

Media Bias and Reputation

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A Bayesian consumer who is uncertain about the quality of an information source will infer that the source is of higher quality when its reports conform to the consumer's prior expectations. We use this fact to build a model of media bias in which firms slant their reports toward the prior beliefs of their customers in order to build a reputation for quality. Bias emerges in our model even though it can make all market participants worse off. The model predicts that bias will be less severe when consumers receive independent evidence on the true state of the world and that competition between independently owned news outlets can reduce bias. We present a variety of empirical evidence consistent with these predictions.

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I. Introduction

On December 2, 2003, American troops fought a battle in the Iraqi city of Samarra. Fox News began its story on the event with the following paragraph:

In one of the deadliest reported firefights in Iraq since the fall of Saddam Hussein's regime, US forces killed at least 54 Iraqis and captured eight others while fending off simultaneous convoy ambushes Sunday in the northern city of Samarra.

The *New York Times* article on the same event began

American commanders vowed Monday that the killing of as many as 54 insurgents in this central Iraqi town would serve as a lesson to those fighting the United States, but Iraqis disputed the death toll and said anger against America would only rise.

And the English-language Web site of the satellite network Al Jazeera (AlJazeera.net) began

The US military has vowed to continue aggressive tactics after saying it killed 54 Iraqis following an ambush, but commanders admitted they had no proof to back up their claims. The only corpses at Samarra's hospital were those of civilians, including two elderly Iranian visitors and a child.

All the accounts are based on the same set of underlying facts. Yet by selective omission, choice of words, and varying credibility ascribed to the primary source, each conveys a radically different impression of what actually happened. The choice to slant information in this way is what we will mean in this paper by media bias.

Such bias has been widely documented, both internationally and within the United States (Groseclose and Milyo 2005).¹ Concern about bias has played a prominent role in many policy debates, ranging from public diplomacy in the Middle East (Satloff 2003; Peterson et al. 2003) to ownership regulation by the Federal Communications Commission (Cooper, Kimmelman, and Leanza 2001). Moreover, survey evidence

¹ The differences between the slant of Arab and American news sources in covering the Middle East are documented at length by Ajami (2001). A sampling of recent works documenting bias in U.S. national media includes books by Alterman (2003), Coulter (2003), Franken (2003), and Goldberg (2003). Underhill and Pepper (2003) discuss accusations of prejudicial reporting at the BBC.

revealing rising polarization and falling trust in the news media has prompted concerns about the market's ability to deliver credible information to the public (Kohut 2004).

In this paper, we develop a new model of media bias. We start from a simple assumption: A media firm wants to build a reputation as a provider of accurate information. If the quality of the information a given firm provides is difficult to observe directly, consumer beliefs about quality will be based largely on observations of past reports. Firms will then have an incentive to shape these reports in whatever way will be most likely to improve their reputations and thus increase their future profits by expanding the demand for their products.

Our first set of results shows that firms will tend to distort information to make it conform with consumers' prior beliefs. To see why, consider that a noisy or inaccurate signal is more likely to produce reports that contradict the truth. An agent who has a strong prior belief about the true state of the world will therefore expect inaccurate information sources to contradict that belief more often than accurate ones. Suppose, for example, that a newspaper reports that scientists have successfully produced cold fusion. If a consumer believes this to be highly unlikely *a priori*, she will rationally infer that the paper probably has poor information or exercised poor judgment in interpreting the available evidence. A media firm concerned about its reputation for accuracy will therefore be reluctant to report evidence at odds with consumers' priors, even if they believe the evidence to be true. The more priors favor a given position, the less likely the firm becomes to print a story contradicting that position.

Our second main result is that when consumers have access to a source that can provide *ex post* verification of the true state of the world, firms' incentives to distort information are weakened. If a firm misreports its signal so as to move closer to consumers' priors, it runs the risk that the truth will come out and its report will be falsified, damaging its reputation. As the likelihood of *ex post* feedback about the state of the world improves, the amount of bias occurring in equilibrium decreases. Our model therefore predicts less bias in contexts in which predictions are concrete and outcomes are immediately observable—weather forecasting, sports outcomes, or stock returns, for example. It predicts more bias in coverage of a foreign war, discussion of the impact of alternative tax policies, or summary of scientific evidence about global warming, contexts in which outcomes are difficult to observe and are often not realized until long after the report is made.

The analysis of feedback foreshadows our third result: Competition in the news market can lead to lower bias. A firm competing with another news outlet runs the risk that, if it distorts its signal, the competitor's report will expose the inaccuracy and thus reduce consumers' assess-

ments of the distorting firm's quality. We also show that if all firms in a market are jointly owned, bias can remain unchanged even as the number of firms gets large.

At the end of the paper, we present empirical evidence on the determinants of bias. We review a range of existing evidence suggesting that feedback can limit bias and that in high-feedback settings, such as weather reporting, bias tends to be relatively minor. We also highlight the fact that local sports columnists do not excessively favor their local teams in forecasting game outcomes, which is consistent with an important role for rapid feedback in limiting the incentive to slant. Finally, we discuss anecdotal evidence suggesting that media firms in more competitive markets have stronger incentives to reveal important information and show quantitatively that television news reports leading up to the 2000 election were more equitable in their treatment of Bush and Gore in more competitive markets.

Formally, our work is most closely related to the literature on "herding on the priors," which considers the way agents' incentives to act on or reveal information depend on the prior beliefs of those who will ultimately determine their rewards. In this vein, Brandenburger and Polak (1996) show that a firm manager concerned about his firm's current stock price may choose the action favored by shareholders' priors even when he has private information showing that this is inefficient. The manager's desire to maximize current stock prices plays a role similar to that of the reputational incentives in our framework: it gives the decision maker an incentive to slant its action toward the prior beliefs of another agent. Prendergast (1993) shows that similar concerns will lead a worker to skew her reports to match the data that her manager has received, again leading valuable information to be lost in equilibrium.² In contrast to much of this literature, however, the reputational concerns we model provide an additional incentive for honesty, which in turn guarantees the presence of an informative equilibrium. In this sense, our model is also related to work on reputational effects in sender-receiver games (see, e.g., Effinger and Polborn 2001; Morris 2001; Avery and Meyer 2003; Olszewski 2004; Ottaviani and Sørensen 2006, forthcoming). We deviate from these papers in highlighting the importance of the receiver's prior beliefs for the equilibrium reporting strategy and in showing the effects of ex post revelation on equilibrium reporting.³ Our framework is also related to political scientists' models of "pandering" to voters (Canes-Wrone, Herron, and Shotts 2001).

Topically, our work is related to the growing body of economic re-

² See also Heidhues and Lagerlöf (2003) for an application to political competition.

³ See Ely, Fudenberg, and Levine (2002) and Ely and Välimäki (2003) for other models in which reputational concerns lead to distortions in equilibrium.

search on media bias. Existing economic models of bias all take as given that some agents in the economy—consumers (Mullainathan and Shleifer 2005), reporters (Baron 2004), or governments (Besley and Prat 2004)—*prefer* news suppliers to distort the information they provide.⁴ In contrast, our model shows that bias can arise even when consumers of news care only about learning the truth, sellers of news care only about maximizing profits, and eliminating bias could make all agents in the economy better off. While we do not deny that some agents may prefer the news media to distort their reports, our findings suggest that caution is warranted in interpreting media slant as evidence for such tastes. Additionally, our framework generates novel, testable predictions that distinguish it from these existing theories. Most notably, our prediction that increased competition lowers the incentive to bias reports toward consumer priors contrasts sharply with that of Mullainathan and Shleifer (2005), who argue that increased competition will *tighten* the connection between priors and reports.

In Section II, we discuss the role of reputational incentives in media markets. In Section III, we present the model for a simple monopoly case and show that equilibrium bias is correlated with consumer priors and decreasing in the amount of ex post feedback. In Section IV, we extend the model to allow for multiple firms and develop the intuition that competition can reduce bias by increasing the likelihood that erroneous reports are exposed. In Section V, we extend the model to allow consumers with heterogeneous prior beliefs to coexist in the same market. We show that it is possible to have segmented equilibria in which each firm provides information to only one type of consumer and slants its reports accordingly, and that the key comparative statics remain valid in this setting. Section VI presents empirical evidence supporting our key findings, and Section VII presents conclusions.

II. Credibility, Quality, and Bias in the Media

In this section, we present evidence supporting two key building blocks of our model: Media firms try to build a reputation for truthful reporting, and consumers' assessments of the quality of news sources depend on prior beliefs. We also present evidence confirming the intuition suggested in the first paragraph of Section I that firms' reporting strategies are highly related to the prior beliefs of their consumers.

⁴ An earlier version of Mullainathan and Shleifer's (2002) paper does not assume that consumers have a taste for confirmatory information but generates similar behavior through a mechanism in which consumers think categorically.

A. *The Importance of Reputation in Media Markets*

At the heart of our model will be media firms' desire to maintain a reputation for accuracy in reporting. The high costs firms are willing to incur to gather information provide strong evidence of such an incentive,⁵ as does the response of media firms whose reports are revealed to have been inaccurate. For example, on September 8, 2004, CBS News anchor Dan Rather reported the emergence of new evidence indicating that President Bush's family had pulled strings in order to get him into the Texas Air National Guard and avoid his having to serve in Vietnam. When later information indicated that the documents on which the report was based may have been fabricated, both Rather and Andrew Heyward, president of CBS, issued apologies emphasizing the importance of a reputation for truth telling in journalism. Heyward wrote that "nothing is more important to [CBS] than our credibility and keeping faith with the millions of people who count on us for fair, accurate, reliable, and independent reporting. We will continue to work tirelessly to be worthy of that trust" (Heyward 2004). Rather's statement echoed Heyward's, explaining that "nothing is more important to [CBS] than people's trust in our ability and our commitment to report fairly and truthfully" (Rather 2004).

Similarly, the exposure of Jayson Blair's fraudulent reporting at the *New York Times* prompted the resignation of top-ranking editors Howell Raines and Gerald M. Boyd. Former Tupperware chief executive Warren L. Batts remarked, "They, of course, had to resign. . . . Any company has to sell the credibility of its product, but a media company has nothing else to sell" (Kirkpatrick and Fabrikant 2003, B9).⁶

B. *The Influence of Priors on Quality Assessments*

Our model will draw on a general property of Bayesian updating about source quality, namely, that a source is judged to be of higher quality when its reports are more consistent with the agent's prior beliefs.⁷ A large body of psychological research documents a strong connection

⁵ To take one example, Andrew Lack, president of NBC News, estimated at the beginning of the war in Afghanistan that covering it would cost each network approximately \$1 million per week—10 percent of their total weekly expenditures (Auletta 2001). One would not expect to see this level of expense if consumers were not significantly concerned with the factual content of news.

⁶ An investigation by the *Times* discovered that Blair had "fabricated comments," "concocted scenes," and "selected details from photographs to create the impression he had been somewhere or seen someone, when he had not" (Barry et al. 2003, 1). *New York Times* publisher Arthur Sulzberger Jr. called Blair's deceptions "an abrogation of the trust between the newspaper and its readers" (1).

⁷ Gentzkow and Shapiro (2005b) provide a proof of this property under fairly general conditions. See also Prendergast (1993) and Brandenburger and Polak (1996).

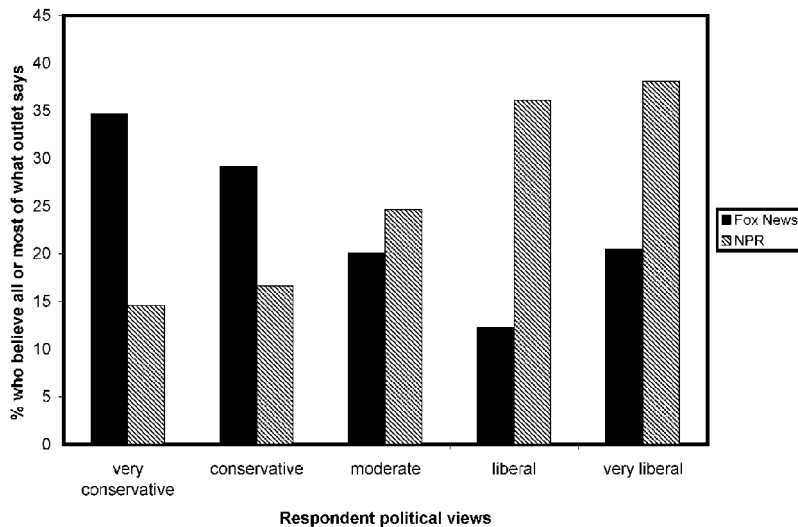


FIG. 1.—Political views and assessments of news media believability. Data come from the Pew Research Center for the People and the Press's 2002 News Media Believability Survey. Exact wording for a survey question on respondent political views: "In general, would you describe your political views as very conservative, conservative, moderate, liberal, or very liberal?" Exact wording for a survey question on media believability: "Now, I'm going to read a list. Please rate how much you think you can BELIEVE each organization I name on a scale of 4 to 1. On this four point scale, '4' means you can believe all or most of what the organization says. '1' means you believe almost nothing of what they say. How would you rate the believability of (the Fox News CABLE Channel/National Public Radio) on this scale of 4 to 1?"

between subjects' prior views and their assessments of information sources. In perhaps the best-known paper on this subject, Lord, Ross, and Lepper (1979) show that experimental subjects evaluating studies of the deterrence effect of the death penalty rate studies supporting their prior beliefs as both more "convincing" and "better done."⁸ This basic finding is replicated and expanded by Lord, Lepper, and Preston (1984), Miller et al. (1993), and Munro and Ditto (1997). Along the same lines, Koehler (1993) shows that scientists rate experiments as higher-quality when the experimental results conform to the scientists' belief about a controversial issue.

Evidence on consumer assessments of media quality in the real world shows a similar pattern. To take one example, figure 1 shows that in a recent survey, nearly 30 percent of respondents who described themselves as "conservative" indicated that they thought they could believe

⁸ This paper is often cited as evidence that consumers have confirmatory bias, i.e., a taste for information that confirms their prior beliefs. We simply note that the evidence on evaluating the quality of information sources is equally consistent with a Bayesian model.

all or most of what the Fox Cable News Network says. In contrast, less than 15 percent of self-described liberals said that they could believe all or most of what the network reports. Ratings of National Public Radio show the opposite pattern: more than 35 percent of liberals believe all or most of what NPR says, as opposed to less than 20 percent of conservatives.⁹ Taken together, these pieces of evidence strongly suggest that prior beliefs influence consumers' judgments of quality in the way a Bayesian model would predict.

C. *The Influence of Consumer Priors on Media Reports*

A large body of anecdotal evidence suggests a connection between consumers' prior beliefs and media firms' slant. Consider, for example, Ames's (1938, 77) description of the problem faced by southern newspaper editors in their coverage of lynchings: "As individuals, they are unanimously opposed to mob violence but, as editors who are caught in the general atmosphere of a given trade territory, they do not reflect their own ideas but those of the people upon whose goodwill their papers depend for revenue." The result of this pressure was that southern editorials in the period almost universally condoned lynchings.

A more recent example is the reported difference in coverage of the war in Iraq between U.S. networks and Arabic-language news channels such as Al Jazeera. As Lt. Josh Rushing, an American press officer, explains in the documentary *Control Room*, "It benefits Al Jazeera to play to Arab nationalism because that's their audience, just like Fox plays to American patriotism for the exact same reason" (Turan 2004, E6).

Even *within* a given firm, slant can vary depending on the audience. For example, CNN's domestic cable channel broadcasts quite different content from CNN International, which is broadcast worldwide. Chris Cramer, president of CNN International, writes that its audience "expects us to have a non-U.S. viewpoint." The difference is also illustrated by coverage in the aftermath of September 11: the domestic channel prominently displayed an American flag during its broadcasts whereas the international broadcasts quickly dropped the flag (Kempner 2001, 1G).

We now turn to more systematic evidence. Newspaper endorsements of presidential candidates display a pattern of conformity to local po-

⁹ Other evidence comes from Gallup Organization (2002). Respondents in nine Islamic countries were asked to report whether each of the following five descriptions applies to CNN: has comprehensive news coverage; has good analyses; is always on the site of events; has daring, unedited news; and has unique access to information. In Gentzkow and Shapiro (2005*b*), we show that an index of these quality assessments is strongly correlated with respondents' reported favorability toward the United States. To deal with the possibility of reverse causality, we also construct a proxy for favorability based on respondents' reported religiosity and show that this also has a strong correlation with quality assessments.

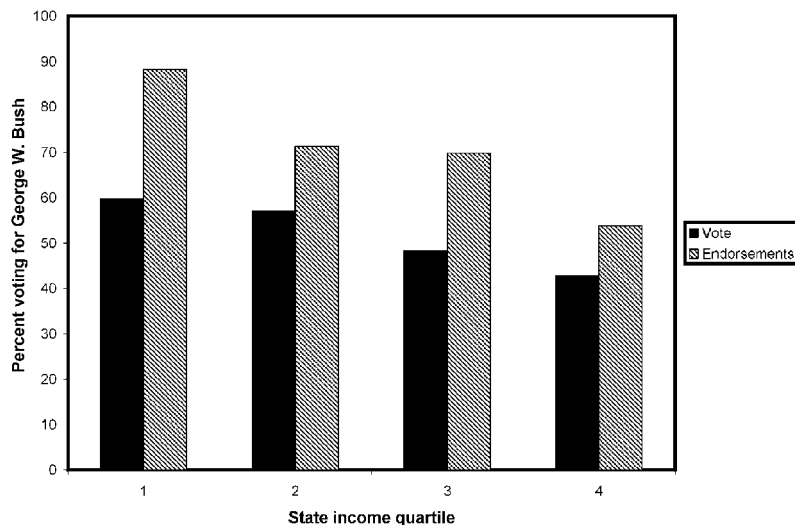


FIG. 2.—Newspaper endorsements and ideology across U.S. states in the 2000 election. Data on voting behavior are taken from the Federal Election Commission (<http://www.fec.gov/elections.html>). Percent for Bush reflects percentage of the two-party vote. Data on state per capita income come from USA Counties 1998 CD-ROM. Data on newspaper endorsements come from Bush (<http://www.georgewbush.com>) and Gore (<http://www.algore.com>) official campaign sites; data posted at <http://www.wheretodoresearch.com/Political.htm#Endorsements>. Percent for Bush reflects percentage among papers endorsing either Bush or Gore.

litical opinion. As figure 2 shows, in the 2000 U.S. presidential election, Bush's share of the two-party vote was considerably lower in richer states (Glaeser, Ponzetto, and Shapiro 2005). Bush received almost 60 percent of the two-party vote among states in the lowest income quartile, as against just over 40 percent in the states in the highest quartile. As the figure illustrates, newspaper endorsements displayed a similar pattern, with almost 90 percent endorsing Bush in the bottom quartile and less than 55 percent in the top quartile. Although this graph is by no means conclusive, it certainly suggests a significant connection between consumer beliefs and media slant.

Existing work in political science also suggests a correlation between the editorial position of newspapers and the views of their readers. For example, Dalton, Beck, and Huckfeldt (1998) show survey evidence from the 1992 presidential election suggesting that the editorial stance of local newspapers is correlated with local perceptions of candidates. Erikson (1976) documents a similar relationship using aggregate data on voting patterns in the 1960s. In Gunther's (1992) analysis of national survey data, he finds that only 2 percent of respondents had political

views categorized as “very distant” from those of their primary newspaper.

III. Media Bias in a Monopoly

In this section we present a simple model in which a single media firm reports to homogeneous consumers. There is a binary state of the world, $S \in \{L, R\}$, and a large population of consumers who must each choose a binary action $A \in \{L, R\}$, which gives a payoff of one if $A = S$ and a payoff of zero otherwise.¹⁰ We assume that consumers and the firm place prior probability θ and θ^F , respectively, on the true state being R .¹¹

At the beginning of the game, the firm receives a signal $s \in \{l, r\}$ about the true state, whose distribution depends on the firm’s quality. With probability λ , the firm is “high-quality” and has a signal that perfectly reveals the true state. With probability $1 - \lambda$, the firm is “normal” and has an imperfect but informative signal distributed according to

$$\Pr(l|L) = \Pr(r|R) = \pi,$$

where $\pi \in (\frac{1}{2}, 1)$. We assume that the firm knows its own quality with certainty. We also assume that $\theta \in [\frac{1}{2}, \pi)$ and $\theta^F \in (1 - \pi, \pi)$. These restrictions ensure that the firm’s best guess as to the true state will depend on its signal and also that its signal will be valuable to consumers.¹² The assumption that $\theta \geq \frac{1}{2}$ is made without loss of generality and serves to limit the set of cases we need to consider.

After seeing its signal, the firm publishes a report $\hat{s} \in \{\hat{l}, \hat{r}\}$. Normal firms are free to report either \hat{l} or \hat{r} , and we denote a normal firm’s strategy conditional on its signal by $\sigma_s(\hat{s}) = \Pr(\hat{s}|s)$. Without loss of generality, we will restrict attention to strategies with $\sigma_r(\hat{r}) \geq \sigma_l(\hat{r})$ (cases

¹⁰ We follow much of the previous literature in modeling the information provided by media firms as an informative signal about some unknown state of the world, and assuming that consumers value this information because they face some decision whose payoffs are connected with the true state. This could represent actual decisions that depend on the news, either with large instrumental consequences (whether to join a terrorist group opposing the United States) or with minor consequences (what position to support in an argument with friends). It could also represent consumers who value information intrinsically as in Grant, Kajii, and Polak (1998).

¹¹ Although we will allow for the possibility that $\theta = \theta^F$, the choice to specify firm and consumer beliefs separately rather than assuming a common prior does affect the results slightly because it means that the comparative statics we present on θ will hold the firm prior constant. As we point out below, however, the comparative statics would only be strengthened if we moved firm and consumer priors together.

¹² In the case in which $\pi < \theta^F$, the firm’s best guess is that the true state is R regardless of its signal. We would want to define “bias” in this case to be the probability that the firm’s report deviates from its best guess of the true state (the proper definition with respect to welfare). Bias would therefore involve the firm’s reporting \hat{l} “too often” rather than \hat{r} too often as in the case we will analyze. However, the key comparative statics, that firm reports are correlated with consumer priors and that bias decreases with feedback, would remain unchanged.

in which this does not hold are equivalent to a relabeling of \hat{l} and \hat{r} . We assume that high-quality firms always report their signal (and thus the true state) honestly.¹³

The most straightforward interpretation of these assumptions is that the normal type has the freedom to lie. But note that our formulation can also accommodate subtler forms of bias such as “spin.” In the example discussed at the beginning of the paper, for example, we could think of two possible reporting strategies as “emphasize the fact that American troops were defending themselves” or “emphasize the fact that American troops killed a large number of Iraqis.” Replacing the option to report either \hat{l} or \hat{r} with this choice of emphasis would change nothing about the formal structure of the game. In this reformulation, a news firm observes real-world events and then chooses what to emphasize in its report. As long as high-quality firms emphasize civilian casualties more often when civilian casualties were actually high, this case will fit naturally into our model. This observation is related to a common and fairly general feature of economic models of communication, namely, that language has meaning only in equilibrium (Crawford and Sobel 1982).¹⁴

Consumers choose whether or not to purchase the firm’s product and thus learn the value of \hat{s} . Rather than specify the pricing and profit structure in detail, we make two reduced-form assumptions: (i) all consumers purchase the product in equilibrium, and (ii) a change in the distribution of \hat{s} (conditional on the true state) that increases consumers’ willingness to pay for the firm’s report does not reduce consumer welfare and strictly increases firm profits. These assumptions would hold, for example, in a model in which the firm sets a monopoly price and extracts all the consumer surplus.¹⁵

After making the purchase decision and possibly learning \hat{s} , each consumer chooses an action A . Note that if consumers received utility from this action immediately, they would also know the true state. Since we wish to model feedback about the truth explicitly, we assume that

¹³ Allowing both types to have discretion would complicate the exposition and lead the model to have multiple equilibria in general. As we show in Gentzkow and Shapiro (2005*b*), however, the equilibrium we analyze in which high types report truthfully is in fact the unique equilibrium of the more general model under an intuitive stability criterion.

¹⁴ Although the fact that the model is invariant to relabeling the reporting strategies is trivial, the comparative statics are also robust to more substantive changes in the way we model the technology of reporting. In Gentzkow and Shapiro (2005*b*), we extend the model to allow for a continuous underlying signal, which approximates the case in which firms receive several signals each period and choose which to print and which to omit. We show that all our key results remain valid in this alternative specification.

¹⁵ Alternatively, we could relax assumption i and allow the number of consumers who buy the firm’s product to depend on the expected value of the information in the firm’s report. A firm that set a zero price but extracted revenues from advertising would then be better off the more useful its reports were expected to be.

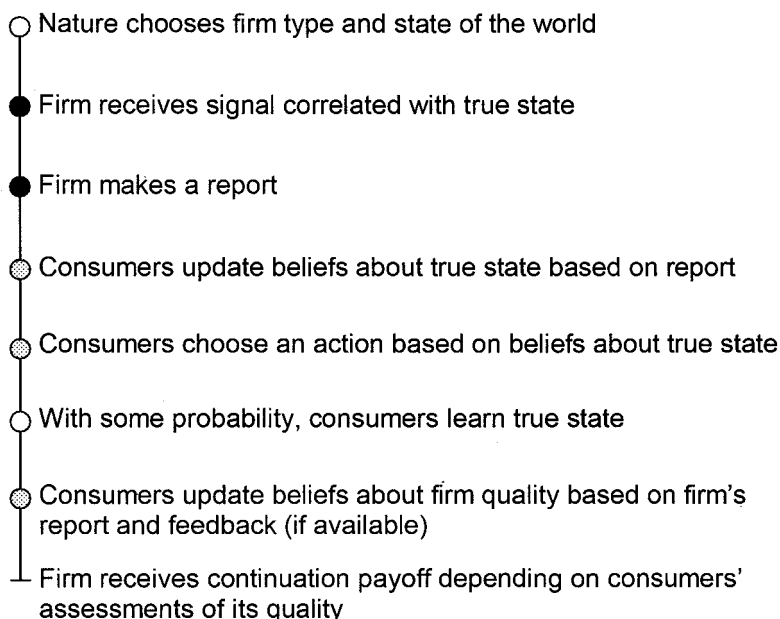


FIG. 3.—Timing of the monopoly game

consumers do not receive utility until the end of the game, but all consumers immediately learn the true state with probability $\mu \in [0, 1]$. Letting $X \in \{L, R, 0\}$ denote the feedback received, with $X = 0$ indicating the case of no feedback, we will abuse notation slightly and denote by $\lambda(\hat{s}, X)$ a consumer's posterior probability that the firm is high-quality given a report of \hat{s} and feedback of X .

Finally, we assume that the firm receives a continuation payoff $\sum_i f(\lambda_i)$, where f is a continuous and strictly increasing function of its argument and λ_i is the posterior belief of consumer i . This could easily be derived by assuming a second period with exactly the same structure as the game just described. Second-period profits would then be increasing in λ_i because each consumer's expected gain from learning \hat{s} will be higher the greater the probability the firm is high-quality. It can also be generated by a repeated structure in which overlapping generations of consumers interact with a long-lived firm (Gentzkow and Shapiro 2005a).

The timing of the game is summarized in figure 3. Note that the structure of the game implies that the firm's choice of a report \hat{s} affects its objective function only via the continuation payoffs $f(\lambda_i)$. Therefore,

any \hat{s} played in equilibrium must maximize the expectation of the continuation payoff over possible realizations of the consumer feedback.

A. *Inferring Quality from Content*

As a first step to analyzing the outcome of this game, we consider how a consumer's posterior belief about firm quality depends on the firm's strategy, the accuracy of its signal, π , and the consumer's prior, θ . We focus for now on the case in which consumers do not receive feedback.

Consider the posterior after a report of \hat{r} and no feedback, $\lambda(\hat{r}, 0)$. When we set aside the degenerate case in which the firm always reports \hat{l} , this is a strictly increasing function of the likelihood ratio:

$$\frac{\Pr(\hat{r} | \text{high})}{\Pr(\hat{r} | \text{normal})} = \frac{\theta}{\theta[\sigma_r(\hat{r})\pi + \sigma_l(\hat{r})(1 - \pi)] + (1 - \theta)[\sigma_r(\hat{r})(1 - \pi) + \sigma_l(\hat{r})\pi]}.$$

The key observation that drives many of the results below is that the more consumers' prior beliefs favor the state R , the more highly they will rate the quality of a firm that reports \hat{r} . To see this, note that the derivative of the likelihood ratio with respect to θ has the same sign as $\sigma_r(\hat{r})(1 - \pi) + \sigma_l(\hat{r})\pi$, which is strictly positive under our maintained assumption that $\pi < 1$. Intuitively, as θ increases, the probability that a high type reports \hat{r} increases faster than the probability that a normal type reports \hat{r} , since the latter's report is more weakly related to the true state. This makes \hat{r} a better indicator of quality.

We can also see immediately that the likelihood ratio is strictly decreasing in both $\sigma_r(\hat{r})$ and $\sigma_l(\hat{r})$ (since increasing them makes \hat{r} a better indicator that the firm is normal). It is also weakly decreasing in π (strictly if $\theta > \frac{1}{2}$ and $\sigma_r(\hat{r}) > \sigma_l(\hat{r})$) since increasing π makes normal firms more likely to receive a signal of r and thus more likely to report \hat{r} but does not affect the distribution of the high type's reports.

Applying the same logic to beliefs after a report of \hat{l} , we arrive at lemma 1.

LEMMA 1. Suppose that normal firms report both \hat{r} and \hat{l} with positive probability and that $\theta > \frac{1}{2}$. Then $\lambda(\hat{r}, 0)$ is strictly increasing in θ and strictly decreasing in $\sigma_r(\hat{r})$ and $\sigma_l(\hat{r})$. Similarly, $\lambda(\hat{l}, 0)$ is strictly decreasing in θ and strictly increasing in $\sigma_r(\hat{r})$ and $\sigma_l(\hat{r})$. Finally, $\lambda(\hat{r}, 0)$ is decreasing in π and $\lambda(\hat{l}, 0)$ is increasing in π , strictly whenever $\sigma_r(\hat{r}) > \sigma_l(\hat{r})$.

B. *Two Special Cases*

To fix ideas, we treat first the special cases of no feedback ($\mu = 0$) and perfect feedback ($\mu = 1$). In the no-feedback case, the consumer's posterior on the firm's quality will be $\lambda(\hat{s}, 0)$, which depends only on the firm's report. In equilibrium we must have $\lambda(\hat{r}, 0) = \lambda(\hat{l}, 0)$. To see this, note that if $\lambda(\hat{r}, 0) > \lambda(\hat{l}, 0)$, normal firms would prefer to always report \hat{r} , which in turn would imply $\lambda(\hat{l}, 0) = 1$, a contradiction.

In order for the posterior to be independent of the firm's report, from the consumer's perspective, the equilibrium distributions of the high and normal types' signals must be the same. This requires that the normal firm report \hat{r} with probability θ and \hat{l} with probability $1 - \theta$. Note that this immediately rules out the normal firm truthfully reporting its signal, since a truthful normal firm reports \hat{r} with probability $(1 - \theta)(1 - \pi) + \theta\pi < \theta$.

There are many possible strategies for the normal firm that would cause its signal to have the necessary distribution and thus many possible equilibria.¹⁶ Since the firm must distort its signal in a way that increases the overall probability of reporting \hat{r} , all of these strategies will involve some garbling of the signal l (i.e., $\sigma_l(\hat{r}) > 0$). For now, we will focus on the most informative equilibrium—the one in which the firm does not simultaneously garble r signals.¹⁷ We show below that with even a small probability of feedback, μ , the model has a unique equilibrium, and the one considered here is the limit of these unique equilibria as $\mu \rightarrow 0$.

In equilibrium, then, the firm biases its signal in the direction of consumers' prior.¹⁸ Using lemma 1, we can see immediately that the intensity of this bias, $\sigma_r^*(\hat{r})$, will be increasing in the strength of the prior θ . Increasing θ increases $\lambda(\hat{r}, 0)$ and decreases $\lambda(\hat{l}, 0)$, thus making it more attractive to report \hat{r} ; $\sigma_r(\hat{r})$ must then increase to restore equilibrium. The same logic shows that increasing π reduces the intensity of bias. Intuitively, since R is the most likely state, a normal firm with a more accurate signal is more likely to report \hat{r} and so requires less

¹⁶ For example, there is a pure babbling equilibrium in which normal firms randomly choose \hat{r} with probability θ and \hat{l} with probability $1 - \theta$ (independently of s).

¹⁷ It is straightforward to show that this is the equilibrium that maximizes the probability that the consumer chooses the correct action, from the perspective of the consumer's prior θ .

¹⁸ In this simple case, we can solve for the bias explicitly. Equilibrium requires that

$$\Pr(\hat{r} | \text{normal}) = \sigma_r(\hat{r})[\theta\pi + (1 - \theta)(1 - \pi)] + \sigma_l(\hat{r})[\theta(1 - \pi) + (1 - \theta)\pi] = \theta.$$

Setting $\sigma_r(\hat{r}) = 1$, we have

$$\sigma_l(\hat{r}) = \frac{(2\theta - 1)(1 - \pi)}{\theta(1 - \pi) + (1 - \theta)\pi}.$$

It is straightforward to check that this is increasing in θ and decreasing in π .

distortion to match the high type's signal. Finally, note that since the prior on quality λ cancels out in the equilibrium condition $\lambda(\hat{r}, 0) = \lambda(\hat{l}, 0)$, bias will be independent of λ . Therefore, as is common in reputation-based models, even an arbitrarily small chance that the firm is a high type is sufficient to pin down its reporting incentives (Kreps and Wilson 1982; Milgrom and Roberts 1982).

Consider, next, the special case in which the consumer receives feedback with certainty ($\mu = 1$). Because any disagreement between feedback and report implies that the firm must be the normal type, the firm will always prefer to match the feedback if possible. Intuitively, this will mean that the firm should report whichever state it believes is most likely after seeing its signal, s . Since we have assumed that the signal is sufficiently strong to outweigh the firm's prior (i.e., that $\pi > \theta^f > 1 - \pi$), this will lead to truthful reporting.

This argument would be exactly correct if the gain in continuation payoff from correctly matching the R state were equal to the gain from correctly matching the L state. This is not a priori obvious since the consumer's judgments will depend on her conjecture about the normal firm's strategy. Suppose, however, that the gain from correctly reporting R were greater—that $\lambda(\hat{r}, R) > \lambda(\hat{l}, L)$. This would mean that the firm might have an incentive to deviate and report \hat{r} after seeing a signal of l but would always report truthfully after seeing r . But this would imply that normal firms are more likely to correctly match R states than L states, and so we would have $\lambda(\hat{l}, L) > \lambda(\hat{r}, R)$, a contradiction. From this logic it follows that the only equilibrium is honest reporting. Note that this is also the most informative strategy, in the sense that it most efficiently conveys the firm's information to the consumer.

C. *Equilibrium Reporting*

We turn next to a formal treatment of the more general case of $\mu \in (0, 1)$. The firm's expected payoff is essentially a weighted average of the two special cases described above. With probability $1 - \mu$, the consumer receives no additional information about the true state and forms a posterior on the basis of her prior beliefs and her conjectures about the firm's strategy. With probability μ , a feedback report arrives, and the consumer can base her judgment of the firm's quality on the true state. Because the equilibrium conditional on feedback involves truthful reporting, we would expect equilibrium bias in the general case to be decreasing in μ .

Formally, we can write the expected gain to reporting \hat{r} rather than \hat{l} after seeing signal s as

$$\Delta(s) = (1 - \mu)\Delta^{nf} + \mu\Delta^f(s),$$

where

$$\begin{aligned} \Delta^{nf} &= f(\lambda(\hat{r}, 0)) - f(\lambda(\hat{l}, 0)), \\ \Delta^l(s) &= \theta^r(s)[f(\lambda(\hat{r}, R)) - f(0)] - [1 - \theta^r(s)][f(\lambda(\hat{l}, L)) - f(0)]. \end{aligned}$$

(We abuse notation slightly and let $\theta^r(s)$ represent the firm's posterior on the true state after seeing s .) Note that the two terms in brackets are the gains to correctly matching the R and L states, respectively. They follow from the fact that a firm that fails to match the feedback report cannot be a high type, and so $\lambda(\hat{l}, R) = \lambda(\hat{r}, L) = 0$. Note that since $\theta^r(r) > \theta^r(l)$ and so $\Delta^l(r) > \Delta^l(l)$, the gain to reporting \hat{r} (\hat{l}) is strictly larger (smaller) after seeing r than after seeing l .

To gain some intuition for the comparative statics, suppose that we begin from the case of perfect feedback ($\mu = 1$), in which normal firms report their signals truthfully. Because a truthful normal firm reports \hat{r} less often than a high-quality firm, we know that $\Delta^{nf} > 0$; if there were no feedback, the firm would want to deviate and report \hat{r} after seeing l . Truthful reporting also implies that $\Delta^l(l) < 0$, since $\lambda(\hat{r}, R) = \lambda(\hat{l}, L)$ and $\theta^r(l) < \frac{1}{2}$; conditional on feedback, the firm strictly prefers to report l signals truthfully.

Consider, now, what happens as we decrease μ . For a firm that saw a signal l , this shifts weight from the negative term $\Delta^l(l)$ to the positive term Δ^{nf} , decreasing the net gain to reporting truthfully. As long as firm strategies do not change, neither $\Delta^l(l)$ nor Δ^{nf} changes with μ , so we will eventually reach a value of μ strictly greater than zero where $\Delta^l(l) = 0$. If μ falls beyond this point, the firm will strictly prefer to report \hat{r} even after seeing l . It cannot be an equilibrium for the firm to always report \hat{r} because in this case reporting \hat{l} would lead consumers to believe that the firm was high-quality for sure.¹⁹ The firm must therefore begin garbling l signals with a small probability; this increases the probability that a normal firm reports \hat{r} , causing the net reputational payoff to reporting \hat{r} to fall. There will thus be a range of high μ in which the firm reports truthfully and a range of lower μ in which the firm plays a mixed strategy defined by the condition $\Delta^l(l) = 0$. In this range, the firm biases its signal toward consumer priors, and the probability of bias is decreasing in μ .

It is easy to see that when the firm is playing a mixed strategy, the bias will also be increasing in θ . Increasing θ increases Δ^{nf} by lemma 1

¹⁹ Making this argument precise requires us to handle the zero-probability event that the firm deviates and reports \hat{l} , but then the consumer receives feedback that the true state was R . We discuss the formalities in the proof of proposition 1.

and does not change $\Delta'(s)$.²⁰ Since neither $\lambda(\hat{r}, R)$ nor $\lambda(\hat{l}, L)$ changes, this provides a strict incentive to report \hat{r} , and in order to restore equilibrium the firm must garble l signals into \hat{r} more often.

Given the general form we have assumed for the continuation payoff, there is no clear comparative static with respect to π .²¹ However, in the limit as $\pi \rightarrow 1$, a normal firm's signal becomes nearly as accurate as that of the high type, so that the normal firm's reputational incentives no longer favor distortion and honest reporting becomes the unique equilibrium strategy.

The complete characterization of equilibrium is given in proposition 1, which is proved in the Appendix. Note that the equilibrium reporting strategy is now unique: with even arbitrarily little feedback, the firm will choose the most informative strategy to try to match the conditional distribution of the high type's reports. Note too that since the firm garbles only l signals, the limit of these equilibria as $\mu \rightarrow 0$ is the one discussed for the case of no feedback above.

PROPOSITION 1. The unique perfect Bayesian equilibrium reporting strategy is for a normal firm to report r signals truthfully and to misrepresent l signals with probability $\sigma_i^*(\hat{r}) \in [0, 1)$. This probability is weakly increasing in θ , strictly whenever $\sigma_i^*(\hat{r}) > 0$. For any $\theta \in (\frac{1}{2}, 1)$, there exists $\mu^* \in (0, 1)$ such that this probability is zero for $\mu \geq \mu^*$ and is positive and strictly decreasing in μ for $\mu < \mu^*$. The limit of $\sigma_i^*(\hat{r})$ as $\pi \rightarrow 1$ is zero.

To make clearer how the equilibrium works, figure 4 shows the equilibrium bias as a function of θ for two different values of μ . When μ is very close to zero, there is bias for almost all θ and it is strictly increasing in θ . As μ increases, the bias falls, and there is a range of low θ for which the equilibrium is truth telling.

D. Welfare

Because we have modeled bias as a garbling of the firm's signal, it should be immediately clear that consumers' willingness to pay for an unbiased signal would be strictly higher than for a biased signal. Recall that we have assumed that a change in the distribution of \hat{s} that increases consumers' willingness to pay for the firm's report does not reduce consumer welfare and strictly increases firms' profits in the first period.

²⁰ Note that if we assumed that the firm and consumers had identical priors, then $\theta^i(s)$ and hence $\Delta'(s)$ would be increasing in θ , thus strengthening the comparative static on θ .

²¹ Increasing π makes it more likely that a normal firm's report matches the feedback and so decreases both $\lambda(\hat{r}, R)$ and $\lambda(\hat{l}, L)$. Depending on the shape of the function $f(\cdot)$, this could either increase or decrease $\Delta'(l)$, and so the net effect on the incentive to report \hat{r} is ambiguous.

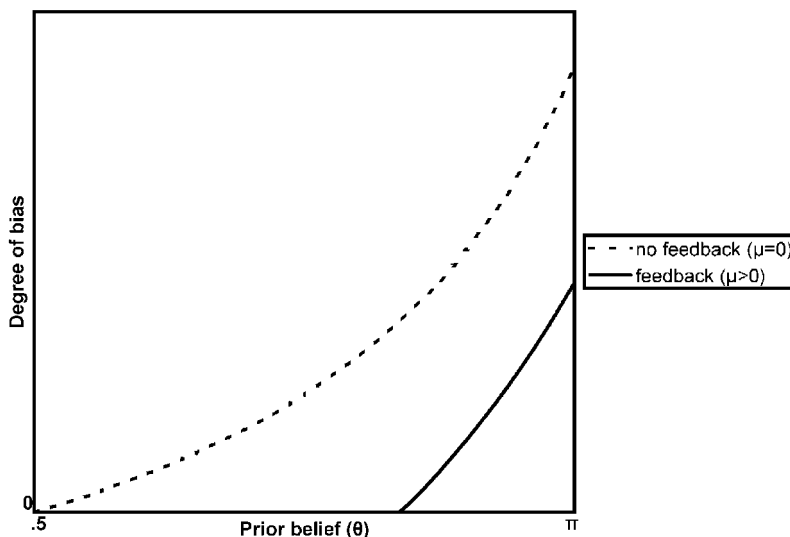


FIG. 4.—Numerical example. Vertical axis shows equilibrium probability of reporting \hat{r} given that the newspaper with the scoop receives a signal of l . Horizontal axis shows prior probability θ . Dashed line shows equilibria for the limit case of no feedback ($\mu = 0$). Solid line shows equilibria for the case of a positive probability of feedback ($\mu = .5$). Drawn for the case of $f(x) = x$, $\pi = .7$, $\theta^F = .5$, and $\lambda = .3$.

This means that eliminating bias cannot make consumers worse off (from the perspective of the consumer’s prior) and that it strictly increases firm profits in the first period.²²

The other element of welfare to consider is the effect of eliminating bias on the firm’s expected continuation payoff, where the expectation is taken with respect to the firm’s prior θ^F . This is more subtle because reducing bias would improve the accuracy of consumers’ inferences about quality. This would tend to increase the continuation payoffs of high-quality firms and decrease the continuation payoffs of normal firms. However, the magnitude of this learning effect will be small if the change in consumer beliefs about quality is small. This will be true in particular if λ (the prior probability that the firm is high-quality) is close to zero. To see this, observe that since the normal firm reports both \hat{r} and \hat{l} with positive probability in equilibrium, there is no event that reveals the firm to be high-quality for sure. Therefore, as $\lambda \rightarrow 0$,

²² Note as an aside that we have not assigned consumers a continuation payoff that depends on their beliefs about the firm’s quality. In a model in which future interactions were defined explicitly, we might expect consumers to be better off the more they learned about firm quality. But eliminating bias must also at least weakly increase this payoff, since an unbiased signal provides strictly more information about the firm’s type, and so we would still find a strict increase in overall willingness to pay.

the posteriors $\lambda(\hat{s}, X)$ become arbitrarily close to zero for all \hat{s} and X . This means that the change in continuation payoffs when bias is eliminated will approach zero.

We can thus state the following result.

PROPOSITION 2. Suppose that the equilibrium bias $\sigma_i^*(\hat{r})$ is bounded away from zero in a neighborhood of $\lambda = 0$. Then for small λ , consumers would be weakly better off and the firm strictly better off if the firm were required to report its signal truthfully.

It is easy to find parameters for which the equilibrium bias is indeed bounded away from zero around $\lambda = 0$. Recall that in the model with no feedback we showed that bias in the most informative equilibrium was independent of λ and also that this was the limit of the full model's equilibria as $\mu \rightarrow 0$. For any $\theta > \frac{1}{2}$, we can therefore typically find μ small enough that the limit of bias as $\lambda \rightarrow 0$ is strictly positive.

IV. Competition and Endogenous Feedback

Thus far we have taken the probability of feedback, μ , to be exogenous. This was meant to capture a variety of ways that consumers might obtain additional information ex post—direct experience, contact with friends, and so forth. In this section, we explore a specific case in more detail: feedback that is provided by competing media firms. We discuss the kinds of incentives that would lead competing firms to provide accurate feedback in equilibrium and show that increasing competition will tend to decrease reporting bias.

We assume that there are J firms in the market. One of these firms has a “scoop” on the true state of the world; this means that the firm receives a possibly noisy signal s of the true state S and reports it exactly as the monopoly firm did in the last section. That is, if the scoop firm is high-quality (with probability λ), it receives a perfectly accurate signal and reports it honestly; if it is normal, it receives a noisy signal equal to the true state with probability π and is free to report either \hat{r} or \hat{l} .²³ At the end of the game, the firm receives a continuation payoff equal to $\sum_i f(\lambda_i)$. We extend the model by adding a “feedback stage” in which the remaining $J - 1$ firms observe the scoop firm's report and also learn the true state with certainty. Each of these firms j then publishes a report, which we denote $\tilde{s}_j \in \{\tilde{l}, \tilde{r}\}$. We continue to assume that there is an

²³ Implicitly, we are assuming that the firm with the scoop always makes a report, but in principle we could endogenize this choice. Of course, a firm that knows that it is the normal type might prefer not to make a report, so as to avoid making an error and revealing its type. This temptation would be especially strong if consumers did not know which firm has the scoop. On the other hand, if high types always make a report when they have the scoop, then there will be reputational incentives to make a report even if consumers do not know which firm has the scoop. Understanding how these trade-offs play out in equilibrium is an interesting issue beyond the scope of this paper.

exogenous probability $\tilde{\mu} > 0$ that the true state is revealed after all reports have been made.

In specifying consumer behavior, we want to capture the idea that increasing the number of competing firms makes it more likely that consumers will read a feedback report ex post. We continue to assume for simplicity that all consumers read the scoop firm's report and that they must choose their action A immediately after reading it. We then assume that each consumer can choose one of the $J - 1$ feedback reports or the outside option of reading none of them, which provides some exogenous constant level of utility. The utility of reading each of the feedback reports includes an independently and identically distributed random component with full support, so that the probability that each consumer reads a feedback report, denoted $\phi(J)$, is strictly increasing in J and approaches one as $J \rightarrow \infty$.

Observe that if all $J - 1$ firms report the true state accurately in the feedback stage, the assumptions we have made mean that the scoop firm's problem will be exactly equivalent to the monopoly problem analyzed above: it chooses its report to maximize its reputation knowing that consumers will either have no feedback about the truth or learn the true state with certainty. The only difference is that the probability of feedback will now be a strictly increasing function of J . Proposition 2 thus implies that given truthful reporting, bias is weakly decreasing in J and strictly decreasing in J whenever the equilibrium calls for positive bias.

This observation treats competing firms as a mechanical device whose reports are exogenously fixed to perfectly reveal the true state. But reputational incentives such as those that drive our earlier results can also lead competing firms to uncover the true state and to report it truthfully. To see this, assume that each of the J firms may be high-quality with probability λ and that each firm j receives a continuation payoff $\sum_i f(\lambda_{ij})$, where λ_{ij} is consumer i 's posterior on j 's quality and $f(\cdot)$ is strictly increasing. Assume that in the feedback stage, high-quality firms always report the true state honestly, but normal firms can choose their reports freely. Each normal firm j will choose its feedback report \tilde{s}_j to maximize the ex post perception of its quality knowing that there is a probability $\tilde{\mu}$ that consumers receive exogenous feedback. Note that the game between a feedback firm and its readers is identical to our monopoly model above, with the restriction that the normal type knows the true state for sure rather than having a noisy signal ($\pi = 1$).

It then follows almost immediately from proposition 1 that the unique equilibrium is for all feedback firms to report the true state honestly. We showed that the limit of the unique equilibria as $\pi \rightarrow 1$ is honest reporting. The only complication at $\pi = 1$ is that if consumers expect a firm to report honestly, the event that its report disagrees with the

exogenous feedback becomes a zero-probability event. Assuming that their belief in this case is that the firm is normal for sure easily supports the equilibrium. Any other candidate equilibrium would have positive equilibrium probabilities at all nodes and would be ruled out by the same argument that established uniqueness for π close to one.

PROPOSITION 3. Let $\bar{\mu} = \tilde{\mu} + (1 - \tilde{\mu})\phi(J)$ denote the total probability that a given consumer receives feedback about the true state. Then in equilibrium all feedback firms report truthfully, and the scoop firm plays the equilibrium strategy of the monopoly game with feedback probability $\mu = \bar{\mu}$. Equilibrium bias is therefore weakly decreasing in the number of firms J (strictly whenever there is positive bias in equilibrium) and is zero for J sufficiently large.

This proposition is straightforward because the feedback firms are motivated only by their own reputations. Their only incentive is thus to ensure that their reports match any feedback consumers receive ex post. To highlight the importance of this independence, we now consider the opposite extreme in which the J firms are jointly owned, a case of particular interest in the policy debate. We assume that the firms are either all high-quality (with probability λ) or all normal, so reputation is formed at the level of the owner. High-quality firms always report the true state truthfully in both the scoop and feedback stages. We assume that the owner receives a continuation payoff $\sum_i f(\lambda_i)$, where λ_i is consumer i 's posterior on the firms' joint quality and $f(\cdot)$ is strictly increasing.

We first show that the unique equilibrium in the feedback stage is for normal firms to confirm the report of the scoop firm regardless of the true state. To see that this is an equilibrium, suppose that consumers expect this strategy and consider a (normal) firm that is reporting in the feedback stage. Because both high-quality and normal firms always confirm, consumers' beliefs about quality will remain strictly greater than zero if the firm follows its strategy of repeating the scoop firm's report and there is no exogenous feedback. This occurs with positive probability since $\tilde{\mu} < 1$. If the firm deviates and contradicts the report, we assign consumers the belief that the firm is normal for sure regardless of the exogenous feedback. The firm will then strictly prefer to confirm since if it contradicts it receives the lowest possible reputation for sure. To see that the equilibrium is unique, consider an alternative in which a feedback firm contradicts the scoop firm's report with positive probability. Consumers must assign a posterior of zero when they see a contradiction. A firm whose strategy called for it to contradict would therefore strictly prefer to deviate since consumers must assign it a posterior strictly greater than zero if it confirms and there is no feedback, an event that occurs with positive probability.

Next, observe that given this equilibrium in the feedback stage, in-

creasing the number of firms has no effect on the scoop firm's decision. Both normal firms and high-quality firms always report the same thing in the scoop and feedback stages, so consumers never change their quality assessments on the basis of the feedback stage report. The decision of all J firms to jointly report either \hat{r} or \hat{l} is thus exactly equivalent to the monopoly problem analyzed earlier. We therefore have the following result.

PROPOSITION 4. Suppose that all firms are jointly owned. Then in equilibrium, firms in the feedback stage always confirm the scoop firm's report, and the scoop firm plays the equilibrium strategy of the monopoly game with feedback probability $\mu = \bar{\mu}$. Equilibrium bias is therefore independent of the number of firms J .

The assumption that all firms have the same quality is important for this result. If we relax this assumption, the effect of joint ownership will depend on the relative weight of the two firms' reputations in the owner's continuation payoff.

In the analysis above, we have shown that with independent ownership, truthful feedback reporting can be supported by firms' desires to maintain their own reputations for quality. It is possible, however, that feedback firms might also have an incentive to *harm* the reputation of the scoop firm, say because the two firms' products are viewed as substitutes in the continuation game. Intuitively, such rivalrous incentives can have two competing effects on the quality of ex post feedback. On the one hand, consider a case such as the one we have modeled above in which feedback firms can misreport. If the feedback firms were solely concerned with damaging the reputation of the scoop firm, this would give them a motivation to lie and make it more difficult to sustain an equilibrium in which their reports are fully revealing. On the other hand, suppose that feedback reports are verifiable but costly to issue. Then a feedback firm interested in damaging the scoop firm's reputation would not bother to pay the cost to confirm a *correct* scoop report, but might be willing to undertake effort to expose an incorrect one. Therefore, the stronger the incentive to harm the scoop firm's reputation, the less likely an incorrect report is to go unchallenged. These kinds of competitive incentives might exacerbate bias in a world of unverifiable feedback but could help discipline it in a world in which feedback is verifiable but costly to report.

V. Heterogeneous Priors and Market Segmentation

In the model thus far, all consumers have identical beliefs about the state of the world, and consequently any two consumers who see the same report and feedback will make identical inferences about newspaper quality. This seems a reasonable starting point for thinking about

differences in slant across markets, for example, why Al Jazeera and CNN differ or why local newspapers may differ in their political orientation. But in many key settings of interest, firms with different biases compete in the same market. In this section, we extend the model to consider a case in which two firms report to consumers with different priors,²⁴ and we illustrate why media firms might segment the market according to prior beliefs.²⁵

We will assume that there are two equally large groups of consumers, denoted L and R , with prior beliefs about the true state $1 - \theta$ and θ , respectively, with $\theta > \frac{1}{2}$. For simplicity we suppose that the firm's prior is $\theta^F = \frac{1}{2}$, the average prior belief of the consumers. Consumers each can view only one firm's report, and we assume that they choose to view the report that will provide the greatest expected utility, that is, that maximizes the probability of choosing the correct action A . In the event that two newspapers provide the same expected utility, a consumer will randomize, choosing each with equal probability. As before, all consumers receive feedback about the true state with probability μ .

We make the same assumptions about the two firms that we made about the monopolist above. Each firm is high-quality with probability λ , in which case it sees the true state and reports truthfully. Otherwise, a firm is normal, it sees a signal equal to the true state with probability π , and it can choose its report freely. Both types and signals are drawn independently across firms. Each firm j receives a continuation payoff $\sum_i f(\lambda_{ij})$, defined over consumers' quality assessments of that firm, λ_{ij} , where $f(\cdot)$ is strictly increasing.²⁶

Consider first how a consumer's decision of which paper to read depends on her beliefs about each firm's equilibrium reporting strategy. Because we have modeled bias as pure distortion, we should expect it to reduce the value of a signal to all consumers. It is important to note, however, that the perceived cost of bias will depend on a consumer's

²⁴ See Morris (1995) for a discussion of the role of heterogeneous priors in economic theory and Morris (1994) for an application with heterogeneous priors.

²⁵ Mullainathan and Shleifer (2005) point out a different intuition for market segmentation, namely, that price competition leads firms to avoid offering similar products.

²⁶ We note three points about the assumption on continuation payoffs. First, nothing would change if we let the function $f(\cdot)$ differ by firms as long as it was strictly increasing for both. Second, because we have assumed that consumers can see only one firm's report, the results would also not change if we let one firm's continuation payoff depend on a consumer's belief about both its own and its competitor's quality (the firm cares only about the consumers who see its report, and these consumers' beliefs about its competitor will be constant). Finally, assuming $f(\cdot)$ is strictly increasing *does* rule out some natural specifications of the continuation game. For example, suppose that there were a second period in which consumers chose whichever firm they believed to be higher-quality (and firms received a fixed advertising revenue per consumer). Then $f(\lambda_i)$ would be a step function with $f' = 0$ almost everywhere. What we would require in this case is some stochastic component in consumer utility—a cost of time, utility from reading the sports section, etc.—that would “smooth out” consumer demand.

type. A firm that biases its signals to the right—that is, that sometimes distorts l signals but always reports r signals truthfully—will be relatively more attractive to type R consumers than to type L consumers, because type L consumers expect l signals to arrive more often. We can see this formally by noting that a consumer who follows the signal of a normal firm that biases l signals with probability σ^* will choose the correct action with probability $\pi + (1 - \pi)\sigma^*$ if the true state is R and probability $\pi(1 - \sigma^*)$ if the true state is L . Using her prior belief that the state is R with probability θ , a type R consumer would calculate that if she follows the firm's signal she will choose the correct action with probability $\pi - \sigma^*(\pi - \theta)$. A type L consumer, on the other hand, would expect to choose the correct action with probability $\pi - \sigma^*[\pi - (1 - \theta)]$, which is strictly smaller. The same logic shows that a firm that biases its signals to the left will be relatively more attractive to type L consumers.²⁷ If the two firms have equal bias in opposite directions—if one distorts l signals with probability $\sigma^* > 0$ and the other distorts r signals with the same probability—the type R consumers will strictly prefer the right-biased firm and the type L consumers will strictly prefer the left-biased firm.

We can then see immediately that there can be equilibria in which the consumer market is completely segmented by type. Suppose for the moment that all type R consumers buy from firm 1 and all type L consumers buy from firm 2. Then the equilibrium strategy of firm 1 will be that of a monopolist in a market in which all consumers have prior θ —that is, to distort l signals with some probability and report r signals truthfully—and the equilibrium strategy of firm 2 will have the same bias but in the opposite direction. If the monopoly strategy calls for distortion with any positive probability, type R consumers will indeed choose firm 1 and type L consumers will choose firm 2.

This is not the only equilibrium of the game, however. Consider what happens when a firm has equal numbers of consumers of each type. Suppose that consumers expect the firm to report honestly and that they see no ex post feedback. If the firm reports \hat{r} , the R types will increase their estimate of its quality (say to λ_{high}) and the L types will decrease their estimate of its quality (say to λ_{low}). Its continuation payoff per consumer will be $[f(\lambda_{\text{high}}) + f(\lambda_{\text{low}})]/2$. But because the problem is symmetric, this will also be its payoff if it reports \hat{l} ; the only difference is that it will then be the L types who have posterior λ_{high} . The firm must therefore be indifferent about its report conditional on no feedback. Since it strictly prefers to report truthfully conditional on feedback, truthful reporting will be an equilibrium for any firm with equal numbers of each type. We can go further and show that *any* firm with equal

²⁷ The relationship between prior beliefs and the information value of binary signals is explored in detail by Suen (2004).

numbers of consumers of each type must report honestly in equilibrium. To see this, suppose that a firm sometimes reports \hat{r} after seeing l . Relative to the case of honest reporting, this strictly reduces all consumers' posteriors after an \hat{r} report and strictly increases their posteriors after an \hat{l} report. Thus the incentive to report \hat{l} after l would be even stronger than when consumers expect honest reporting, and the firm would prefer to deviate from its presumed strategy. The same argument shows that the firm cannot report \hat{l} after r .

There are then two types of equilibria with honest reporting. First, suppose that all consumers of both types will buy from firm 1. Then firm 2 will be indifferent about its report (since it has no consumers) and firm 1, as we just observed, will report honestly. If firm 2 plays any strategy with a positive probability of distortion, all consumers will indeed prefer to buy from firm 1. Second, suppose that consumers of both types divide evenly between the two firms. Then both firms will report honestly, consumers will be indifferent between them, and consumers will indeed divide evenly.

The proof of the following proposition establishes that these three types of equilibria are generically unique. The genericity argument is required because there is one other equilibrium configuration that is possible in principle: one consumer type strictly prefers one firm and the other consumer type is indifferent between the two. We show that if such an equilibrium does exist for some payoff functions $f(\cdot)$, it will not exist for small perturbations of the payoff functions.

PROPOSITION 5. For generic continuation payoffs, the game with heterogeneous priors has three types of equilibria:

1. A *segmented equilibrium*, in which one firm is read only by group R consumers and biases its reports toward \hat{r} and the other is read only by group L consumers and biases its reports toward \hat{l} . This type of equilibrium exists for any parameter values such that $\sigma_i^*(\hat{r}) > 0$.
2. An *effective monopoly*, in which one firm reports honestly and the other lies with positive probability, and all consumers read the report of the honest firm. This type of equilibrium exists for all parameter values.
3. An *honest equilibrium*, in which both firms report honestly and consumers divide evenly between them. This type of equilibrium exists for all parameter values.

Observe that in the segmented equilibrium, the firms' strategies are endowed with the comparative statics described in proposition 1, since each firm is playing the monopoly strategy for its respective consumer base. This means that as beliefs become more extreme (θ increases), the firms' reporting strategies tend to diverge, and as feedback strengthens (μ increases), they tend to move back toward honest reporting.

Indeed, for high enough μ , the monopoly strategies call for honesty, so that in these cases, in all (generic) equilibria, consumers receive as much information as possible.

VI. Evidence on the Determinants of Bias

In the model above, we argued that two factors should play a key role in determining the direction and strength of bias: ex post feedback and competition. In this section, we review existing evidence and present new evidence on both predictions.

A. Feedback

As proposition 1 shows, our model predicts that ex post feedback about the true state of the world will tend to reduce media bias. An extreme example of an issue in which feedback is immediate and unambiguous is weather reporting. Although the notion of bias in weather reporting seems strange, consumers certainly have strong prior beliefs about the next day's weather: a forecaster who predicts snow in New Mexico in July would be viewed with suspicion. But since feedback is immediate, this should not deter her from making such a prediction if she truly believes it to be the most likely scenario.

In fact, studies of weather forecasters' predictions reveal excellent reliability. Probability forecasts match up well with observed relative frequencies; that is, a forecast of a 20 percent chance of precipitation tends to be followed by precipitation roughly 20 percent of the time. Additionally, reported confidence intervals for temperatures show nearly exact coverage (Murphy and Winkler 1977, 1984). Given the fact that the weather is known with certainty soon after forecasters make their predictions, it is not surprising that we find little evidence of bias in predicting the weather.

Of course, weather differs from politics not only because of the strength of feedback but because people take actions with concrete and immediate consequences in response to forecasted conditions. Some authors (such as Glaeser [2004]) have argued that psychological biases will have less influence on decisions with larger stakes. The presence of such a force could allow theories based on confirmatory bias to accommodate the observation that weather reporting is relatively unbiased.

We therefore turn next to a forecasting environment with rapid feedback in which emotions run high and concrete stakes tend to be low: sports picking by local newspaper columnists. We draw on data collected by Boulier and Stekler (2003) on *New York Times* sports editors' predictions from 1994 to 2000. For each game, the data set contains the

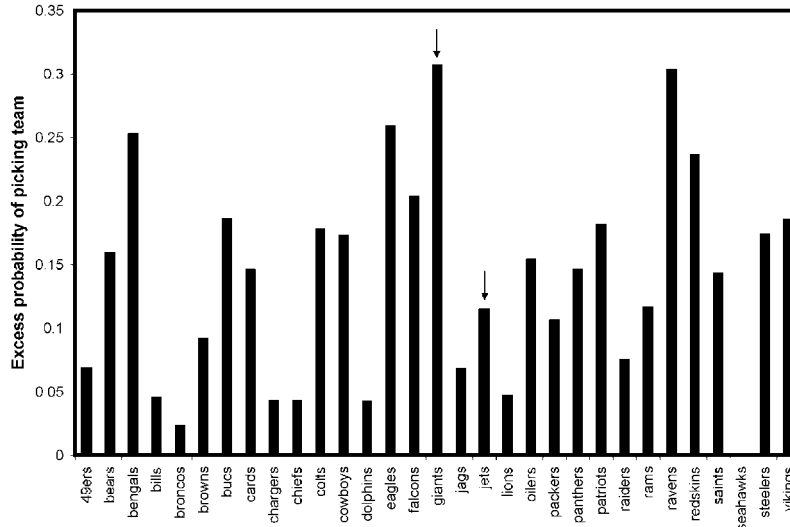


FIG. 5.—Sports picking by *New York Times* sports editor, 1994–2000. Data come from Boulrier and Stekler (2003). The data set contains information on the picks of the *New York Times* sports editor for National Football League games in the 1994–2000 seasons, as well as the outcome of the game and the betting line. The bar for team i represents the estimated coefficient $\hat{\delta}_i$ in a regression of the form $\text{win}_j = \alpha + \delta_i[(\text{home}_j = i) - (\text{away}_j = i)] + \gamma(\text{line}_j) + \epsilon_j$, where win_j denotes whether the editor picked the home team to win game j , home_j indexes the home team in game j , away_j indexes the visiting team in game j , and line_j is a vector of dummy variables representing deciles of the betting line.

opening betting line (as published in *USA Today*) and the editors' picks. If bias is driven primarily by consumers' desire to hear felicitous reports, a natural hypothesis is that the *Times* would favor the New York teams—the Jets and the Giants—to win (relative to the betting market's expectation). In contrast, because outcomes are observed soon after reports are made, our model predicts little such bias in this context.

To investigate this issue, we calculate a measure $\hat{\delta}_i$ of the experts' slant toward team i by estimating a regression model of the form

$$\text{win}_j = \alpha + \delta_i[(\text{home}_j = i) - (\text{away}_j = i)] + \gamma(\text{line}_j) + \epsilon_j,$$

where win_j denotes whether the editor picked the home team to win game j , home_j indexes the home team in game j , away_j indexes the visiting team in game j , and line_j is a vector of dummy variables representing deciles of the betting line.

Figure 5 presents graphically our estimates of $\hat{\delta}_i$ for each team, measured relative to the Seattle Seahawks (the experts' least favored team over this time period). As the figure shows, the Giants are picked more often than average and the Jets less often, but there is no evidence of

overall favoritism toward the New York teams. This fact is surprising if we start from taste-based theories of bias but is consistent with the implications of proposition 1 above.²⁸

Evidence from financial reporting also suggests a role for feedback in limiting media bias. Lim (2001) presents evidence indicating that analysts' forecasts of corporate earnings are more optimistically biased for smaller firms and for firms with more volatile historical earnings and stock returns (see also Das, Levine, and Sivaramakrishnan 1998). Although Lim interprets these findings as evidence that analysts make optimistic forecasts so as to win favor with firms and obtain access to nonpublic information, we propose our model as an alternative explanation. When earnings are less volatile, inaccurate reporting is more easily detected, and so analysts concerned with their reputation for high-quality reports will be less likely to bias their forecasts.²⁹

In related research, several authors have argued that biases in earnings forecasts become less severe as the length of time between the publication of the forecast and the earnings announcement decreases (see Kang, O'Brien, and Sivaramakrishnan 1994; Raedy, Shane, and Yang 2003). Again, a model with reputational concerns offers a possible interpretation of this fact: When the announcement comes quickly on the heels of the forecast, bias is more likely to be detected and to influence consumer decisions about which forecast to purchase in the future.

B. Competition

Because competition increases the likelihood that erroneous reports will be exposed *ex post*, our model predicts that added competition will tend to reduce bias. The reaction to Dan Rather's report on President Bush's service in the National Guard, discussed in more detail in Section II.A, provides one example of the role that competing media outlets can play in exposing flaws in journalism. Anecdotes about the impact of Al Jazeera's relatively independent reporting on media in the Arabic-speaking world provide another. As Otis (2003, A25) reports, "Many experts contend that Egyptian newspapers have improved dramatically in recent years. During the Six-Day War against Israel in 1967, the heavily censored press largely ignored battlefield defeats. Today, Al-Jazeera and other television stations beam raw images of military conflicts into peo-

²⁸ A similar test can be conducted using data collected by Avery and Chevalier (1999) on picks of six experts published in the *Boston Globe* between 1983 and 1994. Results are in Gentzkow and Shapiro (2005*b*). While the writers are more favorable to the home team (the Patriots) than average, the Patriots are not the experts' most favored team and are treated comparably to many other teams in the league. Overall, these data show limited evidence for a taste for confirmation as a driving factor in sports reporting.

²⁹ Bernhardt and Campello (2004) argue that the findings in Lim (2001) may overstate the amount of optimistic bias in earnings forecasts.

ple's homes, preventing newspapers from straying too far from the truth." To take a third example, when an American civilian was beheaded by militants in Iraq, reporting of the story was more common in countries with competitive media environments. In Syria, where all local press and television are state-owned (Djankov et al. 2003), newspapers completely ignored this event. By contrast, in Lebanon, which has a relatively competitive press, most newspapers did report on the beheading (Associated Press 2004). This fact seems to support the view that suppression and distortion of information are less attractive when competition makes the truth likely to come out.³⁰

For a more quantitative investigation of the effects of competition on media bias, we have obtained data from the 2000 Local News Archive (Kaplan and Hale 2001). The data set encodes the characteristics of local election news coverage broadcast between 5:00 p.m. and 11:35 p.m. during the 30 days prior to the general election on November 7, 2000. It covers 74 stations in 58 of the top 60 media markets in the United States. Most important for our purposes, it contains a coding of the number of seconds of speaking time given to George W. Bush and Al Gore. By calculating the total number of seconds given to each candidate by each station i , we can then construct the following measure of biased treatment:

$$\text{bias}_i = \left(\frac{\text{bush}_i}{\text{bush}_i + \text{gore}_i} - \frac{1}{2} \right)^2,$$

where bush_i and gore_i denote the number of seconds given to each candidate by station i . This measure takes on a value of zero when Bush and Gore received equal time in local news coverage of the election and a value of .25 when only one candidate was given coverage. The average of bias_i across the stations in a market will serve as our measure of bias.

Given this measure, we can investigate whether the degree of bias is lower in markets with a greater number of local news broadcasts, as predicted by the model. As table 1 shows, this is indeed the case. Column 1 of the table indicates that one additional television station is associated with a statistically significant reduction in bias of about .006, which is equivalent to about one-third of a standard deviation. As column 2

³⁰ Another example of the role of competition is the coverage of the allegations of torture in the Abu Ghraib prison in Iraq. The CBS program *60 Minutes* was the first to obtain photos from the prison, but it delayed broadcasting them for two weeks. The incentive to suppress the photos in this case was not consumer beliefs but direct pressure from the government: Richard Myers, chairman of the Joint Chiefs of Staff, had personally asked Dan Rather not to broadcast the photos. But what led them to finally be aired was competition: once CBS learned that Seymour Hersh was working on the same story for the *New Yorker*, it decided to put the report on the air (Folkenflik 2004).

TABLE 1
 COMPETITION AND BIAS IN LOCAL NEWS COVERAGE OF THE 2000 ELECTION

	(1)	(2)	(3)	(4)
Number of local news broadcasts, 2002	-.0057 (.0025)	-.0064 (.0025)	-.0062 (.0030)	-.0062 (.0031)
Census region controls?	no	yes	yes	yes
Log(population), 2000			-.0006 (.0043)	-.0004 (.0053)
Log(income per capita), 1999				-.0013 (.0188)
Observations	58	58	58	58
R ²	.0834	.1747	.1751	.1752

NOTE.—Bias is measured as the average across all stations in a market of

$$\text{bias}_i = \left(\frac{\text{bush}_i}{\text{bush}_i + \text{gore}_i} - \frac{1}{2} \right)^2,$$

where x_i denotes the number of seconds given to candidate x by station i , with data taken from the Local News Archive (Kaplan and Hale 2001). Number of local news broadcasts reflects the number of stations showing local news coverage at some time during the day as of July 2002, compiled from <http://www.tvguide.com>. Data on population, income per capita, and census region are taken from the 2000 U.S. Census.

shows, this effect is robust to the inclusion of controls for census region, so it is not merely driven by geographic differences in the thickness of markets. Column 3 highlights that including population, an important determinant of the number of local broadcasts (the correlation between log[population] and the number of news broadcasts is about .5), does not substantially reduce the size of the competition effect or eliminate its statistical significance. Finally, column 4 shows that the effect is robust to an additional control for income per capita, which could also drive differences across locations in the competitiveness of the news market.³¹

Several existing studies of bias in reporting also show effects of competition consistent with our model’s predictions. Dyck and Zingales (2003) argue that newspapers put less “spin” on their reports of company earnings when many alternative sources of information are available. Lim (2001) presents evidence from analysts’ earnings forecasts suggesting that bias is lower the more analysts are providing reports on a given company (see also Firth and Gift 1999). Gentzkow, Glaeser, and Goldin (2006) document that the emergence of independent (i.e., non-party-affiliated) newspapers in the United States was faster in larger cities, suggesting a role for competition in encouraging the growth of more informative news outlets.

VII. Conclusions

The model in this paper presents a new way to understand media bias. Bias in our model does not arise from consumer preferences for con-

³¹ The estimated effect of competition is also robust to controlling for the average total amount of candidate speaking time aired by stations in each market.

firmatory information, reporters' incentives to promote their own views, or politicians' ability to capture the media. Instead, it arises as a natural consequence of firms' desire to build a reputation for accuracy, and in spite of the fact that eliminating bias could make all agents in the economy better off.

An advantage of our model is that it generates sharp predictions about where bias will arise and when it will be most severe. We wish to highlight two policy implications of these results. The first concerns the regulation of media ownership. In the current debate over FCC ownership regulation in the United States, the main argument in favor of limits on consolidation has been the importance of "independent voices" in news markets. Proposition 4 offers one way to understand the potential costs of consolidation: independently owned outlets can provide a check on each other's coverage and thereby limit equilibrium bias, an effect that may be absent if the outlets are jointly owned.

As a second implication, the effect of competition described by proposition 3 has important implications for the conduct of public diplomacy. The U.S. government is currently engaged in a debate about the most effective way to counter what it sees as anti-American bias in the Arab media, especially Al Jazeera. Efforts along these lines have included condemnation of Al Jazeera by top U.S. officials (Rumsfeld 2001), appeals to the emir of Qatar (who sponsors the network) to change the tone of Al Jazeera's coverage (Campagna 2001), and the closing of Al Jazeera's Baghdad office by the U.S.-backed Alawi government in Iraq. Our model suggests a different approach: supporting the growing competitiveness of the Middle Eastern media market and in particular increasing the availability of alternative news sources in local languages. Aside from the direct effect on the beliefs of those who watch these sources (Gentzkow and Shapiro 2004), introducing more news outlets could have the effect of disciplining existing stations and reducing the overall amount of bias in the region.

Appendix

Proofs

Proof of Proposition 1

We show first that it cannot be an equilibrium for the firm to distort r signals with positive probability (i.e., for the firm to play $\sigma_r(\hat{l}) > 0$). Recall from the text that the gain from reporting \hat{l} after r is strictly smaller than the gain from reporting \hat{l} after l . If the firm sometimes reports \hat{l} after r , it must therefore always report \hat{l} after l . A normal firm would then be more likely to correctly match L states than R states, implying $\lambda(\hat{r}, R) > \lambda(\hat{l}, L)$ and thus, since $\theta^r(r) > \frac{1}{2}$, $\Delta^r(r) > 0$. Since $\lambda(\hat{r}, 0) > \lambda(\hat{l}, 0)$ when the firm reports honestly and increasing $\sigma_r(\hat{l})$ increases $\lambda(\hat{r}, 0)$ and decreases $\lambda(\hat{l}, 0)$, we also know that $\Delta^r > 0$. The firm would

therefore strictly prefer to deviate and report \hat{r} after r . Any equilibrium must therefore have at most garbling of l signals into \hat{r} .

Observe next that it cannot be an equilibrium for the firm to *always* garble l signals into \hat{r} . Suppose that consumers expected normal firms to always report \hat{r} and consider a firm that sees a signal of l . If the firm deviates and reports \hat{l} , a consumer who sees no feedback or receives feedback that the state is L will have posterior $\lambda(\hat{l}, L) = 1$, since only high-quality firms report \hat{l} . In these cases, the firm would prefer to deviate. The event that a consumer sees \hat{l} and receives feedback that the state is R has zero probability in the proposed equilibrium, and so beliefs at this node can be arbitrary. Suppose, in the worst case for the firm, that they assume that if this node is reached the firm is normal for sure ($\lambda(\hat{l}, R) = 0$). Payoffs from following the strategy are then

$$(1 - \mu)f(\lambda(\hat{r}, 0)) + \mu\{\theta^F(l)f(\lambda(\hat{r}, R)) + [1 - \theta^F(l)]f(0)\}.$$

Payoffs from deviating are

$$(1 - \mu)f(1) + \mu\{\theta^F(l)f(0) + [1 - \theta^F(l)]f(1)\}.$$

Because $\lambda(\hat{r}, 0)$ and $\lambda(\hat{r}, R)$ are both strictly less than one and $\theta^F(l) < \frac{1}{2}$ (since $1 - \pi < \theta^F < \pi$), the firm strictly prefers to deviate.

Any equilibrium must therefore have a probability of distortion $\sigma_i^*(\hat{r}) \in [0, 1)$. We now show that the equilibrium $\sigma_i^*(\hat{r})$ exists and is unique. Note first that the payoff to reporting \hat{r} after l , $\Delta(l)$, is strictly decreasing in the garbling probability $\sigma_i(\hat{r})$. This follows from the fact that increasing $\sigma_i(\hat{r})$ decreases the posterior on quality after an \hat{r} report and increases the posterior after an \hat{l} report (for any feedback), and that this is strict for no feedback or feedback that matches the firm's report. Now consider two cases. First, suppose that when consumers expect truth telling, $\Delta(l) \leq 0$. Then truthful reporting is an equilibrium, and it is unique because at any candidate $\sigma_i(\hat{r}) > 0$ we would have $\Delta(l)$ strictly negative, and so the firm would prefer to deviate and always report \hat{l} after l . Second, suppose that when consumers expect truth telling, $\Delta(l) > 0$. Then the facts that (i) $\Delta(l)$ is strictly decreasing in $\sigma_i(\hat{r})$ and (ii) $\Delta(l) < 0$ at $\sigma_i(\hat{r}) = 1$ imply that there is a unique $\sigma_i^*(\hat{r}) \in (0, 1)$ such that $\Delta(l) = 0$ when consumers expect $\sigma_i^*(\hat{r})$. This mixed strategy is then the unique equilibrium.

To derive the comparative statics with respect to θ , observe that, for any $\mu \in (0, 1)$, truthful reporting of r signals, and $\sigma_i(\hat{r}) \in [0, 1)$, lemma 1 implies that $\Delta(l)$ is strictly increasing in θ . Therefore, the probability $\sigma_i^*(\hat{r})$ must be increasing in θ in the mixed-strategy range.

For the comparative statics on μ , suppose that $\theta \in (\frac{1}{2}, 1)$, that consumers expect truthful reporting of r signals, and that we are at an equilibrium value of $\sigma_i(\hat{r})$; that is, either $\sigma_i(\hat{r}) = 0$ or both $\sigma_i(\hat{r}) > 0$ and $\Delta(l) = 0$. Then $\Delta(l)$ is strictly decreasing in μ . To see this, note first that the payoff to reporting \hat{r} after l conditional on feedback ($\Delta^f(l)$) must be strictly negative, since the firm believes L to be the most likely state and the reward for correctly matching the L state is greater than the reward for correctly matching the R state. Second, the payoff conditional on no feedback (Δ^{nf}) must be strictly positive. This follows from the fact that $\lambda(\hat{r}, 0) > \lambda(\hat{l}, 0)$ if consumers expect truth telling and the fact that $\Delta(l) = 0$ if consumers expect a positive probability of distortion. The signs of $\Delta^f(l)$ and Δ^{nf} also imply that if consumers expect truth telling, $\Delta(l)$ is strictly

negative for $\mu = 1$ and becomes strictly positive as $\mu \rightarrow 0$. There is therefore a unique $\mu^* \in (0, 1)$ such that the equilibrium is truth telling for $\mu \geq \mu^*$ and a mixed strategy for $\mu < \mu^*$, and the probability of distortion in the mixed-strategy range is strictly decreasing in μ .

For the limit result on π , note that if consumers expect the firm to report honestly, it is straightforward to show that $\lim_{\pi \rightarrow 1} \Delta^H = 0$ and $\lim_{\pi \rightarrow 1} \Delta^L(l) < 0$, which by continuity implies that $\lim_{\pi \rightarrow 1} \sigma^*(\hat{r}) = 0$. QED

Proof of Proposition 5

We first show that each firm must distort at most one signal with positive probability. As in the monopoly case, the expected payoff to reporting \hat{r} is strictly greater after a signal r than after a signal l . (The only way in which seeing r rather than l affects the firm's expected continuation payoff is that it shifts the firm's posterior on the true state toward R , increasing the expected return to reporting \hat{r} conditional on consumers receiving feedback.) Therefore, a firm that sometimes reports \hat{r} after l must always report \hat{r} after r . Similarly, the return to reporting \hat{l} is strictly greater after a signal l , and so a firm that sometimes reports \hat{l} after r must always report \hat{l} after l .

Now, observe that there can logically be four types of equilibria:

1. Type R consumers strictly prefer one firm and type L consumers strictly prefer the other firm.
2. Both consumer types strictly prefer the same firm.
3. Both consumer types are indifferent between the firms.
4. One consumer type strictly prefers one firm and the other is indifferent between the firms.

The discussion in the text established that (i) segmented equilibria exist whenever $\sigma^*(\hat{r}) > 0$ and are the only possible equilibria of the first type; (ii) effective monopoly equilibria exist, and they are the only equilibria of the second type; and (iii) honest reporting equilibria exist, and they are the only equilibria of the third type. To complete the proof we show that equilibria of the fourth type will not exist generically.

Suppose without loss of generality that the type L consumers have a strict preference for firm 1 and the type R consumers are indifferent between the firms. Then firm 1's customers are two-thirds L types and one-third R types whereas firm 2's customers are all R types. Therefore, firm 2 must be playing the monopoly strategy for R types, which will involve distorting l signals with some probability, possibly zero. Denote this probability σ^* . If $\sigma^* = 0$, both types would either be indifferent (if firm 1 reports honestly) or strictly prefer firm 2 (if firm 1 reports with bias), which contradicts our assumption. Therefore, we can restrict attention to cases in which $\sigma^* > 0$.

Note first that firm 1 cannot be playing the same strategy as firm 2, because then L types would also be indifferent between the two firms. Firm 1 also cannot distort l signals with a different nonzero probability because then both types would either strictly prefer firm 1 (if the probability was lower) or strictly prefer firm 2 (if the probability was higher). Firm 1 must therefore distort r signals with some positive probability σ' . From the expression for consumer value de-

rived in the text, we can see that to make the R types indifferent, σ' will be defined uniquely by the equation

$$\pi - \sigma'[\pi - (1 - \theta)] = \pi - \sigma^*(\pi - \theta). \quad (\text{A1})$$

Note that this immediately implies $\sigma' > 0$. In order for the strategy σ' to be an equilibrium, firm 1 must be indifferent about its report when consumers expect it to play σ' and it observes a signal r . Letting $\Delta^f(r)$ denote the relative payoff to reporting \hat{r} after r conditional on feedback and letting $\lambda^R(\hat{s}, 0)$ and $\lambda^L(\hat{s}, 0)$ represent the posteriors of consumers of types R and L , respectively, we must have

$$\frac{2}{3}[f(\lambda^R(\hat{r}, 0)) - f(\lambda^R(\hat{l}, 0))] + \frac{1}{3}[f(\lambda^L(\hat{r}, 0)) - f(\lambda^L(\hat{l}, 0))] = -\Delta^f(r). \quad (\text{A2})$$

Equations (A1) and (A2) are a system with a single unknown, σ' , so there will not be a solution for generic $f(\cdot)$. QED

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