the analysis of accuracy in media relies crucially on how one conceptualizes the demand for news.

In the traditional conception of the demand for news, consumers read, watch, and listen to the news in order to get information. The quality of this information is its accuracy. The more accurate the news, the more valuable is its source to the consumer. Pressure from audiences and rivals forces news outlets to seek and deliver more accurate information, just as market forces motivate auto-makers to produce better cars.[1]

This conception of the news as a source of pure information is dramatically different from that of non-economists studying the media. According to these scholars, private media want to sell newspapers and television programs, as well as advertising space. To do that, they provide a great deal of pure entertainment. But even with news, audiences want their sources not only to inform but also explain, interpret, persuade, and entertain. To meet this demand, media outlets do not provide unadulterated information, but tell stories that hang together and have a message, what is referred to in the business as "the narrative imperative."[2] In this view, news provision can be analyzed in the same way as entertainment broadcasting.[3]

In this paper, we examine these two conceptions of what the consumers want and the media do and evaluate media accuracy under different scenarios. We show, in particular, that these two conceptions have radically different implications for the accuracy of news in the competitive media, and more specifically on the question of which news issues will be reported more accurately.

Our model of rational readers seeking information shows that, indeed, consistent with economists'

[1] Coase (1974), Besley and Burgess (2002), Besley and Prat (2002), Djankov et al. (2003), Stromberg (2001), and Dyck and Zingales (2002) all advance this view of competition in the media as delivering greater accuracy.

[2] Mencken (1920), Lippmann (1921), Hayakawa (1940), Jensen (1979), Graber (1984), Hamilton (2003) and the standard communications textbook (Severin and Tankard 1992) all advance this view of news.

[3] Entertainment broadcasting is analyzed by Steiner (1952), Spence and Owen (1977), Goettler and Schachar (2001) and Gal-Or and Dukes (2003). Gabszewicz et. al. (2001) take the approach closest to ours by conceptualizing news provision in a Hotelling framework. They examine how advertisers impact content whereas we focus on media accuracy.

priors, media reporting is unbiased. We compare this to a specific behavioral model (of which the rational consumers are a special case), which relies on two assumptions, one about reader preferences, and one about the technology of delivering news.[4] We assume that readers hold biased beliefs, which might come from their general knowledge and education, from previous news, from prejudices and stereotypes, or from the views of politicians or political parties they trust. With respect to preferences, we assume that readers prefer to hear or read news that are more consistent with their beliefs. Such biased readers might believe, for example, that corporate executives are cheats and crooks, and prefer news about their indictments to news about their accomplishments. They might think that China is up to no good with respect to the U.S., and appreciate stories about Chinese spies. Some readers might like President Clinton, and prefer to read about partisan Republicans persecuting the hard-working president; others might dislike Clinton, and look for stories explaining in salacious detail the impeachability of his offenses.

The idea that people appreciate, find credible, enjoy, and remember stories consistent with their beliefs is standard in the communications literature (Graber 1984, Severin and Tankard 1992). Basic research in psychology strongly supports it. Research on memory suggests that people tend to remember information consistent with their beliefs better than that inconsistent with their beliefs (Bartlett 1932). Research on information processing shows that people find data inconsistent with their beliefs to be less credible and update less as a result (Lord, Ross and Lepper 1979, Zaller 1992, Rabin and Schrag 1999). According to Graber (1984, p. 130), "stories about economic failures in third world countries were processed more readily than stories about economic successes." People seek information that confirms their beliefs (Klayman 1995). When people categorize, they tend to ignore category-inconsistent information unless it is large enough to induce category change (Fiske 1995, Mullainathan 2002). Severin and Tankard (1992) see the demand for cognitive consistency as crucially shaping which news people listen to, and which they ignore.

Our second assumption is that newspapers can slant the presentation of the news to cater to the preferences of their audiences. The term "slanting" was introduced by Hayakawa (1940), and defined as "the process of selecting details that are favorable or unfavorable to the subject being described." Slanting is easily illustrated in a simple example. Suppose that the Bureau of Labor Statistics releases data that shows the rate of unemployment rising from 6.1% to 6.3%. What are

[4]For concreteness, we talk about newspapers, although our argument applies equally well to television and radio.

the different ways a paper can report this number? One is a single sentence report that simply presents the above fact. But there are alternatives. Consider just two.

Headline: Recession fears grow. New data suggest the economy is slipping into a recession. The Bureau of Labor Statistics reports that the number of unemployed grew by 200,000 people in the last quarter, reaching 6.3%. John Kenneth Galbraith, the distinguished Harvard economist, sees this as an ominous sign of the failure of the administration's policies. "Not since Herbert Hoover has a President ignored economic realities so blatantly. These news are only the beginning of more to come," he said. *Accompanying picture: a long line for UI benefits in Detroit, MI.*

Headline: Turnaround in sight. Is the economy poised for an imminent turnaround? Data from the BLS suggest that it might be. Newly released figures show unemployment inching up just .2% last quarter. Abbie Joseph Cohen, the Chief Stock Market Strategist at Goldman Sachs, sees the news as highly encouraging. "This is a good time to increase exposure to stocks," she says, "both because of the strong underlying fundamentals, and because the softness in the labor market bodes well for corporate profitability." *Accompanying picture: Abbie Joseph Cohen.*

Each of these stories could easily have been written by a major U.S. newspaper; in fact, stories like these, in light of public disclosure of identical facts, are written every day. Neither story says anything false, yet they give radically different impressions. Each cites authority, without acknowledging that a comparably respectable authority might have exactly the opposite interpretation of the news. Each omits some aspects of the data: the first by neglecting to mention the starting point of the unemployment rate, the second by ignoring unemployment levels. Each uses a headline, and a picture, to persuade readers who do not focus on the details. Each, in other words, slants the news, but they slant them in the opposite directions.[5]

Our model of the market for news combines the assumption of readers preferring stories consistent with their beliefs, with the assumption that newspapers can slant stories toward beliefs. We examine two crucial aspects of this environment. First, we consider two alternative assumptions about the nature of competition: monopoly versus duopoly. Our model of media competition is analogous to a Hotelling model of product placement (Tirole, 1988, ch. 7). Newspapers locate themselves in the product space through their reporting strategies (i.e., how they slant). Read-

[5]Slanting is only one of the techniques of persuasion (Cialdini 1984). Another technique is outright fabrication of news, as was routinely done by the Communist press, and is occasionally done even in prestigious Western newspapers (e.g., Jason Blair's reporting for the *New York Times*.)

ers' beliefs determine their "transportation" costs since they face psychic costs of reading papers whose reporting does not cater to their beliefs. We ask whether competition by itself eliminates, or reduces, the slanting of news, as economists often argue. We show that the answer for biased readers is clearly **no**. Competition generally reduces newspaper prices, but does not reduce, and might even exaggerate, media bias.

Second, we study heterogeneity of reader beliefs. What effect does such heterogeneity have on the nature of slanting, and the overall accuracy in media? What is the impact of competition on media accuracy when reader beliefs are heterogeneous, as in the case of beliefs about Clinton? To answer this question, it is crucial to distinguish between an average reader, who reads one source of news, from a hypothetical conscientious reader, who reads all of them. In general, competition with heterogeneous readers tends to polarize beliefs, and increases the slanting by individual media sources and the bias of an average reader. But with heterogeneous readers, the biases of individual media sources tend to offset each other, so the beliefs of the conscientious reader become more accurate than they are with homogeneous readers. Our central finding is that reader heterogeneity plays a more important role for accuracy in media than does competition.

At a broader level, this paper contributes to one of the central issues in economics, namely whether the presence of rational, profit-maximizing firms eliminates any effect of irrational participants on market "efficiency." In the context of financial markets, Friedman (1953) argued long ago that it does, and that rational arbitrageurs keep financial markets efficient. Subsequent research, however, has proved him wrong, both theoretically and empirically (Shleifer 2000, Brunnermeier and Nagel 2003). One finding of this research is that, in some situations, such as stock market bubbles, it might pay profit-maximizing firms to pump up the tulips, rather than eliminate irrationality (DeLong et. al. 1990). Subsequent research has considered the interaction between biased individuals and rational entrepreneurs in other contexts, such as the incitement of hatred (Glaeser 2002) and product design (Gabaix and Laibson 2003). Here we ask a closely related set of questions for the market for news: does competition among profit-maximizing news providers eliminate media bias? We find that the answer, as in both financial and political markets, is no. Powerful forces motivate news providers to slant and increase bias rather than clear up confusion. The crucial determinant of accuracy is not competition per se but consumer heterogeneity.

2 Model Setup

Readers are interested in some underlying variable t, such as the state of the economy, which is distributed $N(0, v_t)$. Let $p = \frac{1}{v_t}$ denote the precision. Readers hold a belief about t that may be biased; beliefs are distributed $N(b, v_t)$. Thus readers are potentially biased about the expected value of t but have the correct variance.

2.1 News and the Technology of Reporting

Newspapers are in the business of reporting news about t. They receive some data that they cover in their papers, perhaps with some slant. Following Hayakawa (1940), we assume that if newspapers slant they do so by selectively omitting specific bits of news.[6] To formalize this idea, suppose a newspaper receives a sequence of positive and negative "bits" or facts. In the example from the introduction, these facts are the unemployment rate, the unemployment rate in the past, expert opinions, other relevant economic indicators, and so on. These bits or facts are modeled as a length L string f consisting of positive $(+1)$, negative (-1) or non-existent $(\emptyset)$ pieces of news. At each position, the probability of each of these values is a function of data $d = t + \epsilon$ where $\epsilon \sim N(0, v_\epsilon)$. This d can be thought of as the underlying signal about the truth that generates the facts which newspapers see. The probability that the piece of news in position i, denoted f_i, is positive, negative or non-existent is given by the distribution function:

$$Pr(f_i) = \begin{cases} +1 & = & qg(d) \\ -1 & = & q(1 - g(d)) \\ \emptyset & = & (1 - q) \end{cases}$$

where $g(\cdot)$ is a continuous and increasing function that is bounded between 0 and 1, and $0 < q \leq 1$. With probability $1-q$, there is no news at position i. If there is news, it is positive with probability $g(d)$ and negative otherwise. Conditional on d, these probabilities are iid across different bits on a string. With multiple papers, we assume that they all see the same string f.

A newspaper that does not slant at all would simply report the string f without alteration. A reader who sees the string f can draw information from the number of $+1$'s and -1's, which we

[6] Importantly newspapers do not slant by simply manufacturing evidence. This assumption is crucial to the results in Section 6, where we examine the beliefs of a conscientious reader who reads both papers.

define as $N_+(f)$ and $N_-(f)$ respectively. By the Law of Large Numbers:

$$\frac{N_+(f)}{N_-(f)+N_+(f)} = g(d) + \eta \to g(d)$$

where η is a noise term that converges to zero as the length of the string $L \to \infty$. Consequently, for large L, the information the reader receives is well approximated by the case in which he simply observes d since $g^{-1}\left(\frac{N_+(f)}{N_-(f)+N_+(f)}\right) \to d$.

In this formalism, a newspaper slants the signal by selectively omitting positive or negative bits of information. To slant upwards, for example, a newspaper would drop negative bits. Instead of reporting $+1, -1, -1, \emptyset, +1, -1, \cdots$ it reports $+1, \emptyset, \emptyset, \emptyset, +1, -1 \cdots$, for example. A paper that wishes to slant upwards by $s > 0$ would produce a string f' by dropping enough -1 to guarantee

$$g^{-1}\left(\frac{N_+(f')}{N_-(f')+N_+(f')}\right) \approx d + s$$

Likewise a paper that wishes to slant negatively by $s < 0$ would simply drop enough positive bits. As $L \to \infty$, the paper can choose to drop bits to better and better approximate any given slant s.

For simplicity, assume that newspapers omit facts in fixed ways. To slant positively, a paper omits the lowest indexed negative bits until it approximates the desired fraction. To slant negatively, a paper omits the lowest indexed positive bits until it reaches the desired fraction. This assumption is simply one way of formalizing the idea that two papers wishing to slant in a particular direction do so similarly.

For most of the paper, the exact technology of slanting is not important. We simply consider a reduced form model wherein newspapers receive data $d = t + \epsilon$, choose a slant s and report $n = d + s$. In this case, define v_d and p_d to be the variance and precision of the signal d. When we speak of d and s, we are, therefore, using a reduced form version of the slanting technology with strings f and omission of facts in which the length $L \to \infty$. The explicit model of slanting, however, becomes useful in Section 6. There we consider how a conscientious reader who reads all available news might be able to cross-check one paper's slant against another's.

2.2 Reader Utility

Suppose readers are rational and unbiased. All they want is information. They dislike slanting because it is costly in effort and time to read slanted news and figure out the "truth". In the BLS

example, the report of the first newspaper does not tell the reader how much the unemployment rate changed, while that of the second newspaper does not contain the unemployment rate. To get a full picture, he would need more information. We assume that a rational reader's utility is decreasing in the amount of slanting. So if he reads a newspaper his utility is:

$$U_r = \bar{u} - \chi s^2 - P$$

where P is the paper's price. If he does not read the newspaper, he receives utility 0.

Biased readers on the other hand get disutility from reading news inconsistent with their beliefs. We model consistency as the distance between the news and the reader's beliefs, b, measured as $(n-b)^2$. In the BLS example, a reader optimistic about the economy would experience disutility when reading stories that suggest a recession. At the same time, even biased readers would dislike blatant and extreme slanting, at least in the long run. Holding constant the consistency with beliefs, they prefer less slanted to more slanted news.[7] So if he reads the newspaper, the overall utility of a biased reader is:

$$U_b = \bar{u} - \chi s^2 - \phi(n-b)^2 - P.$$

where $\phi > 0$ calibrates this reader's preferences for hearing confirming news.

2.3 Newspaper Strategy

Before seeing the data d, a newspaper chooses its strategy $s(d)$ on how to slant and announces the price P it charges. Potential readers decide whether to buy the paper if the price P is lower than the expected utility associated with reading the paper, $E_d[U(s(d))]$. To form expected utility, expectations are taken over d and are assumed to be the true expectations ($d \sim N(t, v_d)$) rather than the biased ones. This approach is an attempt to capture crudely the idea that this is a long-run game. Readers get a general sense of how much pleasure the paper provides them and make their purchasing decisions based on this. It therefore makes more sense to think of expected utility using the empirical distributions. Practically, in the model both assumptions about expectations produce the same results.[8]

[7] This assumption is immaterial to our results. All that we require is that newspapers face some quadratic cost of slanting. This cost could just as easily arise on the supply side with firms facing a technological or private reputational cost of slanting and the results would be the same. The necessary feature is that firms cannot slant freely.

[8] This issue of how to model belief formation in the presence of other irrational behaviors is an endemic one to most behavioral models. See Rabin (1998).

Once readers decide whether to buy the paper, the paper observes its signal d and reports $n = d + s(d)$. Readers read the news and receive their utility. Timing of the full game is as follows:

1. The newspaper chooses a strategy $s(d)$ for how to report the news. When there are two papers, both set strategies simultaneously.

2. Price P is announced. When there are two papers, both set prices simultaneously after the other paper has revealed its strategy.

3. Individuals decide whether to buy the paper based on average utility associated with its strategy $s(d)$ and price P.

4. Newspaper receives data d and reports news $d + s(d)$. If there are two papers, they receive the same data d and report $d + s_j(d)$ where $j = 1, 2$.

5. If individuals bought the paper, they read the news and receive utility.

2.4 Cases Considered

We consider two different distributions of reader beliefs, homogeneous and heterogeneous. Homogeneity means that all readers hold the same beliefs b with precision p. For example, all or nearly all readers in the United States might believe that the Russians are corrupt or that the French are anti-American. Heterogeneity means that there is a distribution of reader beliefs. Such heterogeneity could come from political ideology. For example, opinions about U.S. presidents often divide along party lines. We assume that heterogeneous beliefs are distributed uniformly between b_1 and b_2 where $b_1 < b_2$ and $b_2 > 0$. Readers in this uniform distribution are indexed by $i \in [1, 2]$ so that reader i holds belief b_i. All readers hold their beliefs with precision p. We denote by $\bar{b}$ the average of b_1 and b_2. We also denote reader $i's$ utility function as $u_i(d)$ or $u_{b_i}(d)$ depending on context. The homogeneous and heterogeneous cases are designed to capture two different types of issues: ones on which there is consensus in the population and ones where there is substantial disagreement.

We also examine two cases of industry structure. In the first case, there is a single monopolistic newspaper. In the second, there are two newspapers, indexed by $j = 1, 2$, each seeing the same facts f and therefore the same implied data d. For a monopolist, s^*_{hom} and s^*_{het} denote the optimal slanting strategy for the homogeneous and heterogeneous case. Similarly, P^*_{hom} and P^*_{het} denote

optimal price in these cases. For duopolists, $s^*_{j,hom}$ and $s^*_{j,het}$ denote the optimal strategy of paper $j = 1, 2$ in the homogeneous and heterogeneous cases respectively. Similarly, $P^*_{j,hom}$ and $P^*_{j,het}$ denote each duopolist's optimal price in these two cases.

This formalism of industry structure is similar in spirit to a Hotelling model. Readers' beliefs resemble consumers' preferred locations. Their disutility for inconsistent news resembles transportation costs. Firms choice of slanting rule resembles their choice of location. In this context, our utility function implies quadratic transportation costs and our distribution of reader beliefs in the heterogeneous case corresponds to a uniform distribution of consumers. Consequently, many of our proofs resemble the proofs for the Hotelling models in this case (d'Aspremont et. al. 1979).[9]

2.5 Defining Bias

We are interested in the extent of newspaper bias in the market. We measure this by the average bias of the newspapers in the market, weighted by their market share. In the homogeneous case, where there is only one kind of reader we simply define bias as

$$ARB_{hom} = E_d[(n - d)^2]$$

where n is the news read by these readers. So bias is defined as the average amount by which the news read deviates from the data for the average reader.

In the heterogeneous case, let n_i be the news read by reader $i \in [1, 2]$. Bias is then defined as:

$$ARB_{het} = \int_i E_d[(n_i - d)^2]$$

This measures the average bias that readers encounter.

3 Rational Readers

When readers are rational, newspapers only face a disincentive to slant. The following proposition summarizes the outcomes for different cases.

[9] As with all Hotelling models, the assumptions on transportation costs matter. With linear transportation costs, an equilibrium does not exist. But while the results depend on non-linear transportation costs, they are not specific to the quadratic. Other convex functions produce similar results (Economides 1986). See Brenner (2001) for a survey.

Proposition 1 *Suppose readers are rational. Then whether readers are homogeneous or heterogeneous, the monopolist does not slant and charges the same price:*

$$s^*_{hom} = s^*_{het} = 0$$

and

$$P^*_{hom} = P^*_{het} = \bar{u}$$

In the duopolist case as well, papers do not slant and once again charge the same price:

$$s^*_{j,hom} = s^*_{het} = 0$$

and

$$P^*_{j,hom} = P^*_{het} = 0$$

for all j on the equilibrium path. So the only effect of competition is to lower prices.

Proof: See appendix for all proofs. ■

Proposition 1 illustrates the normal logic of economists' thinking about the media. When readers only seek accuracy in news, newspapers pass on, without slant, the information they receive. Since perfect quality is achieved even without competition, the effect of competition is to reduce the price that readers pay. With both monopoly and duopoly, consumers get what they want, and there is no media bias. In the rest of the paper, we focus on the case of biased readers.

4 Homogeneous Biased readers

We begin with homogeneous readers. The following proposition summarizes the monopolist's behavior.

Proposition 2 *A monopolist facing a homogeneous audience chooses:*

$$\begin{aligned} s^*_{hom}(d) &= \frac{\phi}{\chi+\phi}(b-d) \\ P^*_{hom} &= \bar{u} - \frac{\chi\phi}{\chi+\phi}[b^2+v_d] \end{aligned}$$

if $\bar{u} > \frac{\chi\phi}{\chi+\phi}[b^2+v_d]$. If not, there exists no slanting strategy that results in the news being read.

Because the monopolist can capture all surplus through the price he charges, to maximize profits he merely maximizes expected utility. Because expected utility functions are separable in the value of d, the monopolist maximizes utility for every given value of d. This leads him to slant toward a biased reader's beliefs. The form of the monopolist's slanting is the basis for much of what follows so it is useful to define:

$$s_B(d) \equiv \frac{\phi}{\chi + \phi}(B - d),$$

the slanting strategy if the monopolists slants "around" B. With this notation, the above proposition can be rewritten as $s^*_{hom}(d) = s_b(d)$.

The following corollary derives comparatives statics for the magnitude of slanting.

Corollary 1 *In the homogeneous reader case, slanting increases with the reader preference for hearing confirmatory news and declines with the cost of slanting:*

$$\begin{aligned} \frac{\partial \left| s^*_{hom}(d) \right|}{\partial \phi} &> 0 \\ \frac{\partial \left| s^*_{hom}(d) \right|}{\partial \chi} &< 0 \end{aligned}$$

Proposition 2 suggests a theory of spin. Suppose that a politician, or some other figure of authority, has a first mover advantage, i.e. can choose which data d gets presented to the media first. The papers slant these data toward reader beliefs, but by Proposition 2 d will have significant influence on what they report as compared to their getting data from an unbiased source. For example, by disclosing that a Chinese spy has been found in Los Alamos, a politician can focus the discussion on the risk to U.S. security from Chinese espionage, rather than on the administrative incompetence in the Department of Energy. This effect becomes even more powerful in a more general model of sequential reporting. In this case, the initial spin may shape reader priors which future papers face and consequently slant news towards. The initial spin would then be reinforced even by ideologically neutral papers.

The condition $\bar{u} > \frac{\chi\phi}{\chi+\phi}[b^2 + v_d]$ guarantees that this reader's reservation utility $\bar{u}$ is high enough that he prefers reading the optimally biased news to no news. From now on, we assume that this condition holds.

Assumption 1 *Reader utility from news is high enough that they prefer the optimal news to no news:*

$$\bar{u} > \frac{\chi\phi}{\chi+\phi}[b^2 + v_d]$$

With this assumption in place, we now turn to competition. How does competition between two newspapers affect the above results?

Proposition 3 *Suppose duopolists face a homogeneous audience. Then there is an equilibrium in which duopolists choose on the equilibrium path:*

$$s^*_{j,hom}(d) = \frac{\phi}{\chi+\phi}(b-d)$$

and prices

$$P^*_{j,hom} = 0$$

for both $j = 1, 2$. Readers are indifferent between the two papers.

With a homogeneous audience, competition is Bertrand-like: it simply drives prices down to zero. Each duopolist's slant is exactly equal to the monopolist's slant, and they split the readers between them. The following corollary summarizes the impact of competition on bias in the homogeneous case.

Corollary 2 *For a homogeneous audience, both monopoly and duopoly produce the same amount of average reader bias:*

$$ARB_{mon}(v_d) = ARB_{duo}(v_d)$$

Propositions 2 and 3 are the first critical results of the paper. They show that, when readers have homogeneous biases, competition does not eliminate them - it only leads to price reductions. Both monopolists and duopolists cater to reader prejudices. These propositions basically say that one cannot expect accuracy - even in the competitive media - on issues where the readers share beliefs. The leading examples of such uniformity might be foreign affairs, where there may be a great deal of commonality of views toward a particular foreign country, such as Russia, China, or France, or law enforcement, where most readers might sympathize with efforts by the government to prosecute members of a disliked group (e.g., the Arabs or the rich).

5 Heterogeneous Biased Readers

What happens when readers differ in their beliefs? Newspapers must now decide which one of the heterogeneous reader groups is its target audience.

Proposition 4 *Suppose a monopolist faces a heterogeneous audience with* $\bar{b} = 0$*. There exists a* C_m*, which depends on the parameters of the model, that determines the monopolist's strategy. If* $b_2 - b_1 < C_m$ *the monopolist can maximize profits by choosing:*

$$\begin{aligned} s^*_{het} &= s_{\bar{b}}(d) = \frac{\phi}{\chi+\phi}(\bar{b} - d) = -\frac{\phi}{\chi+\phi}d \\ P^*_{het} &= \bar{u} - \frac{\phi\chi}{\chi+\phi}v_d - \phi^2 b_2^2 \end{aligned}$$

If $b_2 - b_1 > C_m$ *the monopolist chooses not to cover the market, i.e. not all readers read the paper.*

According to Proposition 4, the monopolist covers the market if the dispersion of reader beliefs is small enough. If reader beliefs are too far apart, readers on either extreme will not read the paper. From now on, we focus on the case where the monopolist covers the market (i.e. $b_2 - b_1 < C_m$).

Duopolists, in contrast, respond completely differently to heterogeneity. For tractability reasons, we now consider only the situation where duopolists choose linear strategies.

Proposition 5 *Suppose* $\bar{b} = 0$ *and* $b_2 - b_1 < C_m$ *and that duopolists choose strategies of the* $s_B(d)$ *form. Then duopolists choose:*

$$\begin{aligned} s^*_{j,het}(d) &= \frac{\phi}{\chi+\phi}(z_j - d_j) \\ P^*_{j,het} &= 2\phi b_2(z_2 - z_1) \end{aligned}$$

where $z_j = \pm\frac{-4\phi b_2 + \sqrt{16\phi b_2^2 + 4\phi(\bar{u} - \frac{\chi\phi}{\chi+\phi}v_d)}}{2\phi}$ *are the positions of the firm. Without loss of generality, we assume that* z_2 *is the positive root and* z_1 *is the negative root. All readers read the newspaper, and* $z_1 \leq b_1 \leq b_2 \leq z_2$*.*

Each duopolist positions himself as far away from the other as possible. In fact, duopolists are *more extreme* than the most extreme reader in the population. To see why this happens, consider the pricing stage. The further away each duopolist is from the other, the higher the price he can charge. Consequently, when choosing how to slant, duopolists maximally differentiate

themselves.[10] This is analogous to the standard Hotelling result with uniform distributions and quadratic transportation costs (Tirole 1988, d'Aspremont et. al. 1979). As in the standard Hotelling model, the monopolist caters to both audiences unless they are too far apart, while duopolists situate themselves at the extremes, in this case catering to the two audiences individually. But unlike in the standard Hotelling model, firms here choose positions even further than the most extreme consumer. Practically, this means that news sources can be even more biased than its most biased readers. One cannot therefore infer reader beliefs directly from media bias.

Another point is worth noting:

$$E[\left|s^*_{j,het}(d))\right|] \geq E[|(s^*_{het}(d))|].$$

Duopolists always slant more than the monopolist when readers are heterogeneous. In this sense, competition tends to polarize the news. The following corollary summarizes the impact of competition on bias.

Corollary 3 *Suppose $b_1 - b_2 < C_m$. In the heterogeneous reader case, competition increases the bias of the average reader:*

$$ARB_{mon,het}(v_d) \quad < \quad ARB_{duo,het}(v_d)$$

Corollary 3 shows that, with heterogeneous readers, competition by itself polarizes readership and if anything raises the average reader bias. Entry of a left wing newspaper or a TV station into a local market that was previously dominated by a moderate or slightly right wing monopolist might cause this monopolist to shift its reporting to the right.

Corollary 3 might shed light on the growing controversy in the United States about media bias. Several recent books have angrily attacked media outlets for having a left wing bias (e.g., Goldberg 2002, Coulter 2003). Several equally angry books have responded that other media outlets have an even stronger right wing bias (Alterman 2003, Franken 2003). We suspect that there is a grain of truth in all these books, and that the growing partisanship of alternative media sources is a response to the growth in competition, and market segmentation, in the media. Changes in media

[10]This also illustrates why this result is about competition per se and not about variety alone. A monopolist who could start two newspapers does not need to differentiate to increase market power. He would differentiate simply to cater to reader tastes but would not go beyond the most extreme readers as duopolists would.

technology have lead to significant entry, especially in television. If these media sources divide the market along ideological lines, we expect them to become **more** biased than they were in the regime of moderate competition. This is perhaps what the various commentators are recognizing.

Corollary 3 may also have implications for the effects of entry of new media outlets on the nature of reporting. In a provocative recent study, Gentzkow and Shapiro (2003) examine the responses to a Gallup poll by residents of nine Muslim countries about such topics as the United States, terrorism, responsibility for 9/11, and so on. The authors document a striking pattern of factually inaccurate beliefs, but also show that the media have a strong effect on these beliefs. In particular, those who watch Al-Jazeera Arab Television are much more likely to hold factually false beliefs (as well as anti-American ones) than those watching the CNN.[11] In concluding their paper, Gentzkow and Shapiro appear to endorse recent proposals favoring an expansion of Western news in the Arab world, because such news are likely to moderate opinions and beliefs.

Our model suggests that caution is appropriate. The people who will watch or listen to Western news are already sympathetic to their perspective, and might be already watching CNN, so are unlikely to be strongly affected. On the other hand, such entry might cause Al-Jazeera and similar networks to further differentiate their product by advancing yet more extreme views. The effect might be only to radicalize, rather than moderate, their audience.

6 Reader Heterogeneity and Accuracy in Media

The results so far describe the effect of newspaper competition on overall accuracy:

1. Newspaper competition lowers prices for a homogeneous audience but does not reduce slanting.

2. For a heterogeneous audience, competition increases slanting if reader beliefs are not too far apart. Duopolists have an incentive to segment the market whereas the monopolist would like to pool it, and therefore slant more than does the monopolist.

[11] These results are not unique to the Muslim world. Kull et al. (2003) document significant confusion among large percentages of U.S. respondents on such questions as Saddam Hussein's culpability in 9/11 and the discovery of weapons of mass destruction in Iraq. The study also finds that those who get their news from Fox are less well informed about these issues than those who get their news from PBS/NPR.

These results focus on how an average reader in the population is affected. We can also look at the impact of reporting on a *conscientious* reader, a hypothetical reader who reads all the news available.[12]

In the duopoly case, the hypothetical conscientious reader benefits from reading both papers. She can cross check the two newspapers to reduce the effect of slanting. Suppose each paper receives string f that can be thought of as implying data $d = t + \epsilon$, and paper j reports string f_j. There are now several cases. If the implied slants for both papers are positive and $s_1 > s_2 > 0$, then *every fact* that paper 1 reports, paper 2 also reports. Moreover, because paper 2 is slanting less, it reports some facts that paper 1 does not. Consequently, a conscientious reader would interpret the news as if she has read only paper 2. The case where $0 > s_2 > s_1$ is similar. On the other hand, if the two papers are on opposite sides of the issue so that $s_1 > 0 > s_2$, paper 1 omits some negative details to slant upward and paper 2 omits some positive details to slant downward. The conscientious reader, however, can cross-check both papers. Paper 1 reports the positive facts which paper 2 omits and paper 2 reports the negative facts which paper 1 omits. By cross checking, the conscientious reader gets all the facts, as if she were able to read an unslanted newspaper. Define $xc(\cdot)$ to be the cross-checking function:

$$xc(s_1, s_2) = \begin{cases} min\{s_1, s_2\} & \text{if} \quad s_1 > 0, s_2 > 0 \\ max\{s_1, s_2\} & \text{if} \quad s_1 < 0, s_2 < 0 \\ 0 & \text{otherwise} \end{cases}$$

This function summarizes how the conscientious reader can cross-check the two papers.[13]

Define n_c to be the news the conscientious reader is effectively exposed to:

$$n_c = \begin{cases} n & \text{if} \quad \text{one newspaper} \\ d + xc(s_1, s_2) & \text{if} \quad \text{two newspapers} \end{cases}$$

We then define conscientious reader bias analogously to the average reader bias:

$$CRB = E_d[(n_c - d)^2]$$

[12]We consider how a hypothetical reader might process the news, holding constant what newspapers report.

[13]The extreme cross-checking depends on the two papers slanting stories using the same rule. It is only necessary for our results that the papers use similar rules. Suppose that when one paper omits a fact, it appears in a oppositely slanted paper only with probability z. In this case, the cross checking function becomes $(1-z)s_1+(1-z)s_2+zxc(s_1, s_2)$. Thus the qualitative statements we make are preserved.

This definition of conscientious reader bias is independent of heterogeneity of reader beliefs. However, CRB does depend on the equilibrium news reporting, which in turn may depend on the heterogeneity of reader beliefs.

As the discussion on cross-checking suggests, reader heterogeneity can help the conscientious reader quite a bit. To formalize this, let us compare the case of homogeneous readers with bias b to the case of heterogeneous readers with beliefs distributed uniformly on $[b-\delta, b+\delta]$. The following corollary summarizes our principal finding:

Corollary 4 *The interaction of reader heterogeneity and duopoly lowers conscientious reader bias. When readers are heterogeneous, conscientious reader bias is lower under duopoly than monopoly:*

$$CRB_{het,duo} < CRB_{het,mon}$$

Under duopoly, conscientious reader bias is lower under heterogeneity than homogeneity:

$$CRB_{het,duo} < CRB_{hom,duo}$$

Corollary 4 is the final result of our paper, and its bottom line. It points to the absolutely central role that heterogeneity of reader beliefs plays in assuring accuracy in media. We showed before that, when readers are homogeneous, competition results in lower prices, but not in accurate news reporting. When readers are heterogeneous, the news received by the average reader might become even more biased, as competitive media outlets segment the market. However, such market segmentation benefits a conscientious reader, who can then aggregate the news from different sources to synthesize a more accurate picture of reality. When newspapers are at different sides of the political spectrum, the conscientious reader gets all the facts. While individual news sources slant even more when faced with a heterogeneous public, the aggregate picture becomes more clear. In this respect, reader heterogeneity is the crucial antidote to media bias.

This analysis indicates which issues are more likely to receive accurate media coverage, at least for the conscientious reader. Almost surely, the most likely domain of reader heterogeneity is domestic politics, where readers have diverse beliefs, and media coverage is correspondingly diverse. Such dispersion of reader beliefs could come from their self-interested economic and social preferences, what used to be called "class differences." But, as Glaeser (2002) argues, such differences are reinforced by political entrepreneurs, who have an incentive to create particular beliefs that would

bring them support, especially if these beliefs distinguish them from the incumbent. Newspapers would then follow these entrepreneurs in mirroring and reinforcing the beliefs of their supporters. In fact, in many countries today, and in the U.S. 100 years ago, newspapers were affiliated with political parties (Hamilton 2003). Reader diversity, and newspaper diversity, are partly a reflection of underlying political competition. In other areas of competition, such as sports, we likewise expect local papers to support local teams, thereby creating diversity of coverage across cities reflecting the diversity of reader beliefs.

Perhaps the clearest illustration of this corollary is the coverage of the Lewinsky affair under the Clinton presidency. As we have noted in the introduction, the left wing press presented an enormous amount of information designed to expiate the president's sins, while the right wing press dug out as many details pointing to his culpability. In the end, however, as Richard Posner (1999) remarks in his book, much of the truth has come out and a conscientious reader could get a fairly complete and balanced picture of reality.

7 Conclusion

We have examined the roles of two forces in promoting accuracy in media: competition and reader diversity. We have found that competition by itself is not a powerful force toward accuracy. Generally speaking, competition forces newspapers to cater to the prejudices of their readers, and greater competition typically results in more aggressive catering to such prejudices as competitors strive to divide the market. On the other hand, we found that reader diversity is a powerful force toward accuracy, so long as accuracy is interpreted as some aggregate measure of revelation of information to a reader who takes in all the news. Greater partisanship and bias of individual media outlets may result in a more accurate picture being presented to a conscientious reader.

We have argued that such heterogeneity comes in part from the underlying political competition, whereby political parties, movements, and individual entrepreneurs attempt to generate support by presenting their points of view. If they can generate enough interest, media outlets will try to cater to the very same audiences that the political entrepreneurs attract, and diversity in media coverage will arise endogenously. We contrasted this situation with one where potential audiences share similar beliefs, and where there is no advantage from political entry, such as the coverage of

foreign countries or crime. In these areas, we do not expect to see diversity of reader views, and likewise do not expect to see accuracy in media.

Political competition is only one source of underlying reader diversity. We can also imagine entrepreneurs starting newspapers on their own and, so long as they have deep enough pockets, creating enough demand for unorthodox views to broaden the range of opinions (and slants) that are being covered. Ideological diversity of entrepreneurs themselves may be the source of diversity of media coverage. We should not expect, however, this force to be pervasive, since without a broad political sentiment to support it, newspaper publishing is likely to be a money losing proposition.

We have studied competitive persuasion in the context of markets for news. But the issues are obviously more general. Similar questions arise in politics, in advertising, and in security sales. In all these domains, the influences of audience heterogeneity and of competition on market efficiency remain to be explored.

Appendix 1: Lemmas

Lemma 1 *Define*

$$s_B(d) = \frac{\phi}{\chi + \phi}(B - d)$$

to be the strategy where a newspaper biases around point B. The reader's expected utility of reading such a newspaper is:

$$E_d[U(s_B(d))] = \bar{u} - \frac{\chi\phi}{\chi + \phi}[v_d + b^2] - \frac{\phi^2}{\chi + \phi}[B - b]^2$$

Consequently when $B = 0$:

$$E_d[U(s_0(d))] \quad = \quad \bar{u} - \frac{\chi\phi}{\chi + \phi}v_d - \phi b^2$$

And when $B = b$:

$$E_d[U(s_b(d))] \quad = \quad \bar{u} - \frac{\chi\phi}{\chi + \phi}(v_d + b^2)$$

Proof: Expected utility for $s_B(d)$ is:

$$\bar{u} - \chi \int_d \left(\frac{\phi}{\chi + \phi}(B - d)\right)^2 - \phi \int_d \left(d + \frac{\phi}{\chi + \phi}(B - d) - b\right)^2$$

The first integral is:

$$-\chi\left(\frac{\phi}{\chi+\phi}\right)^2[B^2+v_d]$$

because $E[d]=0$ and $E[d^2]=v_d$. The second integral is:

$$-\phi[\left(\frac{\chi}{\chi+\phi}\right)^2 v_d+\left(\frac{\phi}{\chi+\phi}\right)^2 B^2+b^2-2\frac{\phi}{\chi+\phi}Bb$$

again because $E[d]=0$ and $E[d^2]=v_d$. Collecting terms produces

$$\begin{aligned}
\bar{u}-\frac{\phi\chi}{\chi+\phi}v_d-\phi b^2-\frac{\phi^2}{\chi+\phi}B^2+2\frac{\phi^2}{\chi+\phi^2}Bb &= \\
\bar{u}-\frac{\phi\chi}{\chi+\phi}[v_d+b^2]-\phi b^2+\frac{\phi\chi}{\chi+\phi}b^2-\frac{\phi^2}{\chi+\phi}B^2+2\frac{\phi^2}{\chi+\phi}Bb &= \\
\bar{u}-\frac{\phi\chi}{\chi+\phi}[v_d^2+b^2]-\frac{\phi^2}{\chi+\phi}b^2-\frac{\phi^2}{\chi+\phi}B^2+2\frac{\phi^2}{\chi+\phi}Bb &= \\
\bar{u}-\frac{\phi\chi}{\chi+\phi}[v_d^2+b^2]-\frac{\phi^2}{\chi+\phi}[b^2+B^2-2Bb]
\end{aligned}$$

and hence the result. ■

Lemma 2 *Let $x_1 \leq x_2$ be the bias of two readers. For any $1 \geq c \geq 0$, the strategy that maximizes weighted average reader utility $cE_d u_{x_1}(s(d))+(1-c)E_d u_{x_2}(s(d))$ is:*

$$s_{\bar{x}}(d)=\frac{\phi}{\chi+\phi}(\bar{x}-d)$$

where $\bar{x}=cx_1+(1-c)x_2$.

Moreover, the strategy that maximizes $min\{Eu_{x_1}(s(d)), Eu_{x_2}(s(d))\}$ is $s_z(d)=\frac{\phi}{\chi+\phi}(z-d)$ for some $x_1 \leq z \leq x_2$

Proof: Consider total utility:

$$cE_d u_{x_1}(s(d))+(1-c)E_d u_{x_2}(s(d))=\int_d\left[\bar{u}-\chi s(d)^2-c\phi(d+s(d)-x_1)^2+(1-c)\phi(d+s(d)-x_2)^2\right]$$

Since the right hand side shows no interdependency in d, maximizing this double integral is equivalent to maximizing for very single d, the term:

$$\bar{u}-\chi s(d)^2-c\phi(d+s(d)-x_1)^2+(1-c)\phi(d+s(d)-x_2)^2$$

Taking derivatives with respect to s then produces the first order condition:

$$-2\chi s - 2\phi(d + s - \bar{x}) = 0$$

which implies that the optimal slanting is:

$$\frac{\phi}{\chi + \phi}(\bar{x} - d)$$

For the second part, let $s(d)$ be a candidate slanting strategy that maximizes $min\{Eu_{x_1}(s(d)), Eu_{x_2}(s(d))\}$. Define u_1 and u_2 to be the expected utilities for $s(d)$. Note that s_{x_1} and s_{x_2} maximize reader 1 and reader 2 utilities respectively. Consequently there must be a c such that for $\bar{x} = cx_1 + (1-c)x_2$, the strategy $s_{\bar{x}}$ yields the same ratio of reader 1 and 2 utilities as the candidate strategy does: $\frac{u_1}{u_2}$. But by the first part of the Lemma, $Eu_i(s_{\bar{x}}(d)) \geq u_i$ for $i = 1, 2$. Otherwise, the candidate strategy $s(d)$ would yield higher weighted average utility. But this shows $s_{\bar{x}}$ maximizes the min and hence $s = s_{\bar{x}}$. ■

Appendix 2: Proofs of Propositions

Proof of Proposition 1:

Proof: Consider the monopolist's maximization problem. Reader utility is:

$$U_r = max\{\bar{u} - \chi s^2 - P, 0\}$$

Since readers only dislike slanting, a newspaper gets no benefit from slanting and only pays costs. The optimal strategy for both the homogeneous and heterogeneous case is therefore $s^*(d) = 0$. Since the reader's gross utility in this case is $\bar{u}$, the monopolist can extract all surplus and charge P, so that the reader's net utility is 0.

Consider now the duopoly case. Begin with the homogeneous reader case and proceed by backward induction. Consider the price setting stage. Define V_j to be the utility the reader associates with reading newspaper j. There are two cases here: equal and unequal utilities. For the case of unequal utilities, suppose without loss of generality that $V_1 > V_2$. The price equilibrium is for paper 1 to charge $V_1 - V_2$ and capture the full market. If $V_1 = V_2$, then both papers charge zero.

In the strategy setting stage, holding constant the other's strategy, both papers' profit functions are increasing in the reader utility from the strategies they choose. Consequently, it is a weakly dominant strategy for each paper to maximize reader utility. From the monopoly case, we know these strategies are $s(d) = 0$. It is an equilibrium, therefore, to have both prices and slanting equal to zero.

In the heterogeneous reader case, the logic remains the same because reader utility functions are the same as in the homogeneous case, since utility is independent of beliefs for rational readers. The homogeneous and heterogeneous cases produce the same incentives for the firm. ■

Proof of Proposition 2

Proof: Since the monopolist can extract all surplus, he maximizes expected utility:

$$\max_{s^*(d)} \bar{u} - \chi \int_d (s^*(d))^2 - \phi \int_d (d + s^*(d) - b)^2$$

There are no interdependencies in this utility maximization across d's. Because the maximand is separable in d, choosing the optimal $s^*(d)$ is equivalent to choosing the optimal s^* for each d or:

$$s^*(d) = argmax_s \bar{u} - \chi s^2 - \phi(d + s - b)^2$$

For a given d, differentiating with respect to s produces the first order condition:

$$\chi s + \phi(d + s - b) = 0$$

which implies

$$s^*_{hom}(d) = \frac{\phi}{\chi + \phi}(b - d)$$

Prices then are equal to the expected utility under this strategy. From Lemma 1, we know the expected utility and hence price is:

$$P^*_{hom} = \bar{u} - \frac{\chi\phi}{\chi + \phi}[b^2 + v_d]$$

■

Proof of Proposition 3

Proof: We proceed by backward induction. Consider the price-setting stage. Let V_j be the reader's utility associated with reading paper j. There are two cases here: equal and unequal utilities. For the case of unequal utilities, suppose without loss of generality that $V_1 > V_2$. The price equilibrium is for paper 1 to charge $V_1 - V_2$ and capture the full market. If $V_1 = V_2$, then both papers charge zero.

In the stage where the slanting strategy is set, therefore, maximizing reader utility is as before a weakly dominant strategy: holding constant the other firm's strategy, each firm's profit is increasing in the reader utility associated with its strategy. We know from Proposition 2 that the utility maximizing strategy is to slant $\frac{\phi}{\chi+\phi}(b-d)$. Therefore, it is an equilibrium for duopolists to choose this strategy. Since this means both papers provide equal utility, prices equal zero. This shows that this is an equilibrium. Moreover, this logic directly implies that the only equilibrium involves both papers choosing a slanting strategy that maximizes utility and prices which equal zero on the equilibrium path.[14]

■

Proof of Proposition 4

Proof: The first step is to show that the monopolist's optimal strategy must be of the $s_B(d) = \frac{\phi}{\chi+\phi}(B-d)$ form we defined earlier. To show this, suppose $s(d)$ and P form an optimal strategy for the monopolist. Let $X = \{b_i | Eu_i(s(d)) - P = 0\}$ be the biases of the readers who receive 0 utility in this case. This set must be non-empty. If it were empty, then the monopolist could always raise price by $\epsilon > 0$ without lowering demand since every reader's utility would still be non-zero. But this would violate optimization.

Since $X \subset [b_1, b_2]$ is non-empty, it must have a well-defined inf and sup. Let x_1 and x_2 be the inf and sup of this set and u_1 and u_2 be the utility of these readers. Lemma 2 shows that a strategy of the form s_z where $z = cx_1 + (1-c)x_2$ maximizes $min\{u_1, u_2\}$. But by Lemma 1, all readers with bias between x_1 and x_2 have positive utility from this strategy. So, s_z yields the maximin payoffs for x_1 and x_2 and satisfies the participation

[14] Any slanting strategy that deviates on measure zero from the optimal one also forms an equilibrium since expected utility is the same.

constraint of all readers in X. If $s(d)$ is an optimum, it must therefore equal $s_z(d)$. Otherwise, the monopolist could switch to $s_z(d)$ and increase prices without losing demand. This proves that the monopolist uses a strategy of the type $s_B(d)$.

The second step is to ask which B and P the monopolist would choose in setting a strategy of the form $s_B(d)$. Once the monopolist is restricted to choosing strategies of the form $s_B(d)$, note that we are in a standard Hotelling model with quadratic transportation costs since expected utilities are quadratic in B (Lemma 1). Consequently, the standard results show that the monopolist would cover the entire market and choose $B = \bar{b} = 0$ if $b_2 - b_1$ is small enough. The price formula is given by the expected utility of reader b_2 in Lemma 1 since this is the reader with smallest utility. ■

Proof of Proposition 5

Proof: To show this strategy is an equilibrium, we proceed by backward induction. Consider the price-setting stage. Suppose the two firms have set the strategies $s_{z_j}(d)$. What price would they charge? Suppose firm j charges price P_j. A reader with bias x receives utility:

$$\bar{u} - \frac{\chi\phi}{\chi+\phi}[v_d + x^2] - \phi[z_j - x]^2 - P_j$$

from reading paper j (Lemma 1). The reader x that is indifferent between these two papers is defined by equating the two utilities:

$$\begin{aligned}
\bar{u} - \frac{\chi\phi}{\chi+\phi}[v_d + x^2] - \phi[z_2 - x]^2 - P_2 &= \bar{u} - \frac{\chi\phi}{\chi+\phi}[v_d + x^2] - \phi[z_1 - x]^2 - P_1 \\
\phi[(z_1 - x)^2 - (z_2 - x)^2] &= P_2 - P_1 \\
\phi[z_1^2 + x^2 - 2z_2x - z_1^2 - x^2 + 2xz_1] &= P_2 - P_1 \\
2x\phi[z_2 - z_1] &= P_2 - P_1 + \phi(z_2^2 - z_1^2) \\
x &= \frac{P_2 - P_1}{2\phi(z_2 - z_1)} + \frac{z_2 + z_1}{2}
\end{aligned}$$

So when "located" at z_j each firm's profits is given by $P_1\frac{x-b_1}{b_2-b_1}$ and $P_2\frac{b_2-x}{b_2-b_1}$ for firm 1 and 2 respectively. Focusing on firm 2's problem, differentiating profits with respect to P_2 produces:

$$\frac{b_2 - x}{b_2 - b_1} - \frac{P_2}{b_2 - b_1}\frac{\partial x}{\partial P_2} = 0$$

$$\begin{aligned} b_2 - x &= P_2 \frac{1}{2}\phi(z_2 - z_1) \\ 2\phi b_2(z_2 - z_1) - \phi(z_2^2 - z_1^2) - (P_2 - P_1) &= P - 2 \end{aligned}$$

Focusing on symmetric equilibria provides the price formula:

$$P_2^* = 2\phi b_2(z_2 - z_1) - \phi(z_2^2 - z_1^2)$$

Our choice of z_2 and z_1 in the proposed equilibrium guarantee that this satisfies the participation of constraint of the marginal reader (chosen so that $x = 0$).

We now move to the strategy setting stage. Notice that the postulated strategies are symmetric: $z_2 = -z_1$. In this case, the price that either firm charges in the second stage is equal to: $2\phi b_2(z_2 - z_1)$. This price is strictly increasing in z_2 as long as the participation constraint of the indifferent consumer is not violated. Consequently, a firm can always deviate from this strategy profile unless z_j is set so that the price charged by the firms must equal the reservation utility of the indifferent consumer. At this point, neither firm has an incentive to deviate in either direction. If firm 2 reduces z_2 it lowers prices that can be charged. If it raises z_2 it loses market share without being able to raise price.

At $z_2 = -z_1$, for symmetric prices the indifferent consumer will be the 0 bias one (since we have assumed $b_1 = -b$ and $b_2 = b$. The equilibrium is therefore determined by

$$2\phi b_2(z_2 - z_1) = E[U_0(s_{z_1})]$$

Since $z_2 = -z_1$, this produces the quadratic equation:

$$4\phi b_2 z_2 = \bar{u} - \frac{\chi\phi}{\sigma + \chi} v_d - \phi z_j^2$$

Solving this equation shows that the corresponding strategy is:

$$z_2 = \frac{-4\phi b_2 + \sqrt{16\phi b_2^2 + 4\phi(\bar{u} - \frac{\chi\phi}{\chi+\phi} v_d)}}{2\phi} > 0$$

By symmetry, the strategy for paper 1 is

$$z_1 = \frac{4\phi b_2 - \sqrt{16\phi b_2^2 + 4\phi(\bar{u} - \frac{\chi\phi}{\chi+\phi} v_d)}}{2\phi} < 0$$

This is the strategy described in the proposition. Prices for this strategy are given by the indifference of the reader with 0 bias.

Finally, we must show that $z_2 \geq b_2$ and $z_1 \leq b_1$. Because $b_2 - b_1 < C_m$, a paper located at 0 would provide positive utility to a reader at b_2. Consequently a paper at b_2 would give a reader at 0 non-negative utility. Since z_2 is chosen to make the reader at 0 indifferent, it follows that $z_2 \geq b_2$. The argument for z_1 is exactly the same. ■

Proof of Corollary 4

Proof: Consider the first comparison: $CRB_{het,duo} < CRB_{het,mon}$. From Propositions 5 and 4 we know that duopolists report more diverse news than the monopolist when readers are heterogeneous. But from the functional form of $xc(\cdot,\cdot)$, we know that this diversity allows the conscientious reader to cross-check and thus produces less bias for her overall.

Consider the second comparison $CRB_{het,duo} < CRB_{hom,duo}$. By Propositions 5 and 3 we know that reporting in the heterogeneous case is more diverse. So, once again, the increased diversity means lower conscientious reader bias. ■

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